VOLUME TWO

HINTS & KINKS

for the Radio Amateur

... A Symposium of the Selected Practical Money-Saving Ideas of 236 Experimenters

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HINTS & KINKS

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Foreword

THE SUCCESSFUL RADIO AMATEUR is, by very nature, an ingenious fellow. Without a high order of resourcefulness and an ability to improvise he could never overcome the ever-present problem of inadequate work-shop equipment and the equally common handicaps of insufficient apparatus and money. Evidence of this inherent ingenuity is to be seen on all sides. One cannot visit any good amateur station without finding clever improvisations either in the construction of individual components or in the manner in which the whole station is assembled. It may be just a new way to mount a coil or a new scheme for making the antenna do something it never did before. Whatever it is, it is invariably of value to the rest of us.

With the object of putting the best of these "brain storms" into circulation, there has appeared in *QST*, these many years, a department devoted to the general subject of hints and kinks. This department, conducted by George Grammer, has enjoyed great popularity. The ideas contributed to it by ingenious amateurs have helped us all in our search for ways and means to improve our equipment. Unfortunately this garnered gold of amateur experimentation has often been lost to sight, shadowed by some big article or forgotten in the excitement of some major development. Then, too, there has been the annoying business of vaguely remembering a squib on exactly the problem confronting one but being unable to find it when it is most needed. These factors led us, in May, 1933, to publish a collection of the best ideas, schemes and methods offered by *QST* contributors during the three years prior to that date. That first edition of *Hints and Kinks*, reprinted in November, 1933, was well received everywhere. It established definitely the value of a single grouping of selected "experimental expedients" classified and indexed.

The present booklet is a larger and more comprehensive collection of ideas offered by *QST* contributors since 1934. Much of the material has appeared in the Hints and Kinks department of *QST*. Some of it has been gleaned from larger articles where it was doubtless lost to the view of many. Arranged in its present form, the material should constitute a potent help in time of trouble. It should provide the suggestion of many intriguing possibilities for putting back to work abandoned apparatus now gathering dust in the attic. It should, above all, enable us, in one way or another, to improve the functioning of our stations.

We express our thanks to those amateurs whose willingness to offer the result of their work to the amateur world has made this publication possible.

ROSS A. HULL
Editor

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Volume One of this publication, first printed in May, 1933, is now out of print.

HINTS & KINKS
for the Radio Amateur

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HINTS & KINKS
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I

In the Workshop

Soldering-Iron Outlet

A GOOD many of us use the dollar or dollar-fifty variety of soldering iron; most of

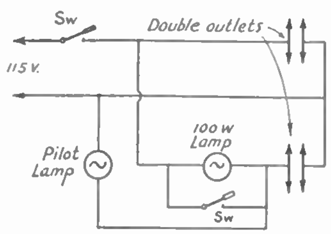

FIG. 1 — HANDY OUTLET BOARD CONNECTIONS, WITH PROVISION FOR REDUCED VOLTAGE ON THE SOLDERING IRON

them will burn up on ordinary 115-volt house current if left on for any period of time. The diagram of Fig. 1 shows a convenient way to lengthen the life of the iron. A 100-watt lamp, shunted by a s.p.s.t. switch, is connected in series with the socket for the soldering iron plug.

By closing the switch, the iron may be heated quickly to operating temperature. Then by opening the switch the lamp is put in the circuit and the iron is maintained at a temperature which will keep the solder melted but will not tend to burn up the iron. A lamp of different rating may be used if desired; larger lamps will keep the iron hotter and vice versa.

In my case the lamp, switches and two double outlets are mounted on a board as one unit. The upper double socket is connected directly across the line, providing 115 volts, while the lower outlet not only takes care of the iron but also provides another socket for experimental purposes at reduced voltage. When the shunting switch is closed, four 115-volt outlets are available. The pilot lamp is a precautionary measure against leaving the master switch on unintentionally.

— *Bren Quereau, W5BJ*

Soldering-Iron Holder

THE odd pieces of copper tubing usually found in the shack can be used to make a

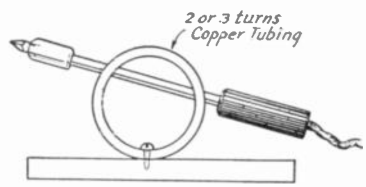

FIG. 2 — A SOLDERING-IRON HOLDER MADE FROM SCRAP COPPER TUBING

really fine soldering-iron holder. A typical method of using the tubing is shown in Fig. 2. Two or three turns of tubing are fastened to a board at the ends; the iron is pushed between the turns and is held fast when not in use.

A holder of this type dissipates the heat readily, even when the iron is left on for long periods.

— *A. F Korn, W2AMM*

— . . . —

Some Coil-Winding Kinks

HERE are some suggestions for making wire stay in place on tubing forms.

Those who try to wind heavy wire on an ungrooved form and keep the turns in place know it's quite a tough job. Not everyone has facilities for grooving a form, so here's a method which works well if smooth forms have to be used. The stunt is to wind a coil, just as copper tubing would be wound, on a small-diameter form such as a dry cell. The diameter of the finished coil will be slightly larger than the dry cell because of the "spring" of the wire. The permanent form to be used should be slightly larger than the coil just finished, the difference in diameter depending upon the size of wire used. About one-half inch is satisfactory for No. 8 wire. The end of the coil is forced apart to fit tightly over the form and the rest of the turns forced on by turning the coil on the form. Roughening the form with sandpaper helps make the coil stay in place. — *W2CWT*

W2GEB makes a point of winding space-wound coils when the temperature is high and the wire expanded. Then when the temperature is back to normal the wire contracts and grips the form tightly. Warming the wire in an oven before winding should make the job independent of the weather.

Another method making use of the temperature coefficient of the wire is used by W9HTT. In making the coil the needed length of wire is first measured off and one end attached to a solid support. The other end is fastened to the form and the coil wound by "walking up" the wire. As the wire is wound on, a helper heats it with a blow-torch at a distance of about six inches from the form. On cooling, the contraction sets the turns firmly. W9HTT has wound coils of wire as large as No. 4 by this method and has had no trouble with turns loosening afterward.

Those who want to try unity-coupled circuits will find these hints of interest:

Some of the gang seem to be having trouble threading the grid-coil wire through the plate-coil tubing in unity-coupled outfits. Simply wind the wire to be used for the grid coil around a tube base or other small form so that when the form is removed the coil will be smaller than the plate coil. The wire then will push through the tubing and the end can be caught and pulled through the hole drilled at the center turn. I use No. 20 b.b.e. (braid, braid, enamel) wire. — *W9PHY*

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Making Inductance Clips

It is hard to do a neat job of making small clips to go on tubing, etc., with a pair of pliers. This kink may help.

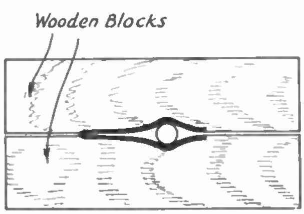

FIG. 3 — SPRING CLIPS FOR TRANSMITTING INDUCTANCES CAN BE FORMED READILY WITH THE HELP OF A PAIR OF WOOD BLOCKS AND A VISE

A strip of phosphor bronze or other suitable material of the proper width is bent in the middle to form the two sides of the clip. A nail or rod of approximately the same diameter as the tubing on which the clip is to work is then inserted between the blades at the point where the bends should occur. The whole is then put in the vise between two small blocks of very hard wood, the nail carefully set at right angles to the length of the material, and the vise screwed home. Fast and neat — and the two halves come opposite each other! The outer lips are then bent back slightly with pliers. A small through bolt may be put about mid-way the length of the clip if necessary. — *K. B. Warner, W1EH*

—...—

A Sure-Fire Inductance Clip

After years of trimming and bending the ordinary type of small clip in an

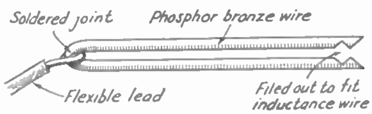

FIG. 4

effort to make it serve as a decent terminal for the leads which must be tapped onto small wire wound inductances, I decided to do something about it.

Accordingly, a bit of No. 19 phosphor bronze spring wire was bent into the shape of a short hairpin as indicated in the illustration, Fig. 4. Before the free ends are brought too close together, they are filed as shown with a small triangular file so that when they are brought together a notch will be provided for the inductance wire to rest in. The flexible wire lead is then soldered to the tail end of the gadget, and at last we have a clip which will permit us to contact our wire wound inductances without shorting out the turn on either side of the one we want. A piece of spaghetti tubing should be slipped over the rear end of the clip to hide the soldered joint and provide insulation.

Possibly the same clip, made of heavier wire, would do for copper tubing coils also. — *Herbert Hollister, W9DRD*

—...—

Tapping Transmitter Coils

A satisfactory method of making taps on heavy wire coils is shown in Fig. 5. A short piece of bare wire, bent as shown, is soldered directly to the turn to be tapped, after the insulation has been scraped off the latter, of course. In soldering, both the bared turn and the tap should be tinned separately and then sweated together without additional solder. This method helps prevent shorting the adjacent turns.

The insulated "clip," the construction of which is also shown in Fig. 5, consists of a jaw taken from a miniature knife switch, the handle being the top of an old binding post. A machine screw of suitable length is first run firmly into the binding-post top, then the head of the screw is clipped off and the assembly fastened to the switch jaw

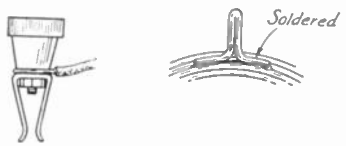

FIG. 5 — DETAILS OF THE INDUCTANCE CLIP CONSTRUCTION AND METHOD OF MAKING COIL TAPS

with a small nut. The connecting wire is fastened between the jaw and handle. The resultant clip is positive, easy to handle, has plenty of contact surface and is neat in appearance.

—···—

A Handy Alcohol Lamp from the Junk Box

THE drawing of Fig. 6 shows the essentials of an alcohol lamp which costs nothing to make, but which nevertheless is a handy gadget to have around the station. Kenneth Ashton, VE5BK, suggested the idea. He writes: "Procure an empty mucilage bottle, the type with the brush inside. Cut off three quarters of an inch of the cap, as indicated in the sketch, make

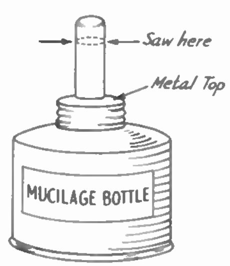

FIG. 6 — ALCOHOL LAMP MADE FROM AN EMPTY MUCILAGE BOTTLE

a wick by the use of several folds or layers of cotton cloth, and fill up with alcohol. Methyl hydrate also works well, but *don't* use gasoline! You'll be surprised at the number of jobs this lamp fills where the usual little soldering iron is out."

—···—

Cutting Sheet Aluminum

MOST amateurs at some time or other wish to make an aluminum cabinet and a receiver with plenty of inside shielding. The first question that comes up is that of cutting sheets to the correct sizes without going to the expense of having it done.

The answer is simple — break the aluminum. All the tools that are necessary are cheap and will be found around any amateur shack. Some kind of a sharp tool with which to mark the aluminum and two pieces of angle iron are all that are necessary.

Lay out the aluminum accurately. Then place the piece to be cut between the two pieces of angle iron with the line marked just showing above the angle iron. Clamp this firmly in a vise. Then take a sharp tool — a wood chisel will do the trick nicely — and with a firm pressure run along the line, making a deep cut in the aluminum. Repeat this three or four times. Then, leaving the aluminum in the same position, do the same thing to the other side. This will cut the surface of the metal and allow a clean break to result.

After making several of these deep cuts on each side, grasp the top of the sheet in both hands and work it slowly back and forth, being careful not to bend it too far in either direction. If you do this the aluminum will bend and will not be flat. After bending it back and forth until it breaks take a file and touch up the edges. If care is used in marking off the sheet, it will be the exact size because the aluminum cannot break in any other place except where it is marked.

If several small pieces of aluminum are wanted for brackets the idea is very well adapted for this kind of work. One long piece is first broken and then the small pieces can be broken one after another until the required number is secured. These only need touching up on the edges.

If a very long piece of aluminum is to be broken it will be necessary to place a "C" clamp on the end of the angle iron farthest from the vise. If this is not done the angle iron will tend to spring apart, allowing the aluminum to bend at that end instead of breaking.

Aluminum up to ⅛ inch has been cut by the writer in this style with entirely satisfactory results. Of course the thicker the aluminum the deeper will have to be the marking. It is surprising, though, how small a mark will permit the aluminum to break.

— *P. D. Zurian*

—···—

Cutting Round Holes in Aluminum

WHEN mounting sub-panel or manufacturer's type sockets in an aluminum-shielded receiver, the question comes up, "How can I cut a nice round hole in the sheet for mounting socket, tube, etc.?"

I have solved this in the following manner:

First procure a pair of heavy carpenter's or machinist's dividers and with one leg drill a hole through till the point just comes through. With this as a center adjust the dividers to the radius of the hole desired and scribe a circle. Make several cuts and then turn the panel over and make several cuts on the reverse side. Open a vise just a trifle larger than the diameter scribed, lay the panel over the opening and strike the inside of the circle several blows with the ball end of a ball peen hammer. Turn over and repeat. Keep turning over till you have lost all confidence in this method, then hit it two or three more times and the inside will drop out, leaving a fine hole with no ragged edges.

— *Charles M. Conley, W9CXG-W9CLX*

Notes on Machining Aluminum

THE increased popularity of aluminum has certainly done much to improve the appearance of amateur apparatus. However, it has often placed a severe strain upon the average amateur's ability as a machinist.

Aluminum does not seem to cut, drill or file like most metals. A drill seems to clog and merely force its way through the work, leaving a bad burr on both sides. The material is so soft that it mars and scratches easily, and though we start with a highly-polished sheet, our finished panel is apt to look like a war relic.

The first trick in avoiding these difficulties is to use a good cutting lubricant. Turpentine is best, but ordinary liquid soap is good. Use a medicine dropper or small oil can and keep plenty of lubricant in the drill hole; if the drill is sharp, the shavings will come out like steel shavings. Dip your file in turpentine and it will cut much more rapidly and will not gum up.

Aluminum's softness presents advantages as well as drawbacks. Large, or irregular shaped holes may be cut with an ordinary jig-saw, just as they might be cut in wood. Use a fine blade and do not force the work. Always use lead or leather covers for vise jaws, or else clamp the work between smooth blocks of soft wood. It is much easier to avoid dents than to remove them!

Avoid using a file on the face of a panel as file scratches are extremely hard to remove. Use a very sharp cold chisel to remove drill burrs or other irregularities.

Holes drilled in the wrong place may be easily filled with Alumweld solder. The only precautions are absolute cleanliness and plenty of heat. Clean the hole with a jeweler's rat tail file and fill it with flux and chips of Alumweld, heating the panel with a blow torch. After filling the hole wash away any excess flux, as it is corrosive. Chip off excess solder with a sharp cold chisel and polish smooth with emery cloth.

The easiest and one of the most distinctive ways of finishing aluminum parts is by sandblasting. This gives a crystalline satin finish, similar to ground glass. If some plant near you has sand blasting equipment, warn the operator to use old sand, only about 30 lb. air pressure, and to work from a considerable distance. This will largely avoid any danger of warping thin parts.

In case you wish a grained finish, start with emery cloth which is coarse enough to remove all dents and scratches. Keep the work wet with liquid soap to cut through any grease films or finger prints. Use increasingly finer grades of emery, finishing with the finest "wet or dry" paper, or with "French emery." If you have sufficient patience, the results will well justify the labor.

Screw heads and other brass parts on the front of the panel may be painted with aluminum paint. However, a much more satisfactory scheme is to have them chromium plated but not polished. Dull chromium plate gives a surprisingly close match to a grained aluminum panel and will last much better than the aluminum paint. Chromium plating of screw heads should cost less than 25 cents per hundred — less than the cost of a can of aluminum paint!

Aluminum may usually be obtained quite cheaply from a dealer in non-ferrous metals. If it is available, it would be well to consider using Duralumin. It is not prohibitively expensive and combines most of the valuable properties of aluminum and mild steel. It cuts like steel, has great strength, weighs but 8% more and costs about 50% more than aluminum. Very often panel thicknesses may be cut in half by using "Dural" with an actual saving in cost and weight.

— *S. G. Lutz,*
218 Sheetz St., West Lafayette, Ind.

Threaded Coil Forms for the Transmitter

THE most difficult items to construct in a c.c. transmitter, I believe, are the oscillator and doubler coils. Of course, if we are making them for a low-power job which does not require coils with wire larger than No. 18, these coils can be made very easily. However, when we graduate to higher power where the coils have to be wound with No. 14 or larger wire, then the difficulties increase in proportion to the wire size, especially if the coils are space wound.

I have space-wound doubler coils on a two-inch form only to have the spacing change and the turns slip together when the temperature rose and the wire expanded. In fact, it is almost impossible to wind a coil of this diameter with No. 12 or larger wire by hand and get the winding tight enough to stay put.

Threaded forms are the answer to these difficulties, but did you ever take a form to a machinest and ask the cost to have it threaded? To have threaded forms without having to pay a small fortune for them resort was made to the following scheme:

The forms are drilled for the terminals and then given a thin coat of melted paraffine with a small brush. After the paraffine has hardened, the coil is then wound with the exact spacing required. The wire is then unwound and we have a marking on the form in the exact position of the winding.

The form is then placed in a vise and using an edge of a small three-cornered file, a "V"-shaped groove is cut in the form, following the wire marking in the paraffine. When the threading has been completed the paraffine is removed by warming the form in an oven and wiping off the paraffine with a rag.

We now have a threaded form on which the wire can be wound with the assurance that it will stay in place indefinitely. Other means may suggest themselves for marking the form other than using paraffine with equal results.

— H. M. Sheffield

Kink for Soldering Coil Prongs

SOLDERING wires in coil form pins is one of those jobs we like least to do, one of the reasons being that it's usually hard to make the solder stick to the pin unless the latter is heated almost to the point where it softens the form, a second being the fact that excess solder and rosin have to be scraped off afterwards. Fig. 7 shows how a simple "alteration" can be made to a soldering iron to simplify the process considerably. A hole about twice the diameter of the pin and about 3/16-inch deep is drilled in the copper point. This is then filled with solder. When coil prongs are to be soldered, the iron is fastened horizontally in a vise, the prongs given just a touch of flux and then dipped in for a second until the solder bites in. The wire should be clipped off rather short, leaving about a sixteenth inch projecting from the pin, before soldering. After the job has cooled a little the excess flux can be wiped off with a rag wet with alcohol.

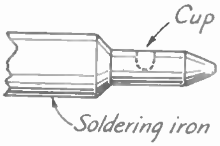

FIG. 7—DRILLING THE SOLDERING IRON FOR SOLDERING COIL PRONGS

One tip — the iron should be big enough so that the solder in the cup will be good and hot. If the iron is too small, a scum will form over the surface and some of it may collect on the outside of the pin. *James Millen — W1HRX*

Dope on Coil Winding

THE very practical coils to be described are wound on forms which are removed after the coil is finished, the turns being supported "on air" by strips of celluloid. The winding form may be of ordinary bakelite tubing or wood, the latter being more satisfactory if a great many coils are to be made. One form will suffice for all coils of that particular diameter.

The wooden mandrels should be turned out of maple or other hard wood. A square piece slightly larger than the desired diameter is used. Before it is turned to size, it should be sawed diagonally into two wedge-shaped pieces. Clamp these together and turn them down to size on the lathe. This procedure eliminates the necessity for a shim to make up for the saw cut if the piece is turned first and then cut diagonally afterwards. Round-head wood screws through the thin ends of the pieces hold them together. A length of 8 inches is satisfactory since it is rarely necessary to wind coils that long. If tubing is used, 8 inches is likewise a good length.

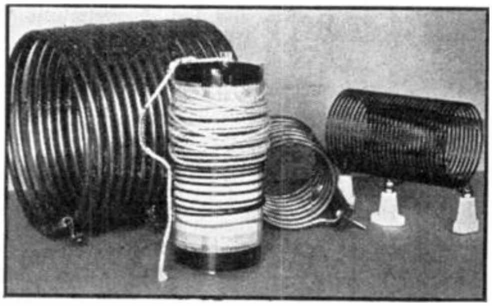

FIG. 8 — DURING THE WINDING PROCESS
This photograph shows the celluloid strips and paper wrappings on a bakelite winding form. Part of the winding has been spaced out with heavy cord.
Several coils made by the method suggested also are shown. The big fellow is six inches in diameter, has sixteen turns of quarter-inch copper tubing, and is as rigid as though it were braced with the old-fashioned longitudinal clamps.

Variety stores carry in their household wares departments two sizes of wooden rolling pins that are "the berries," both for size and cost. These can be cut diagonally in a mitre box.

The materials needed, in addition to the forms, consist of a sheet of celluloid side curtain repair material (from any auto accessory store), some waxed paper, a tube of Duco Household Cement, and of course the wire or copper tubing for the coil.

First cut four strips of celluloid, ½-inch wide and 2 inches longer than the finished coil is to be. Wrap *two* layers of waxed paper on the form, and then one layer of ordinary tablet paper or newspaper over the waxed paper, holding all in place with a tight rubber band at each end. Now slide the celluloid strips under the rubber bands and space them at equal points around the form so that there are four longitudinal "braces."

Run a 6/32 bolt through the form (a ½-inch No. 5 round-head wood screw in the wooden mandrel) at points equal to the intended length of the coil. The 6/32 should be held in place with a nut. Next, secure one end of the wire to one of the bolts or screws and wind on about half the total number of turns close wound, then space out the balance to reach the other bolt or screw at the opposite end. Cut off the wire and secure this end by means of another nut (or by turning down the screw into the wooden form).

Spacing is the next job. This is done by winding a length of chalk line or heavy twine between the turns, starting at the close-wound end. Forcing the twine or cord between the close-wound turns pushes them apart and will close up the wider spacing at the opposite end. Ordinary chalk line will give about 8 turns per inch with No. 12 enameled copper wire, and it naturally follows that if fewer turns per inch are wanted heavier twine or cord must be used. If this method of spacing the turns produces some slack in the last few turns — and it invariably does — take the coil in one hand and hold a fair tension on the winding, then with the other hand turn the form so that the coil acts as a screw working through a thread. This will take out some more slack and a new turn taken around the terminal bolt will hold it tight. When the wire is wound as tightly as possible the spacing cord can be unwound without having the turns of wire slip back together.

The next step is to apply a line of cement from one end of the coil to the other directly over the celluloid. With a toothpick or thin match, press the cement down between the turns so the cement flows out over a good portion of the width of the strip. Another layer of cement can be put on immediately and the same toothpick or match used as a trowel to smooth the cement off and cover the first application. Care should be taken not to apply so much cement that it runs off the strip onto the paper. After all four strips have been

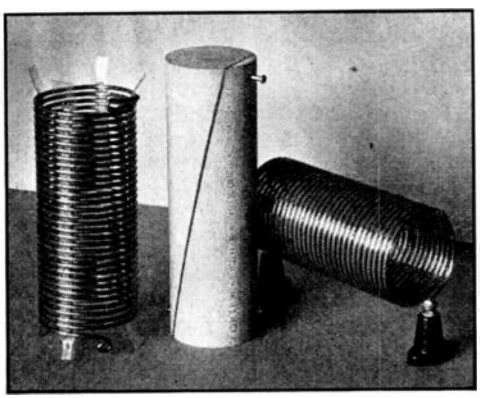

FIG. 9 — THE WOODEN MANDREL SHOWN ABOVE IS CONVENIENT IF MANY COILS ARE TO BE WOUND

A copper tubing coil just as it comes off the winding form is shown at the left; the coil at the right has been "trimmed" and mounted.

treated a third and finishing coat of cement is put on in just the same way as the second coat.

Allow the coil to dry over night, or at least eight hours, before attempting to remove the form. This much time is required for the cement to soften the celluloid, shrink it up between the turns and become sufficiently hard to stand "on its own."

To remove the coil from the wooden forms the screws should *all* be taken out; then, with a firm grip on the coil, a slight tap or two on the thin end of one half of the form will loosen it and it can be pulled out from the other end with no effort at all. The bakelite form is not quite as easy to remove, but it can be done by holding the coil in one hand and pulling the form out with a pair of pliers. The *two* layers of waxed paper facilitate removal.

The ends of the strips are easily trimmed off with a knife or scissors. The methods of mounting, several of which are suggested in the photographs, are left to the constructor's preferences.

For 1- or 1½-inch diameters a full-sized piece of celluloid can be used on a piece of mailing tube (the cardboard being torn out on completion of the coil), but the waxed paper idea still holds good when it comes to removing the winding form.

Everything from No. 14 enameled wire up to and including ¼-inch copper tubing can be used, on diameters up to 6 inches, with this method. The builder can feel certain of obtaining a rigid coil with a minimum of "losser" matter, as well as a commercial-looking job that will do justice to the appearance of the rig.

— *A. D. Muldoon*

Relay Rack Facts

AMATEUR stations of any pretensions usually follow the relay-rack type of construction, and the appearance of even small layouts often can be improved by its adoption. Some of the fellows are having difficulty in finding the dimensions of standard relay racks, however, so here are the figures:

Panel width: 19 inches.
Panel height: multiples of 1¾ inches, less 1/32 inch for clearance.
Rack width: 20 inches.
Clearance between vertical members of rack: 17½ inches.
Mounting holes: spaced alternately ½ inch and 1¼ inches, drilled and tapped for 10–32 screw.
Panel holes: ¼ inch in diameter, centered 3/8 inch in from edge of panel, spaced same as mounting holes in rack.

Panels should be drilled so that the upper and lower edges always will fall just halfway between a pair of mounting holes spaced ½ inch apart.

Plug-In Transmitting Coils

The usual method of mounting copper tubing transmitting coils on G.R.-type wall insulators by flattening and drilling the ends of the tubing is somewhat unsatisfactory in some respects. With the special bushing shown in Fig. 10, flattening and drilling of the coil ends is unnecessary.

The bushing is made of one-inch round brass stock, and is drilled and tapped on one end to fit the 10–32 screw furnished with the insulator. On the opposite end a slightly oversize quarter-

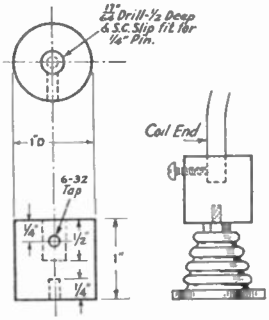

FIG. 10

inch hole is drilled to a depth of a half inch to make a slip fit for quarter-inch tubing. At right angles to this hole a third hole is drilled and tapped to take a 6–32 screw which acts as a set screw when the coil end is in place.

Using a bushing of this type coils can be changed rapidly and easily, with the certainty of always having good electrical contact.

— *Harold V. Flood, Providence, R. I.*

Making Neutralizing Condensers

Many amateurs have encountered difficulty in obtaining adequate neutralizing

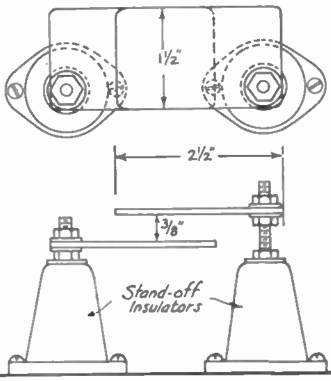

FIG. 11 — NEUTRALIZING CONDENSER DETAILS

condensers for their high-power transmitters. Either the condensers arced over or the insulation would go up in smoke. The solution of this problem is very simple. Each condenser consists of two rectangular 1½ by 2½-inch aluminum plates. The edges of each plate are well rounded and polished. They are mounted as shown in Fig. 11. Adjustment is secured by rotating the plates about their supporting insulators. The spacing is sufficient to withstand the combined plate and r.f. voltages usually encountered when using Type 852 tubes.

A Handy Test Lamp

A useful refinement for the ordinary flashlight lamp and loop so universally used for neutralizing and checking oscillation is illustrated in Fig. 12. The idea originated with T. S. Shaw, W6AVN. A wooden clothespin of the spring type serves as a holder for the usual lamp

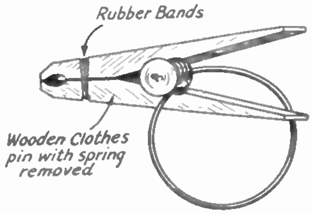

FIG. 12

and wire loop and also as a clip to be snapped on a copper-tubing inductance. The coupling between the loop and the tank coil can be adjusted very readily — and will stay put — if the nose of the clothespin is carved down to a short stub as shown in the drawing. Besides keeping the coupling fixed at the value considered most desirable, both hands are free for the tuning operations.

Curing Parallax

Users of the National Type B vernier dial should welcome this stunt for eliminating the parallax caused by the fact that the celluloid window on which the indicator line is engraved is some distance from the dial scale. The window furnished with the dial should be removed and a new one, cut from stiff celluloid as shown in Fig. 13, substituted. This has an "extension" which is tapered to a point and bent under, the point riding on the dial scale. For good visibility a little black ink should be put on the point. Be careful of the rivets!

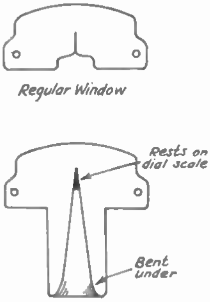

FIG. 13

The scratching noise in the receiver sometimes encountered when this type of dial is used on a metal panel is caused by the brass disc of the dial rubbing against the panel and can be cured by cutting out a disc of celluloid and gluing it to the back of the dial. —*Harry Hurley*

—···—

Leaky Tube Bases

HERE is a kink which may help some of the fellows clear up their notes:

I had trouble in getting a p.d.c. note with my transmitter, a self-excited outfit using a single 10 with 800 volts on the plate. I tried everything imaginable but the note was n.d.c. I found out later that r.f. was leaking from the plate to the grid through the base of the tube.

I took the tube out and filed a slot in the base about ⅛ of an inch wide and about 3/16-inch deep as shown in Fig. 14. In doing this care must be taken not to file too deeply as one may break the glass tip which is enclosed in the base.

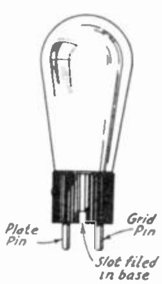

FIG. 14

After putting the tube back into service I found that the n.d.c. had disappeared altogether and I got p.d.c., and at times crystal reports. I also noticed that my signal strength increased from an average S6 to S7.

—*Andrew Janiga, Jr., W9HPQ*

—···—

Cheap transmitting coil forms can be made from old phonograph records. Boil the record in water until soft, then cut in strips and shape them about a cylinder of the desired diameter. After hardening, the forms can easily be drilled for mounting on stand-off insulators. —*W9LSN*

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When making plug-in coils on tube bases, if the base is too short for the required winding a piece of an old three-cell flashlight case of the fibre type will just slip over the base, thus extending the available winding length.

—*Ray Howdeshell, Minong, Wis.*

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W4EG makes high-voltage fixed tank condensers from old engraved copper plates and half-inch extensions for loose-leaf binders, all obtainable from engraving establishments. No bolts are needed since one extension screws into the next through a hole bored in the copper plate, and the shoulder of the extension holds each plate firmly in place. The capacity can be made anything desired simply by using enough plates, and final tuning can be done with a very small high-voltage variable condenser connected in parallel.

Fellows using bread cans from the five-and-ten stores for monitors, oscillator shields, etc., will do well to solder the seams in the cans even though they appear to make good electrical connection. A lot of noise can be generated in creaky joints and it might just as well be killed off before it starts. —*W5BSK*

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W2DGU suggests the following method for removing paint from aluminum taken from old auto bodies: Lay the aluminum on a flat surface and cover the entire piece with cloth, preferably wool. Mix equal parts of boiling water and ammonia and add a small handful of washing soda. Soak the cloth with the mixture and let it stand for about an hour. The paint will soften and can be scraped off with a fine-edged tool. Be careful not to apply too much pressure, as the tool will dig into the piece and make unsightly scratches.

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W9FFH finds an old toothbrush handle filed down to work like a screwdriver is FB for adjusting neutralizing condensers, trimmers, and other variables where there is danger of a short-circuit or troublesome body capacity.

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W9NHN constructed an inexpensive and good-looking transmitter rack by purchasing a metal household utility cabinet, substituting a wood panel for the back, and painting with black shoe dye, a non-conductor. These cabinets come in sizes suitable for transmitter racks and have five or six metal shelves. The hinged doors form the back of the rack, and the transmitter is shielded and protected.

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If bakelite rod is not available, celluloid knitting needles, purchasable at any dry-goods store, will make a good substitute. They can be obtained in thicknesses from one-eighth to one-quarter inch.

Dry-goods store also can furnish darning needles, which are a great help in chasing fine wires through the pins in coil forms.

—*T. Bruce Kingsford*

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The turns of transmitting coils wound with No. 14 or larger wire can be spaced quite easily by using a section from one of the old inside spring antennas, if one which fits tightly on the coil form is available. It will slide along as the regular winding is put on, will hold tight enough to give good spacing, and will unscrew or pull off easily after the coil is completed. The spacing coil should have about the same number of turns as the coil to be wound. —*W3AAJ*

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Sponge earphone cushions are just the thing for the fellow who wears glasses. If regular cushions are unobtainable, rubber sponges with holes in them will make a good substitute. —*W3EDG*

A new "solution" for shining up copper tubing is suggested by W8LLI. It consists of a cup of vinegar with three tablespoonfuls of salt. Rub the tubing with the mixture, rinse, and dry; W8LLI guarantees that a fine lustre will result.

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W5PY says that a pair of surgeon's forceps makes a most useful addition to the ham's tool kit. Besides being long and thin enough to get into those almost-inaccessible places, the forceps are provided with a locking catch on the handle by which they can be clamped on the nuts and screws which are forever slipping out of ordinary pliers. Your family doctor probably has an old pair which are rusted and of no value to him.

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W2DPH sends in the following formula to keep the drill lubricated in drilling holes through glass:

Camphor, 1 oz.
Spirits of turpentine, 1½ oz.
Ether, ⅜ oz.

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Inexpensive panels may be made using Prestwood, Masonite building board or similar material. A good crackle finish may be applied by giving the panel one coat of clear Duco or Tri-Seal and allowing it to dry over night. Then spray on a coat of Kem Art Metal Finish, or lay it on thickly with a brush, taking care that the brush marks do not show. Allow this to dry a couple of hours and then bake in a household oven at 225 degrees for 1½ hours. This will produce a regular commercial job. This finish, which comes in several colors, may also be used on metal panels. Both types are produced by the Sherwin-Williams Paint Co. and should be obtainable through any of their dealers. — *W8GVO*

Crackle-finish Masonite is now available in many radio stores. — EDITOR.

"High Power Cement" makes a swell stickum for repairing ceramic standoffs cracked by putting on too much elbow grease when tightening the screws. — *W3AAJ*

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When cheap milliammeters go bad under overload, the trouble is that the small permanent magnet in back of the solenoid has lost its magnetism. The needle no longer goes back to zero but flops loosely all over the scale. To fix it, take the meter apart and take out the small magnet. Wind some cotton-covered wire, about No. 20, around it, starting with one pole and going around to the other; the direction of winding is not important. Then connect the wires to a storage battery for a moment. The magnetism will be restored and the meter will be as good as ever. The calibration should not be seriously affected. — *W2DTE*

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Resistor Color Code

SINCE a good many small resistors are now sold with only color-code identification of resistance value, hams will find a knowledge of the color system used of value. Resistors are marked as follows: The body color represents the first figure of the resistance value; the second figure is given by the color at one end, and the number of ciphers following the first two figures by the color of the dot or band on the body. Figures are represented by the colors given in the table below:

0 — Black	5 — Green
1 — Brown	6 — Blue
2 — Red	7 — Violet
3 — Orange	8 — Gray
4 — Yellow	9 — White

For example, a 75-ohm resistor would have a violet body, green end, and a black dot or band (indicating no ciphers) on the body. Similarly, a 50,000-ohm resistor would have a green body, black end, and orange dot or band (three ciphers following the first two figures).

2

Ideas for the Receiver

Midget Portable Receiver

The circuit of the receiver used at VE4EA will be of interest to anyone planning a portable receiver. The outfit uses two 2-volt tubes and, complete with batteries, fits into an aluminum case measuring only $4\frac{1}{2}$ by 6 by 7 inches. Although the plate voltage is only $13\frac{1}{2}$, the receiver operates well on all frequencies up to at least 25 Mc.

As the diagram shows, the set consists of a regenerative space-charge detector and one stage of audio. The secret lies in the use of the space charge detector, which enables real results to be obtained with low plate voltage.

The space charge idea was tried out a few years ago, but it was not used very extensively because no suitable tubes were available; however, there are several now that seem to be just what the doctor ordered. The 46 and the 49 are examples. Both of these tubes have two grids, but they are not screen-grid tubes; the latter types are not satisfactory because of high plate-to-screen capacity and other reasons (see *Radio Engineering*, Terman).

Now for a few details. The circuit is fairly conventional except for the inner grid in the 49, which has positive bias applied to it to cancel out the space charge to some extent. The outer grid is used as the control grid. The audio stage uses a 30, the filaments of both tubes being connected in parallel. Filament power is obtained from a bank of six No. 2 Unicells in series-parallel to give 3 volts. A fixed resistance drops the voltage to 2 volts. It had been decided to use four cells in parallel for filament supply, but the set didn't oscillate very well with $1\frac{1}{2}$ volts on the filaments, so the series-parallel arrangement was used. Three small-size $4\frac{1}{2}$-volt "C" batteries are used for plate supply and they are strapped in the case wherever they fit. Standard manufactured sets of coils can be used as the tickler turns do not seem to be very critical.

It was noticed that the ratio of plate to inner grid volatges seemed to be fairly important, and that $13\frac{1}{2}$ and 6 seemed to be best. A bad fringe howl showed up when the plate voltage was reduced, although the tube still would oscillate with 9 volts on the plate. The total plate and inner grid current is $5\frac{1}{2}$ milliamperes and the filament current is .18 ampere, so battery life should be fair. An attempt to control regeneration by varying the inner grid voltage did not work very well, although it represents a possibility. As it is, the usual throttle condenser works satisfactorily except for a slight detuning effect.

— *Roy Usher, VE4EA*

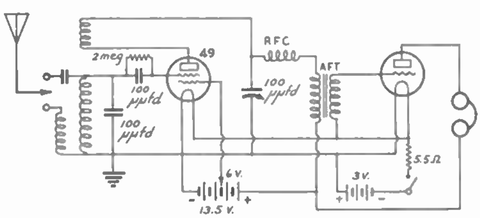

FIG. 1 — SPACE-CHARGE REGENERATIVE DETECTOR IN A LOW-VOLTAGE TWO-TUBE PORTABLE

Regular manufactured coils can be used in the detector circuit, since tickler turns are not critical. Both antenna coil and coupling condenser are used, the former on the lower frequencies and the latter on the higher frequencies, also depending upon the antenna. The coupling condenser need have a capacity of only a few micromicrofarads, and may be made by bending two small pieces of metal strip to face each other, with a spacing of about 1/16th inch between "plates." The audio transformer used by VE4EA has a ratio of 3 to 1.

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A Novel D.C. Receiver

The receiver circuit of Fig. 2 is used by John M. Everitt, Ridgewood, N. J., to secure the benefits of the so-called "electron-coupled" or screen-grid feed-back detector circuit, with filament-type tubes. In the original circuit (published in the Experimenter's Section in January, 1933, *QST*) the regeneration tap on the tuned-circuit coil was connected to the cathode of an indirectly-heated type tube; with directly-heated filaments a simple connection to one side of the filament will not work because it is necessary for the whole filament to be above ground for r.f. In Mr. Everitt's circuit this is accomplished by connecting one side of the filament to the tap on the coil and feeding the other through an r.f. choke. This is a thoroughly practical proposition with low filament-current tubes such as those in the 2-volt series.

Naturally the feature of greatest interest in the circuit is the filament choke, RFC_1 in Fig. 2. Of this Mr. Everitt says, ". . . almost anything works at RFC_1 with some success. I have used various cylindrical and bank windings on a piece of half-inch dowel. A choke made of 21 feet of No. 33 s.s.c. wire wound in three separated banks on the dowel seems a little better than anything

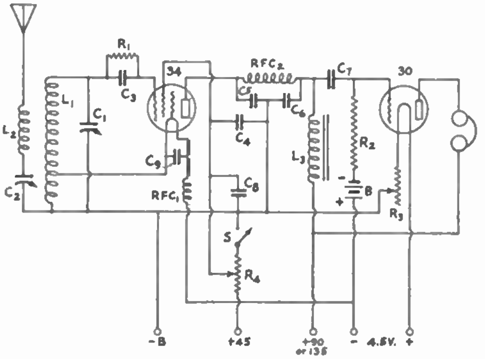

FIG. 2 — RECEIVER CIRCUIT USING 2-VOLT TUBES AND SCREEN-GRID FEEDBACK

C_1 — 135-μμfd. variable.
C_2 — 250-μμfd. variable.
C_3 — 250 μμfd.
C_4 — .004 μfd.
C_5, C_6 — 100 μμfd.
C_7 —.01 μfd.
C_8 — .5 μfd.
C_9 —.006 μfd.
R_1 — 5 megohms.
R_2 — 1 megohm.
R_3 —20-ohm rheostat.
R_4 — 100,000-ohm potentiometer with switch.
B —3-volt flashlight battery.
RFC_1 —See text.
RFC_2 — Any good short-wave choke.

Coil Data

Band	L_1	L_2
14,000 kc.	*6 turns tapped at 2nd*	*3 turns*
7000 kc.	*13 " " " 1½*	*5 "*
3500 kc.	*25 " " " 2nd*	*10 "*
1750 kc.	*60 " " " 2½*	*10 "*

The 14,000-kc. coil is wound on a tube base; all others are on regular plug-in forms, diameter 1½ inch. No. 30 d.c.c. wire used for 1750-kc. coil; No. 20 for all others. All coils close-wound.

else I have tried. . . . It makes but little difference if C_9, across the filament, is omitted. Slightly more feedback is necessary with the 34 than with a 58. The rig is at least as sensitive as the 32 or 34 in the conventional hook-up, and the regeneration control is as smooth and definite as on the a.c. model. The 34 seems to be a little better than the 32; with the 34 fringe howl is almost entirely absent. A disproportionate amount of tickler is necessary on the higher-frequency coils, probably because of capacity leakage between the filment choke and the aluminum chassis."

Bandspreading can be secured by using two variable condensers, one having a maximum capacity of 100 μμfd. and the other 35 μμfd., in parallel in place of the single condenser shown at C_1. In this receiver the filaments are connected in series, and the voltage drop through the 34 detector filament and the choke, RFC_1, is used to bias the Type 30 amplifier. Additional bias is provided by the 3-volt battery in the amplifier grid-return circuit.

— . . . —

Further Dope on the Tapped-Coil Detector

The following from John M. Everitt, gives further information on the use of two-volt tubes in the version of screen-grid feedback circuit which maintains the screen at ground potential for r.f.:

"Since the tapped-coil detector circuit for d.c. tubes was first suggested and described in *QST*, a number of readers have written to me for further details and suggestions. Most of their troubles were apparently with the filament choke.

"The diagram of Fig. 3 shows a fool-proof method of obtaining the feedback. It is self-explanatory, but I will give the location of the tap for a few representative coils:

Turns in total winding	*Tap, turns from bottom*
3	½
6	1
15	1
30	2⅕
60	3⅕
90	6

If a plate by-pass is used, slightly less turns below the tap should be employed.

"There is no difficulty in reaching 5 meters, but above about 10,000 kc. a Type 32 should be

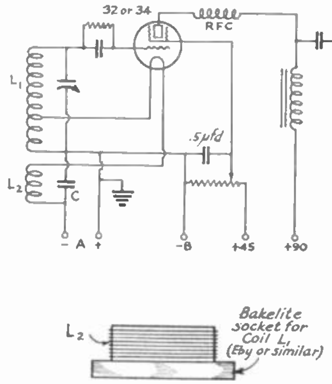

FIG. 3 — DETECTOR CIRCUIT WITH CATHODE TAP AND FIXED FILAMENT COIL FOR USE WITH FILAMENT-TYPE TUBES

Circuit values are usual for regenerative receivers. Data on points at which L_1 should be tapped are given for coils of various sizes in the text. The coil L_2 consists of 10 or 12 turns of small wire (about No. 30) wound around the coil socket, which must be of the type having an extruded top. Condenser C is 0.05 μfd.

used instead of the 34 tube, because of the internally connected suppressor in the latter. On the lower frequencies, however, the 34 gives considerably greater output.

"I have been using the circuit with a stage of t.r.f. and a '30 audio amplifier for some time with very pleasing results."

The chief point of interest in the circuit is of course the fixed coil L_2 in the return filament leg. This coil should be wound in the same direction as L_1, and the lead from the filament should go to the upper terminal of the winding. The voltage induced in L_1 from L keeps the return leg of the filament at the same r.f. potential as the leg connected to the tap on the detector coil.

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Screen-Grid Detector Coupling

HOMEMADE detector couplers using old audio transformers as audio chokes do not always perform as they should; the following letter from Pensyl Mawby, of Trenton, N. J., offers a suggestion which may help in cases where trouble has been encountered:

"I never bought one of those nice, expensive 500-henry chokes used to couple a 35 or 24 detector to a 27 audio; my dollars had to be stretched over too many miles. As per suggestions in *QST* I tried all sorts of old audio transformers, including single stage, p.p. transformers, output audio chokes, etc. with only fair results. I also tried the 250,000-ohm plate resistor without much success.

"In desperation I tried the circuit shown in Fig. 4. The volume was very much better; the

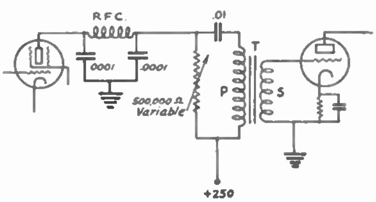

FIG. 4—SCREEN-GRID DETECTOR COUPLING USING A VARIABLE RESISTOR AND AN AUDIO TRANSFORMER

sensitivity was marvelously better. English and German b.c. 'phones are easy to listen to and identify as never before (without antenna, only water pipe to one post and radiator to ground).

"Maximum sensitivity seems to be reached by using 6 to 8 megs. as detector grid leak and high resistance value in the detector plate circuit. Quality is then not at its best. By reducing the resistance, sensitivity is less, quality is improved and tube noises are less. It is a simple matter to pick up a very weak carrier using a high value and then adjust for best results."

A really good audio transformer — one having large primary inductance — should be used. Mr. Mawby's transformer is a Samson Symphonic.

Improved Regeneration Control for the Screen-Grid Detector

THE circuit of Fig. 5 is suggested by Manfred Asson, ES2D, to overcome some of the disadvantages of screen-voltage regeneration

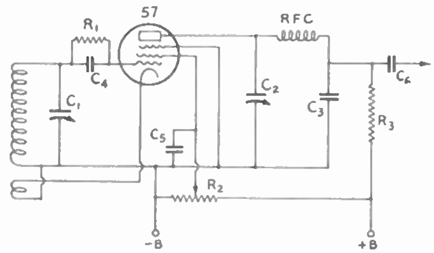

FIG. 5 — A NOISELESS REGENERATION CONTROL WHICH DOES NOT AFFECT TUNING

C_1 — Tuning condenser.
C_2 — Regeneration control condenser, 100 to 250 μμfd. max. capacity.
C_3 — 100 μμfd.
C_4 — 100 μμfd.
C_5 — 0.01 μfd., paper.
C_6 — 0.01 μfd., audio coupling condenser.
R_1 — 5 megohms.
R_2 — 50,000-ohm potentiometer.
R_3 — Plate coupling resistor, 300,000 ohms (Choke may be substituted).
RFC — High-frequency r.f. choke.

control of a screen-grid type detector. As is well known, screen-voltage control tends to cause a frequency change in the circuit and, unless a very good potentiometer is used, is likely to be noisy. Also, since the detector sensitivity is considerably dependent upon a rather critical value of screen voltage, the effective sensitivity is likely to vary considerably if in order to obtain oscillation it is necessary to go very far from this optimum value. This is especially the case when the detector is coupled to the antenna without the benefit of an isolating r.f. stage.

In ES2D's arrangement the working regeneration control is C_2, a variable by pass across the plate circuit. Screen-voltage is controlled by potentiometer R_2; this serves as an auxiliary control which, once set so that C_2 functions properly, need not be touched. The number of turns on the cathode tickler should be adjusted so that with C_2 at about half scale, the tube will go into oscillation when R_2 puts about 30 volts on the screen grid. ES2D has used this system on 7 and 14 mc., and writes that the regeneration control has no effect on tuning, and is of course noiseless.

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An Effective Regeneration Control

FIG. 6 shows a modification of the ultraudion circuit that I have found very effective as a regeneration control in a t.r.f. receiver. As you will note, the cathode circuit is through an r.f. choke to ground, shunted by a variable condenser. By using a fairly large condenser (350 $\mu\mu$fd.) with a low minimum capacity, regeneration can be controlled from the broadcast band to above 28 megacycles.

The rest of the circuit is conventional. It will be

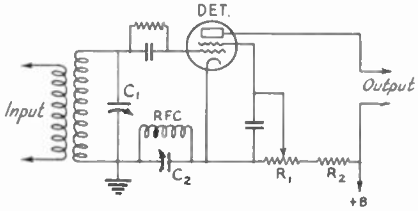

FIG. 6 — MODIFIED ULTRAUDION CIRCUIT FOR CONTROL OF REGENERATION

C_1 is the usual tuning condenser; C_2 the regeneration-control condenser. R_1 is a 50,000-ohm potentiometer, R_2 a 25,000-ohm fixed resistor. RFC is a short-wave type sectional-wound choke.

noted that we have retained the 50,000-ohm potentiometer in the screen circuit. This is optional, but useful in maintaining screen voltage at the point which gives greatest detector sensitivity.

The advantage of the circuit is the extreme smoothness of control and absence of any tuning effect. — *H. H. Marlin, W9CFG*

Improving Detector Stability

A note from Griffin Chiles, W5TR, offers what seems to be a good suggestion for freeing the regenerative detector from frequency variations with regeneration-control settings and variations in line voltage:

"The sketch of Fig. 7 shows an improved electron-coupled detector arrangement. The oscillating portions of the circuit (I used a 24-A) are orthodox; the improvement lies in the regeneration control.

"The voltage divider consists of two fixed resistors chosen to meet the following requirements: first, to divide the 'B' voltage so as to provide proper screen voltage; second, to draw sufficient current from the 'B' supply to cause appreciable voltage drop across variable resistor R_3, which is used to control regeneration.

"The voltage divider circuit is incorporated in the detector circuit wiring, and is entirely separate from other voltage dividing equipment.

"It will be seen that this is a true electron-coupled oscillating circuit and, inasmuch as oscillation starts each time with the same voltage applied across R_1-R_2, the calibration is substantially constant. The regeneration control has negligible effect on tuning, and an increase of 20 or 30 volts in the 'B' supply shifts the frequency only slightly. A decrease of course will take the detector out of oscillation, but on reducing R_3 it comes back in on the same frequency. This makes line fluctuations harmless."

If the variable resistor R_3 is 50,000 ohms, a

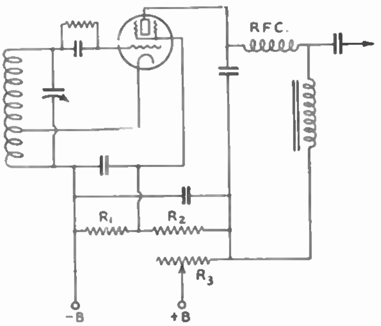

FIG. 7 — IMPROVING DETECTOR STABILITY BY CONTROLLING PLATE AND SCREEN-GRID VOLTAGES SIMULTANEOUSLY

common value, the total resistance of R_1 and R_2 probably should not exceed 50,000 ohms, and preferably should be less for most effective control. Some experimenting with resistor values may be needed for maximum sensitivity and smoothest control. A fair starting point would be to make R_1 about one-fourth the resistance of R_2.

Increasing I.F. Selectivity by Regeneration

It is well known that regeneration in the i.f. amplifier is very effective in improving the selectivity of a superhet receiver. Here is probably the simplest way of introducing the regeneration. It is as effective as any method if control of the selectivity is not necessary.

My own receiver has two stages of i.f. at 450 kc., using 58-type tubes. The first step was to take the first i.f. stage off the gain control and ground the cathode through its 400-ohm bias resistor. Then I took a piece of insulated pushback wire about 4 inches long and twisted one end around the control grid cap. The rest of the wire was then placed next to the tube down inside the tube shield. The grid-plate capacity of the tube was increased enough to make it oscillate. I then cut off about ¼-inch of wire at a time till the tube was just below the oscillation point. It was then necessary to rebalance the i.f. amplifier.

Result — the receiver now tunes about twice as sharply as it did before. The quality of 'phone signals suffers somewhat because of cutting of the side-bands, but as far as I am concerned the width of the ham 'phone bands has been doubled.

It is important that the gain control does not act on the regenerative stage; otherwise the setting of the gain would affect the selectivity.

I believe this little stunt is worthy of a few lines. It is a haywire arrangement, of course, but it certainly does the business — and has the advantage of requiring the purchase of no parts nor the expenditure of any great amount of time. In my particular case I was forced to something like this because the construction of my i.f. transformers is such that it would be very difficult if not impossible to mount a tickler coil next to the grid coil.

— *Earl I. Anderson, W8UD, Douglas, Mich.*

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Stabilizing the 2A7 Converter

The 2A7 (or 6A7) as a combined oscillator-mixer for high-frequency superhets has made a rather poor reputation for itself from the stability standpoint, particularly because of frequency changes with "B" voltage variations. While the instability is not so bothersome in 'phone reception, it becomes annoying in ordinary c.w. reception and makes satisfactory single-signal c.w. reception extremely difficult.

Wolcott M. Smith, of Springfield, Mass., has suggested the use of neon bulbs in a voltage-stabilizing circuit which maintains practically constant voltage on the oscillator-portion anode despite fairly wide changes in the plate-supply voltage source. The major cause of oscillator instability is thereby eliminated. The circuit, shown in Fig. 8, consists simply of a voltage divider with two neon bulbs in series as one section of the divider. Fig. 8 also shows how plate voltage for the beat oscillator can be taken off the divider in addition to the voltage for the high-frequency oscillator.

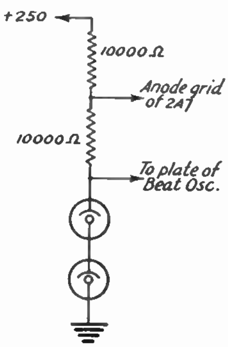

FIG. 8 — NEON-BULB STABILIZING CIRCUIT FOR H.F. SUPERHET OSCILLATOR

The neon bulbs used are the spiral-element type with the series resistors removed.

The neon bulbs should be the new type having a spiral grid as one element. The older type with the small semi-cylindrical plates does not seem to work satisfactorily. The resistor in the base of the lamp must be removed; this can be done quite readily by filing around the base of the shell at the bottom of the threads and unsoldering the center connection.[1] The base then can be taken off and the resistor removed, the wire being soldered directly to the shell. The base may then be replaced, the center connection re-soldered, and some solder run around the filed part of the shell to keep the base in place.

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Oscillator-Mixer Coupling with the 6F7

Probably most amateurs know the 6F7 at least by name. It consists of two separate tubes in one bulb, one an r.f. pentode and the other a triode, a common cathode being used for the two sections. The circuit diagram of Fig. 9 shows a method of using the tube as a combined mixer-oscillator in superhet receivers, the point of interest being the method of coupling between oscillator and mixer sections. This arrangement is suggested by B. P. Hansen, W9KNZ, who has found it superior on many counts to coupling circuits previously tried.

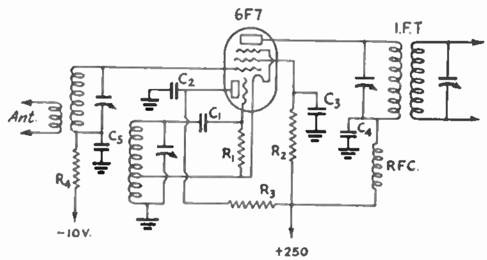

FIG. 9 — CATHODE OSCILLATOR-MIXER COUPLING FOR THE 6F7

C_1 — 500-μμfd. mica.
C_2 to C_5, inc. — 0.1-μfd. paper.
R_1, R_2 — 100,000 ohms.
R_3 — 50,000 ohms.
R_4 — 250,000 ohms.
RFC — 60-millihenry r.f. choke.
Tuned circuit constants usual for the type of tuning system employed.

W9KNZ writes: "This is the stablest and quietest converter circuit I have tried so far, and I don't exaggerate when I say I've tried more than a couple. The cathode of the tube is placed above ground by the r.f. drop across the portion of the oscillator coil between cathode tap and ground, and since the cathodes of the two sections of the tube are the same the mixer cathode will also be above ground by this voltage. This means that the r.f. drop appearing across this section of the oscillator coil also will be applied to the mixer grid. There may be regeneration in the mixer, too, although this stage is perfectly stable. The conversion gain seems to be rather higher than with the more common layouts, while the noise level is lower than on anything so far tried here. Stability is swell — probably the grounded-plate oscillator has something to do with that. Also, while the

[1] Neon bulbs without the resistor in the base are now available. They are equipped with auto-headlight type bases to distinguish them from the regular candelabra-base lamps provided with series resistors.

coupling is certainly direct enough, there is freedom from the usual 'pulling' so common with electron-stream coupled mixing circuits. The r.f. circuits must be shielded from each other. The r.f. filtering shown might perhaps be dispensed with, but the receiver I'm using it in is rather cramped."

A later letter from W9KNZ indicates that the circuit will handle large signals a bit better if automatic bias instead of fixed bias is used on the mixer section. The proper automatic bias can be secured by inserting a 1700-ohm resistor, by-passed by a 0.1-μfd. condenser, in series with the connection from the lower end of the oscillator coil to ground.

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Improving Selectivity in the Regenerative Receiver

In view of the great interest in noise and QRM reducing circuits the details of a receiver used here may be of value.

The second a.f. of the simple 1V2 receiver (see Fig. 10) may be an old tube working as a limiter by adjusting its plate voltage. Now all signals and QRM have practically the same QRK. That alone helps, but the following peak tube improves it still more. In its plate is the headphone, and a variable mica condenser, C_1, feeds back to the plate of the limiter tube. Therefore a coupling transformer is used and connected so that it feeds back. Two condensers, C_2 and C_3, are switched across the transformer secondary to tune to about 1000 and 100 cycles. The switch also places an additional capacity C_4 in parallel to C_1 for 100 cycles, as a greater value on this frequency is necessary. Once the feedback condenser C_1 is adjusted to a point just before oscillation it need not again be touched. The transformer primary has across it a resistor of about 10,000 ohms as a constant load to prevent changing the feed-back condenser at various limiter tube settings.

If you want to simplify the circuit and prevent connecting the large feedback condenser for 100 cycles, use the larger capacity in parallel to the transformer secondary alone for the low peak frequency. Don't use too great plate voltage on the peak tube or your ear drum gets hot at adjusting the feedback condenser!

Last but not least a separate h.f. oscillator is important for such strong QRM signals as would block the detector. Now, for example, an S9 interference and a wanted S4 signal are first limited until both are the same strength, and after passing the peak stage the interference can be S3 to S5 and the signal S9. Often the difference between wanted signal and interfering signal is only 100 cycles or less; then use the low pitched peak and the signals are still readable until both sigs have the same frequency, where there is no help of course. The same goes for auto and static QRM where either the 1000- or 100-cycle peak may be found best. — *Hans. H. Plisch, OK2AK*

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Calibrated Band-Spread and General Coverage with the Same Coil

The idea diagrammed in Fig. 11 is suggested by Thomas C. Moore, VE3AFT. The circuit shown is particularly adapted to a super-

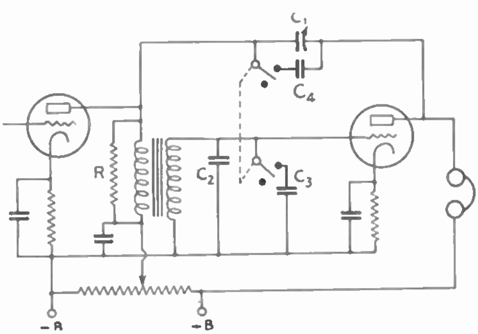

FIG. 10 — VOLUME LIMITER AND REGENERATIVE AUDIO AMPLIFIER FOR REDUCING NOISE AND INCREASING SELECTIVITY IN C.W. RECEPTION

The values of the condensers marked must be determined by experiment. The values of the "tone" condensers, C_2 and C_3, will depend upon the constants of the audio transformer used; values in the usual range of mica condensers — .0001 to .002 μfd. — should give a satisfactory result with most transformers. The feedback condensers, C_1 and C_4, likewise must be adjusted experimentally to give satisfactory regeneration with the tube and plate voltage employed.

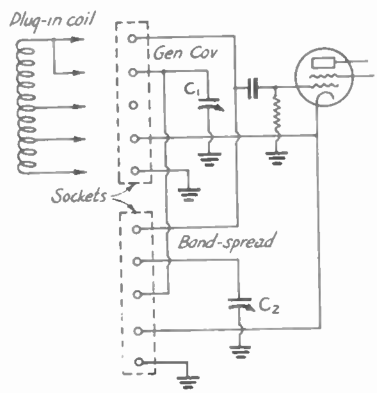

FIG. 11 — WITH THIS CIRCUIT, EITHER GENERAL COVERAGE OR FULL SPREAD OF AN AMATEUR BAND CAN BE OBTAINED ON THE SAME COIL WITHOUT RESETTING A VARIABLE CONDENSER

C_1 is the tuning condenser (100 to 110 μμfd. maximum capacity). C_2, a screwdriver adjusted air padder, is the band-setting condenser which is adjusted only once. Band-spread or general coverage is obtained by shifting the coil from one socket to the other.

het oscillator when used with a separately-tuned first detector circuit, in which case the rather uncritical tuning of that circuit makes band-spread unnecessary. Two coil sockets are used, with the wiring arranged so that when the coil is plugged in the "general coverage" socket the tuning condenser, C_1, is connected across the whole coil. In the "band-spread" socket, the padder, C_2, is connected across the coil, while the tuning condenser is connected across a number of turns which will spread the particular band satisfactorily. In practice C_2 is set to bring the band on C_1 when the coil is in the band-spread socket; no further adjustments are necessary when going to general coverage. The advantage of this system is that both the band-spread and general coverage ranges can be calibrated, since the business of returning a band-setting condenser to a predetermined point to hit the band is eliminated, along with errors in setting.

The same idea can be applied to the regular regenerative detector circuit by making provision for antenna coupling. The antenna might be connected directly to the cathode tap, or, if six-prong forms are used, the extra pin could be used for the antenna connection of a separate coupling coil, the other end of the coil being returned to the ground pin. Also, the same method can be readily applied to r.f. coils in the set.

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Calibrating the Receiver for General Coverage

On finishing the construction of a receiver using the parallel-condenser method of band-spreading, with the band-spreading condenser across only a part of the coil on the higher frequency bands, the following method was used to lay out calibration curves for each set of coils. Such a calibration is useful in locating commercial and b.c. stations of known frequency, and also as a guide to band-spread tuning across the whole range without overlapping and without missing any frequencies.

First, with the band-spread dial at zero, tune across the whole range with the band-setting or tank condenser and get a series of readings from signals of known frequencies. Plot a curve for these. Then set the band-spread dial at 100, repeat this operation, and plot a second curve. Then the intersections of the two curves with a vertical line at any particular location (corresponding to any particular setting of tank condenser dial) will show the range of frequencies that can be covered by the band-spreading condenser for that particular setting of tank condenser. A typical curve is shown in Fig. 12.

To get the proper settings of the tank condenser to cover the whole range on band spread, start with some particular setting — say the setting used for the ham band — and mark a vertical line. The point where it intersects upper curve will be highest frequency for this setting. Then follow across horizontally on this frequency to the lower curve and this will be the next setting

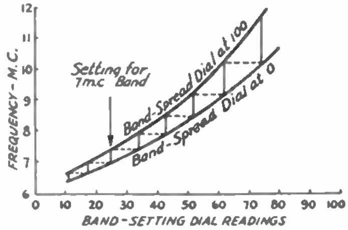

FIG. 12

of tank condenser (set dial at next lower figure to give slight overlap). Continue this over the whole range, marking the tank condenser settings necessary to give complete coverage.

If a low-frequency oscillator is available, the calibration can be made in a very short time. Set oscillator by some b.c. station and get a series of calibration points from its harmonics.

For ordinary use, the approximate setting of band-spreading condenser in order to tune in a station of known frequency can be estimated near enough by noting the position of this frequency on the vertical line between the two curves, but if greater accuracy is wanted, a few more points could be obtained, for other settings of band-spreading dial, say for 20, 40, 60 and 80, and additional curves drawn through these points.

— *H. S. Britt, W7CQE*

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Automatic Tone Control

The utility of a tone control for cutting off high audio-frequency noises in amateur receivers is generally recognized. The type of tone control customarily used is that which attenuates high frequencies only. Also useful under certain conditions, particularly in voice work, is a control attenuating the lower audio frequencies, leaving only the most useful center or "communication band" of frequencies in the output. Interference of the variety that can be cured in a.f. circuits is largely inversely proportional to signal strength; i.e., tone controls are usually needed only on weak signals, with correspondingly less need on strong signals.

An automatic tone control providing both bass and treble attenuation proportionately to signal strength is shown in Fig. 13. A 6C5 is used as the automatic tone control tube (either a 56 or 76 could be substituted, with a change in the cathode bias resistor as indicated). The grid of this tube is tied into the a.v.c. circuit by means of a potentiometer enabling adjustment of operating levels; the a.v.c. voltage is used to increase the negative bias on the 6C5 grid in accordance with signal levels. At no signal the cathode bias alone is applied to the 6C5 grid, and its plate resistance is therefore only about 8000 ohms. Ten volts from the a.v.c. circuit increases this plate resistance to 30,000 ohms, with a rapid rise thereafter. Thus we have the automatic variable resistor for the automatic tone control.

This resistor is effectively in series with C_1,

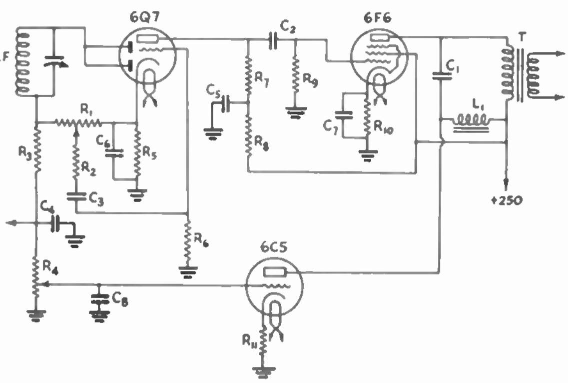

FIG. 13 — AUTOMATIC TONE CONTROL CIRCUIT PROVIDING BOTH BASS AND TREBLE ATTENUATION

The arrow, shown between R_3 and R_4, indicates a connection to the receiver a.v.c. line.

R_1 — 500,000-ohm volume control
R_2 — 50,000 ohms, ½ watt
R_3 — 2 megohms, ½ watt
R_4 — 2-megohm volume control
R_5 — 5000 ohms, ½ watt
R_6 — 1 megohm, ½ watt
R_7 — 250,000 ohms, ½ watt
R_8 — 10,000 ohms, ½ watt
R_9 — 500,000 ohms, ½ watt
R_{10} — 650 ohms, 2 watts
R_{11} — 250 ohms for 6C5; 1000 ohms for 56 or 76.
C_1 — 0.02-μfd., 400 volt rating (values between 0.01 and 0.05 μfd. should be tried)
C_2, C_3, C_4 — 0.05 μfd.
C_5 — 4 μfd. electrolytic, 400 volt
C_6, C_7 — 10-μfd. electrolytic, 400 volt
C_8 — 0.01 μfd.
L_1 — 42–185 henry swinging choke (Thordarson T-7430)
T — Pentode output transformer (tube load 7000 ohms)

which is of such value that with minimum resistance in the 6C5 circuit a quite complete attenuation of the high frequencies will occur. On strong signals, on the other hand, the total effective resistance paralleling the pentode output load circuit will be so great as to have little effect.

So much for the treble control. The bass control is derived more or less as a by-product of the circuit just described The 6C5 plate is fed through L_1. As far as audio frequencies are concerned this circuit is effectively in parallel with C_1 on weak signals, and in series, with a resistance shunt, on strong signals. On weak signals the operation is as follows: C_1 and L_1 in parallel add impedances in such relationship as to establish a decreased load resistance at both low and high frequencies (with the greatest decrease for high frequencies) in the pentode plate circuit. The medium frequencies are, however, scarcely attenuated. The pass band is thus effectively narrowed.

On strong signals two actions occur which render the entire circuit effectively inoperative. Increased resistance in the 6C5 plate circuit effectively places L_1 and C_1 *in series* across the load circuit, rather than in parallel. Normally, the effect of this would be to boost the ends of the frequency range and attenuate the middle frequencies. However, the increased grid voltage on the 6C5 lowers the plate current, which at no signal is 15 ma. At the same time the inductance of L_1 which at 15 ma. is only 42 henries, rises to maximum of 185 henries. Its impedance therefore becomes so great that its effect paralleling the load circuit resistance is negligible.

A surprising improvement in intelligibility and general noise level can be achieved through the proper operation of such a circuit as this, and the elimination of at least one manual control is a decided operating asset.

The Class C Audio Amplifier Applied to Regenerative Receivers

THE amateur c.w. operator will readily recognize the added readability of a signal that "stands out" from the background noise present in nearly every short-wave receiver. We find some operators who like a slight modulation on the signal, others who like the piercing qualities of a pure d.c. note, but all will agree that the ultimate condition is that which would exist should there be no sound in the 'phones other than the desired signal.

The Class-C amplifier as described by W1EYM in the July, 1936, *QST* affords a simple but effective means of accomplishing a marked reduction or complete elimination of background noise. As the article describing this amplifier pertained largely to selectivity, the use of this amplifier as a means of reducing background noise in other than the superheterodyne type of receiver, may have been overlooked by many readers.

The accompanying diagram (Fig. 14) shows a Class-C amplifier somewhat similar to that described by W1EYM. Although an outgrowth of a background-noise reducer designed for use when copying short-wave press in commercial work, it nevertheless offers many possibilities for application to amateur work.

This amplifier may be used with any short-wave receiver having a reasonable amount of gain and properly constructed to have a fairly high signal to noise ratio — provided the receiver is equipped with a power output tube to insure plenty of "drive" for the Class C stage. The writer used the amplifier with a common four-tube t.r.f. receiver with extremely gratifying results.

The output stage of the receiver is coupled to the Class-C amplifier through the condenser C_1. The condenser-coil combination, C_2L_1 is not absolutely necessary, but was found to eliminate a low frequency "hash" present in the output when the bias was adjusted nearly to the point of plate current cut-off. In addition, it serves to "peak" the amplifier at about 500 cycles. The coil is the primary of an output transformer with about half the turns removed.

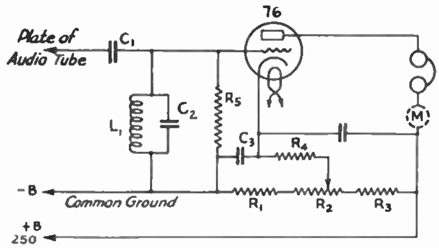

FIG. 14 — CLASS-C AMPLIFIER FOR NOISE REDUCTION

C_1 — 0.01 μfd.
C_2 — 0.00025 μfd.
C_3 — 0.01 μfd.
C_4 — 0.002 μfd.
R_1 — 7500 ohms
R_2 — 500,000 ohm variable
R_3 — 50,000 ohms
R_4 — 15,000 ohms
L_1 — Primary of output transformer with about half turns removed.

The resistor network across the "B" supply is used to obtain the necessary bias for Class-C operation. The center resistor, R_2, is variable, the arm being connected to the cathode through a 15,000-ohm resistor, R_4. In this way, the cathode can be made quite positive with respect to ground. Thus, the grid may be placed at a negative potential with respect to the cathode, variable from nearly Class-A to Class-C conditions.

In operation a signal is tuned in and the bias control adjusted to the point where all background noise drops out. The strength of the signal will decrease but slightly, although a change in tone will usually be noted.

It has been found that a certain minimum difference must exist between the strength of the desired signal and the strength of the background noise level to assure satisfactory operation. Thus, the usefulness of the device will be somewhat limited. The extent of this limitation will depend on the receiver, the location, frequency band used, and upon the amateur himself. Whereas the DX man, listening to weak or fading signals, might find the gadget of little value, the traffic man having schedules with several stations consistently S8 or S9 at his QRA might find his work made much easier and hence the amplifier quite valuable.

Incidentally, the milliammeter in the plate circuit may be used as a means of comparing signal strength. Although of little value on weak signals, it may be used to compare any signals sufficiently loud to permit satisfactory operation of the Class-C amplifier as a background noise reducer. — *Forrest A. Bartlett, W9FYK*

28-Mc. Band-Spread Coils

Though these coils were designed for the National SW3 and 5, there is no reason why they will not work in any receiver employing six-prong coil forms.

Most owners of the SW5 have the black coils lying around. These coils are practically useless for ham work, since the 14-Mc. band occupies only three degrees on the tuning dial. A very good use is now found for them. With a few alterations, they can be converted into 28-Mc. band-spread coils. Here's how:

R.f. coil: Take one turn off the grid winding, drill a small hole and pull the loose end through. Leave the other two windings untouched. Now two turns up from the bottom of the grid coil, drill small holes on each side of the wire, being careful not to break the fine-wire winding. Scrape the wire and solder one lead of a fixed 100-μμfd. condenser (the midget kind with pigtails) to it; the other lead goes to the prong to which the top of the grid coil formerly was connected. This hooks the condenser in series with the tuning condenser as shown in Fig. 15. Now take a small Hammarlund trimmer condenser (EC-35) and bend down the large "ear." This is the "band-locating" condenser; it should then be connected across the ends of the grid coil. The top connection is made by drilling into the top side of the coil form and fastening the bent "ear" and the loose end of the coil, together with a flexible lead that goes to the control-grid cap on the r.f. tube.

The detector coil construction is the same with one exception — instead of the upper end the grid coil going to the band-locating condenser and the flexible lead as already described, a 100-μμfd. condenser, with a ½-watt 5-megohm resistor across it, is placed in series with the free end of the coil and the control grid lead, also shown in Fig. 15.

When these alterations are completed you have some efficient 28-Mc. band-spread coils. Set the 28-Mc. band at about 125 on the dial by adjusting the band-placing condenser on the detector coil in conjunction with a frequency meter; after this is done vary the condenser on the r.f. coil to bring the two circuits into resonance. The r.f. coil setting is not critical, but proper adjustment helps to bring the two coils in step. The spread is about 60 dial divisions.

Those who do not have National coils or the SW3 or 5 will find the following table of coil dimensions useful:

R.F. Coil Windings

Grid — 5 turns No. 20 enamel wire space-

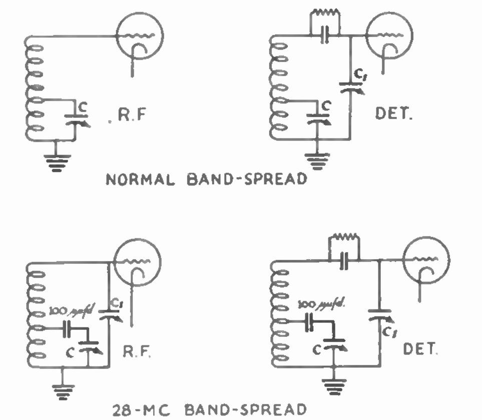

FIG. 15 — WIRING OF THE 28-MC. BAND SPREAD COILS

The normal band-spread arrangement used in the National SW3 and SW5 receivers is shown above. For 28 Mc., 100-μμfd. fixed condensers are connected in series with the tuning condensers (the tuning condensers have a maximum of 90 μμfd. in the National sets) and a mica trimmer is used on the r.f. as well as the detector coil.

wound 3/16-inch between turns, placed well up on the coil form.

Trimmer — 3¾ turns No. 32 wound in between grid winding.

Antenna — 3 turns No. 28 at bottom of coil form.

Detector Coil Windings

Grid — Same as r.f. grid coil.

Input — 2¾ turns No. 32 wound in between grid windings.

Tickler — 3 turns No. 28 at bottom of coil form.

In all other respects the construction is exactly as described above.

A word about the input winding of the detector coil. The National coil has 3¾ turns; I had to take off one turn so that the detector would oscillate in the old plate-feedback circuit, and found that it worked just as well as 3¾ turns in the screen-grid feedback circuit so I left it that way. Five-prong coil forms will suffice for the screen-grid feedback circuit.

The trimmer winding is a big help on these coils, for it peaks the signals as well as acting as a trap for loud local QRM.

— *Clyde C. Anderson, W6FFP*

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A kink for 5- and 10-meter tuners: Twin phone-tip jacks, customarily sold riveted in a small piece of thin bakelite for "phono" connections, will mount very nicely across midget tuning condensers. Coils made of No. 14 wire will plug into them directly. Slight adjustment of inductance for tracking purposes in t.r.f. sets can be made by pushing the coils farther into the jacks.

— *W1NB*

A Cure for Receiver Hum

For some time a tunable hum has been present in my receiver in the vicinity of the 14-Mc. band. Neither a three-section filter consisting of 90 henrys and 48 μfd. nor an r.f. filter in the power supply leads had any effect. The remedy was simply a small by-pass condenser connected across half the center-tapping resistor which is across the heaters, as shown in Fig. 16.

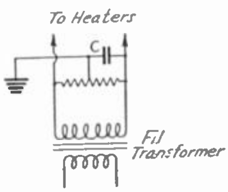

FIG. 16

With this condenser installed, every trace of tunable hum disappeared, and d.c. notes, which previously had been "fuzzy" in the 14-Mc. band, became just as clean-cut as in any other band.

The receiver is a three-tube affair, using one stage of tuned r.f. detector, and one audio. At present, the tubes used are two Type 36's and a 38, but the hum was just the same when two 24's and a 27 were used.

— *Curtis C. Springer, W9EMR*

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An Audio Output Stage for the Regenerative S.S. Receiver

Several months ago I constructed the regenerative single-signal superheterodyne described in the *Handbook* but found that while the set functioned just as the data said it would, the total gain was not sufficient to bring in all signals with the sock I desired.

The obvious solution in such a case as this would be to substitute another tube for the 2A5 used as a second detector, and then use the 2A5 as a straight audio amplifier, but this would have necessitated drilling another socket hole and this in turn would have ruined the appearance of the chassis and also crowded things considerably. However, the problem was solved by using one-half of a 53 as the second detector and the other half as beat oscillator. Since the beat oscillator is coupled to the second detector, this was the logical combination of circuits. The whole audio and second-detector end of the receiver was then wired as shown in Fig. 17. It was found that the audio output was many times greater with this arrangement than when the 2A5 was used as a combination audio and second detector tube.

The circuit of the beat oscillator half of the 53 differs considerably from the former circuit using a 57. The connection that formerly went to the 57's cathode is grounded and the connection that was grounded is coupled through C_1 to the plate of the oscillator half of the 53. The grid connec-

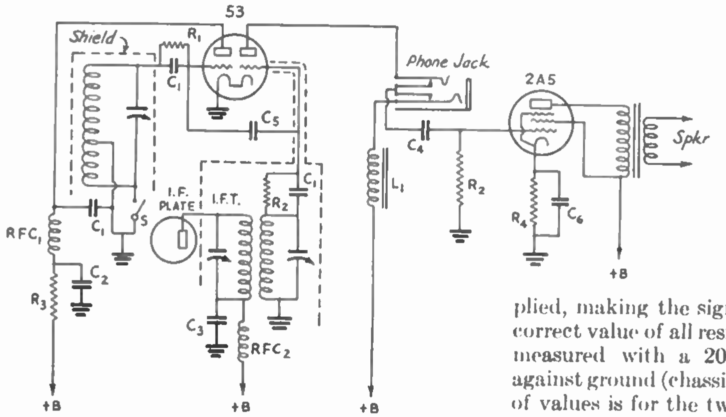

FIG. 17 — THIS CIRCUIT MAY BE USED TO ADD AN AUDIO OUTPUT STAGE TO THE REGENERATIVE S.S. RECEIVER

It requires no additional sockets or major changes in the wiring. A 53 is substituted for the beat oscillator tube in the original circuit, combining the functions of second detector and beat oscillator in one bulb. The 2A5 then becomes a straight audio amplifier.

C_1 — 250-μμfd. mica condenser.
C_2 — 1-μfd. paper condenser.
C_3 — .01-μfd. paper.
C_4 — .01-μfd. mica.
C_5 — Approximately 25 μμfd. (homemade).
C_6 — 10-μfd. low-voltage electrolytic.
R_1 — 50,000 ohms.
R_2 — 1 megohm.
R_3 — 2500 ohms, 5-watt.
R_4 — 400 ohms, 2-watt.
RFC_1 — 60 millihenry choke.
RFC_2 — 10 millihenry choke.
L_1 — 400-henry audio choke.

tion is the same except that the lead is brought out under the chassis. It was found that both parts of the tube worked very well with their common cathode grounded and there was therefore no necessity for inserting cathode bias.

There is really nothing unusual about the rest of the circuit, and the diagram is self-explanatory. The oscillator coupling condenser was made in this instance of about five inches of twisted wire with the dead ends insulated and the other two ends soldered to the two grids of the 53. This was found to give very good results since it did not overload the second detector but still produced a very good beat note.

I am convinced that this change will be welcomed by fellows having one of these receivers, as the gain in audio volume is well worth the trouble.

— *Lewis Van Arsdale, W9NQV*

Notes on Regenerative S.S. Receiver

A GREAT many constructors have written to me regarding construction of the S.S. receiver described in May 1934 *QST*, and in recent editions of the A.R.R.L. *Radio Amateur's Handbook*. While the *Handbook* specifications are correct, a typographical error in the original article gave an improper value for R_{16}, which should be 25,000 ohms, 5-watt, instead of 2,500 ohms. With the lower value too high screen voltage on the second detector and plate voltage on the beat oscillator were applied, making the signals seem very weak. With correct value of all resistors the following voltages measured with a 200-ohms-per-volt voltmeter against ground (chassis) were obtained. The range of values is for the two extreme positions of the volume control R_3.

Tube	*Plate*	*Screen Grid*	*Cathode*
R.F.	170–180	60–85	0–30
1 Det.	170–180	10	0–25
H.F. Osc.	170–180	75–85	0
I.F.	165–175	67–70	3
C.W. Osc.	75–85	7–10	0
2 Det.	150–170	75–85	0

W9NQV describes (in the preceding item) an effective means of adding a stage of audio amplification to the receiver, although this should not be necessary unless loud speaker reception of weak signals is desired on 20 and 10 meters where the gain is not as great as on the lower-frequency bands. A simple expedient which will increase the gain considerably on these bands is to use a 57 first detector in place of the 58, and to use the 40-meter coil on 20 meters and the 20-meter coil on 10 meters in the separately tuned r.f. stage.

Satisfactory coils for 10-meter reception can be wound on the small-sized National isolantite forms. L_4 and L_5 are each 3 turns spaced to one inch length of winding and L_5 is tapped one turn from the ground end, both coils of No. 18 enameled wire. L_3 is composed of 3 turns of No. 36 d.s.c. wire close-wound ⅛ inch from bottom of L_4. The holes in these forms make all these spacings readily attained.

—*R. W. Woodward, W1EAO*

W8DZU has a simple stunt for improving the "local" selectivity of tuned r.f. receivers. It is an ordinary wave-trap — made from a 140-μμfd. midget condenser and some spare plug-in coils — which is connected in the antenna lead and tunes over the band on which the receiver is set. The trap acts as a very effective r.f. input control, enabling distant stations within a few kilocycles of locals to be heard, and has negligible tuning effect on the receiver.

Building Pre-Selectors

W2AND has suggested that the SW-3 receiver makes an ideal basis for the construction of an excellent pre-selector.

Fig. 18 shows the original schematic of this unit, while Fig. 19 gives the circuit after conversion to the pre-selector. The numerals inserted at the points of various connections indicate the five major changes necessary for the conversion. Let's enumerate and explain them individually. Referring to the figures:

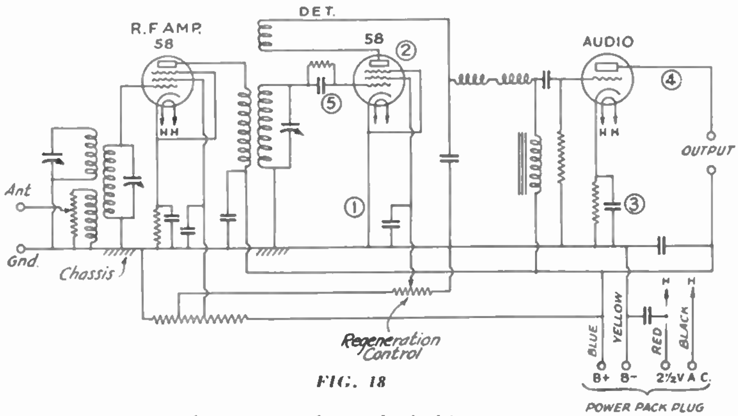

FIG. 18

1. Insert a 300-ohm resistor for cathode bias.
2. Open lead at plate of second tube, formerly the detector.
3. Remove condenser lead from cathode of audio tube and place in shunt with 300-ohm resistor, leaving ground connection intact.
4. Remove lead from plate of audio tube, and connect to the plate of second tube. This provides a direct connection from binding post to plate of second tube.
5. Remove grid leak and condenser of detector and make a direct connection to the grid of tube from the variable condenser.

The two-stage pre-selector unit is now ready for application to the particular receiver in use. It may be adapted to any short wave superheterodyne receiver in the ham station, regardless of whether or not it is already equipped with pre-selection. If the receiver is already equipped with a stage of pre-selection, it will certainly be a revelation to the operator when he once uses this unit in addition. The r.f. gain will be tremendous and the selectivity will be to the nth degree. The application to a receiver not already equipped with pre-selection will put that receiver in the class of the finest short-wave super now available.

Either band-spread or regular coils can be used. The antenna trimmer dial is adjusted only once in the initial installation of the unit, to set the first and second r.f. circuits in resonance. The receiver's r.f. gain control is set on whatever point the operator finds comfortable to the ears, the "S-9" point (minimum gain) being used exclusively at this station. The gain can also be controlled by the operation of the former regeneration knob, which now governs only the gain of the second r.f. tube. This can be disconnected from the circuit if desired, as can any other component parts of the unit which are not being used. All has been left intact in this station since an emergency may arise requiring the original SW-3 for service. It would be very simple to reconvert back to the original circuit.

A Single-Tube Model

Fig. 20 shows a tuned-grid tuned-plate stage used by OA1B, designed and built especially for 14-Mc. 'phone reception by the late Mr. J. L. Stauft. The circuit and physical arrangement are shown in Fig. 20. This unit also was designed to be used with an FB-type receiver and employs SW-3 type coils with the primary

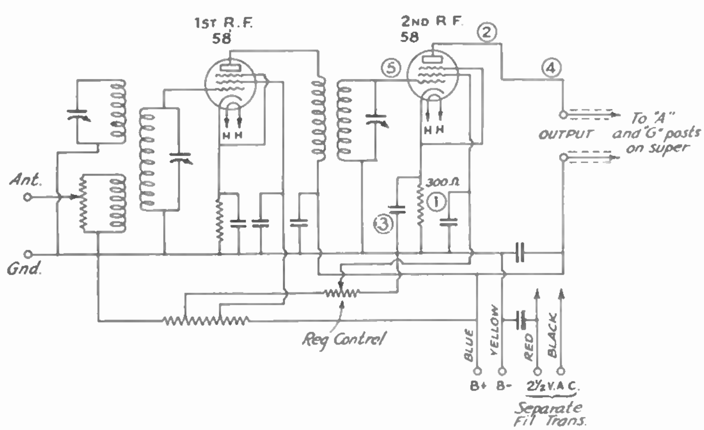

FIG. 19 — CARE MUST BE TAKEN TO SEE THAT THE INPUT CIRCUIT OF THE SUPERHET IS NOT GROUNDED

windings removed. As indicated, the plate and grid circuits are coupled through a 3-plate variable condenser, which serves as the regeneration control in conjunction with the high-resistance variable cathode resistor. In operation, the feedback control condenser is adjusted so that the

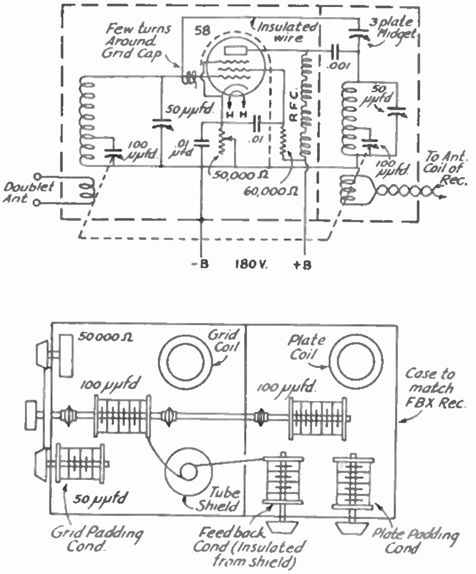

FIG. 20

tube breaks into oscillation with a few hundred ohms of cathode resistance in circuit. Hence, this cathode resistor "handles" much like the regeneration control of a t.r.f. receiver. The point just below oscillation gives the maximum selectivity and gain. Under these conditions the signal strength is tremendously increased with a considerable reduction in background noise, the calibrated volume control of the FBX being kept down between "R6" and "R9" at all times—indicating no small improvement in useful sensitivity.

Still another regenerative single-stage arrangement, used by W2AOE in his Single-Signal superhet, is shown in Fig. 21. Quoting from his short description:

"In the original design, some image trouble was encountered on 14 Mc. I finally decided to add regeneration to the r.f. stage to eliminate this difficulty and, at the same time, to increase the sensitivity. The problem was to do this job easily and quickly without adding more controls to the receiver. I did this by using the antenna coupling coil as a regenerative winding located in the cathode of the r.f. tube. In my receiver I had a cathode filament control operating on the first r.f. and detector stages. I cut the detector out of this circuit so that it is working at full gain and, at the same time, removed the a.g.c. from both tubes.

"Coupling to the antenna is now made with a two-turn coil wound on the outside of a Faraday (static) shield which fits over the coil socket so that the regular National coil (SW-3 type) may be plugged into the socket inside of the shield without difficulty. I made this shield from some 'air-wound' inductance similar to the sort of coil George Grammer made for his transmitter, described in March, 1934, *QST*, except that the material available was close-wound. No alteration was necessary in the former antenna coupling coils to secure regeneration on all bands.

"In operation, the receiver now works very smoothly, image response is completely eliminated, and a healthy increase in gain is obtained. With the r.f. gain control turned up and the i.f. gain control turned down, considerably less set noise results.

"Undoubtedly the boys who have built their own Single-Signal receivers would like to make the change. It certainly is a great improvement."

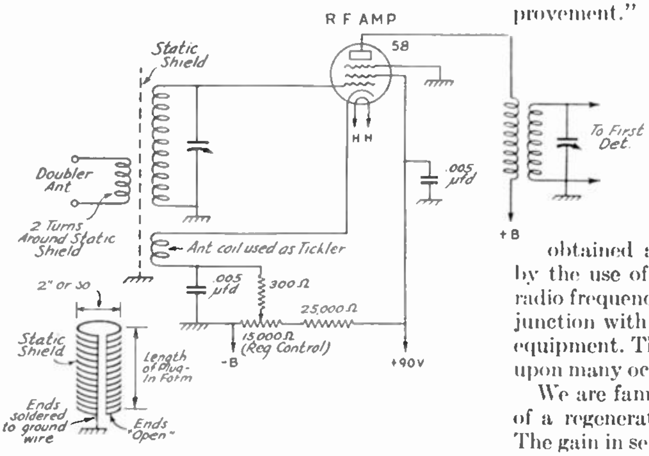

FIG. 21

Regenerative Amplification at Signal Frequency

Additional sensitivity and selectivity may be obtained at the cost of slight inconvenience by the use of a regenerative receiver having no radio frequency amplification, when used in conjunction with regular superheterodyne receiving equipment. That there is need of such sensitivity upon many occasions will be generally recognized.

We are familiar with the re-radiating qualities of a regenerative receiver of the type specified. The gain in sensitivity is obtained because of that quality.

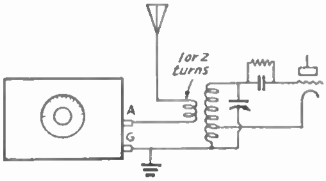

FIG. 22 — USING A REGENERATIVE DETECTOR AS A SIGNAL-FREQUENCY BOOSTER FOR AN AMATEUR-BAND SUPERHET

No constructional changes in either superhet or regenerative detector are required.

The procedure is as follows: Disconnect the antenna from your regular receiver and introduce the regenerative receiver between the antenna and the antenna post of the regular receiver. The antenna is connected to the antenna post of the regenerative receiver and the ground terminal of the regenerative receiver is connected to the antenna post of the regular receiver. Let the assumption be that an 80-meter signal had been tuned in prior to the introduction of the regenerative receiver. The next step will be to tune in that 80-meter signal on the regenerative receiver and it will be noticed that a very decided gain in signal strength is obtained.

Another method is to introduce an old regenerative b.c. tuner, such as the Radiola III, for instance, in the lead from an s.w. converter to the antenna post of a broadcast receiver used as an i.f. amplifier. The result is the same but the inconvenience is not so great, since the regenerative set need be tuned only once.

Other applications also may suggest themselves. — *Leonard C. Jensen, W1IW*

Editor's Note. — This scheme has excellent possibilities for increasing the amplification and providing signal-frequency selectivity with amateur-band superhets having no pre-selection. Its chief advantage is the fact that a discarded regenerative receiver (most ham stations have one) can be used without the necessity for even slight changes in the wiring of the superhet receiver.

Fig. 22 shows how the method has been used successfully with a receiver of the FB-7 type using the detector of the two-tube receiver described in June, 1934, *QST* as the regenerative signal booster. Although the ground post on the regenerative set can be connected to antenna on the super and the antenna run to the antenna post on the regenerative set, as suggested by W1IW, it has been found preferable to connect the ground posts of the two receivers together and couple the antenna lead to the regenerative tube through a turn or two around the detector coil as shown. This "ties down" the regenerative set and avoids body-capacity effects. The coupling to the regenerative tube is readily adjusted by varying the number of turns on the coupling coil. The coupling should be fairly tight, but not so tight as to prevent the regenerative tube from going into oscillation.

In operation both super and regenerator should be tuned just as they would if both were independent and were being used to pick up the same signal. With regeneration at minimum the regenerative tube will have practically no effect on the signal; with the regenerative circuit tuned to the signal frequency and adjusted just below the point of oscillation, however, there is a very marked increase in signal strength, depending upon the initial pick-up. If a short antenna is used, the increase may be as much as four or five R's, being particularly noticeable on 'phone signals. Careful observation indicates that the increase in signal strength is accompanied by an increase in the signal-noise ratio, the difference being perhaps one point on the S scale as judged aurally. That is, if the original signal was S4 and the background S2, adding regeneration might increase the signal to S8 and the background to S5. At any rate, it has been possible to bring up signals to readability from being just audible in the background without regeneration. Maximum gain is of course secured when the regenerator is worked just below the oscillating point; however, a definite gain results with the regeneration backed off far enough so that the tuning is not critical.

This method of introducing regeneration also provides a means for reducing image response in supers without pre-selection. Actually the image signal is left unaffected by the regeneration, but the increase in desired signal strength gives a decided improvement in the desired-signal to image ratio. Again talking in ham language, let us suppose that without regeneration the background is S3, the desired signal S5 and an interfering image S6. With regeneration at the critical point, the signal will be increased to perhaps S8, the background to S5, and the image will be unaffected. However, if the superhet gain control is reduced to bring the background back to S3, the desired signal will drop to S6 and the image to S4, approximately. In other words, the image is now considerably weaker than the desired signal instead of stronger as it was without regeneration, for the same background noise level in both cases. The figures are of course only approximate. In practice it has been possible to pull up an amateur signal from being unreadable below an interfering image to the point where it was perfectly readable with the image practically inaudible. This was done using a small antenna; the improvement may not be quite so marked with a larger receiving antenna.

The "catch" is of course that for maximum results the tuning of the regenerative circuit is just as critical as though the tube were being used as a detector. However, for general listening the regeneration can be backed off so that the superhet operates normally; when additional gain or selectivity is needed the regenerator can be brought into play. Since no constructional work is required it may be well worth a trial by those having ham supers without pre-selection.

—...—

A Simple Audiometer

A PRACTICAL audiometer of simplified design may be of interest to amateurs who want to give as correctly as possible reports of relative signal strengths. In judging radio signals the memory cannot retain for comparison the exact strength of the preceding day, and the ear itself is often insensitive to volume changes as great as two-to-one or even more. It is surprising how great a change must be made to appeal to the ear as a change of volume. A person trained in relative evaluation can differentiate between five values; very strong, strong, medium, weak and very weak. But the majority of us do well to distinguish between strong and weak.

A glance at the diagram, Fig. 23, will show its simplicity. In its commercial form the audiometer has a compensating series resistance which keeps the input impedance constant as the 'phones are shunted down the scale. In the simplified construction, however, this refinement is unnecessary because the impedance of the entire shunt resistance is purposely kept low relative to the impedance of the 'phones. The audiometer has five steps. Continuously variable adjustable resistors will not do because they vary too much. A small inductance switch with dependable fixed resistors should be preferred. The 0.1-ohm resistor is made up from a 1-foot 6-inch length of No. 28

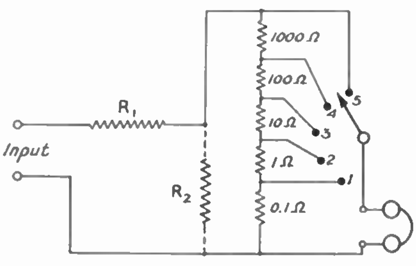

FIG. 23 — A SIMPLE AUDIOMETER FOR MEASUREMENT OF RELATIVE SIGNAL STRENGTH

R_1 is used to match the required output tube load; 5000 ohms will be satisfactory in most cases. R_2 is a shunting resistor to be used only when the volume is too great without it; 10 to 500 ohms should be satisfactory.

wire wound on a small wooden dowel. The optional resistance, R_2, may be used with higher volume.

It will be noted that each step increases the resistance across the 'phones (and therefore the voltage), by the approximate factor of 10:1. The power ratio, then, is 100:1; the common logarithm of 100 (and hence the number of bels) is 2; the number of decibels is 10 times this or 20. Therefore the steps are 20 db each.

On two stages of audio it rates a fair loudspeaker signal 5 and a very weak 'phone signal 1. In operation a signal is tuned in with the switch on tap 1, where it will be loudest. Then the switch is moved up the scale, putting the 'phones across smaller and smaller resistances until the signal can barely be heard. If the signal is heard weakly on 3 and goes out on 4, we rate the signal 3 on the 1–5 scale. Of course the figures mean nothing in themselves; they simply indicate the relative strength. It should be pointed out that using the same system any number of steps may be used to show any number of relative strengths.

—...—

Increasing C.W. Selectivity

IN TINKERING around I have run across a little scheme that seems to me to have possibilities as an inexpensive way of increasing the selectivity of c.w. receivers.

The stunt is to take the audio output of an autodyne detector, put the beat note through a low-pass filter, then build up the pitch with one or more frequency doublers to a tone desirable to copy. If the low-pass filter cuts off at 200 cycles, we can then separate stations 200 cycles apart and two doublers will bring the maximum tone pitch up to 800 cycles. Fig. 24 shows a simple layout tried at W3CIJ.

The low-pass filter was the common tone control carried to the extreme. A push-push doubler was used to cancel out the fundamental tone. Cathode resistor bias was used to get linear amplification. It might seem that the low-pass filter is unnecessary, but if it is not used there will be a beat between each two actual signals.

Results obtained here were about what would

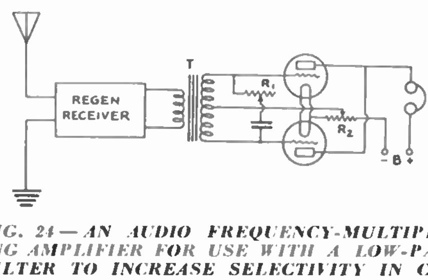

FIG. 24 — AN AUDIO FREQUENCY-MULTIPLYING AMPLIFIER FOR USE WITH A LOW-PASS FILTER TO INCREASE SELECTIVITY IN C.W. RECEPTION

be expected. The audio transformer (or transformers as another stage was ahead of the doubler) seemed to cut off at about 100 cycles. With the tone control cut down low there was a nice peak in this region. The 100-cycle tone, of course, doubled to 200 cycles with plenty of higher harmonics to make the pitch sound higher. The receiver when tuned sounded something like a single receiver with two crystals either side of zero beat, except that the tone of a pure c.w. signal was changed to something that sounded like the old rotary sparks and was pleasing to copy. This must have been due to the harmonics generated in the doubler. By jiggling the bias resistor and plate voltage on the doubler many changes in tone could be brought about.

— John P. Shanklin, W3CIJ

Power Amplifiers for Regenerative Receivers

MANY amateurs have trouble from howling when they attempt to put a power amplifier on their two- or three-tube regenerative receivers. With the idea of discovering the cause of this trouble, the two-tube a.c. receiver using a 58 detector and 56 audio described in the A.R.R.L. *Handbook* and *QST* for June 1934 was set up and a 2A5 pentode audio power stage resistance-coupled to the 56. No decoupling circuits were used and a 10-μfd. cathode resistance condenser was the only by-passing employed. The resistance used in the plate circuit of the 56 was the usual value of 50,000 ohms.

When the receiver was turned on, a low-frequency audio oscillation started immediately. The oscillation would cease only when the audio volume control was turned below about one-quarter way towards the full volume position. A decoupling network was then tried in the grid circuit of the 2A5. R_3, a resistance of 250,000 ohms, was inserted and the cathode by-pass condenser connected across both R_3 and R_4. After this change, the volume control could be advanced to mid-position without motor-boating. A decoupling network in the plate circuit of the 56 had no effect. A large plate by-pass condenser was next tried and when this capacity was increased to 16 μfds., it was possible to advance the volume control to almost maximum position.

At this point the value of R_1, the 56 plate circuit resistance, was reduced to 20,000 ohms. Although no reduction in gain could be noticed with the lower value of load resistance, the audio amplifiers were entirely stable at full volume. Later investigation showed that the plate by-pass capacity could be reduced to 8 μfds. with the lower value of plate circuit resistance.

Transformer coupling between the 56 and 2A5 was next tried. Tests with three or four different transformers showed that this type of coupling not only provided an appreciable improvement in gain over resistance coupling, which might be

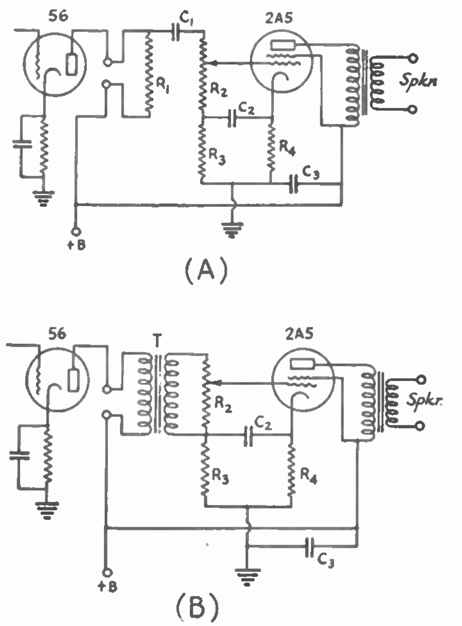

FIG. 25—SUGGESTED CIRCUITS FOR A SINGLE STAGE POWER AMPLIFIER

R_1—20,000 ohms, 1 watt.
R_2—500,000-ohm potentiometer.
R_3—250,000, ½ watt.
R_4—400 ohms, 1 watt.
C_1—.02 μfds.
C_2—1 μfd., 50 volts.
C_3—8 μfds., 400 volts.
T—Interstage audio transformer.

expected, but that the audio system was much more stable. With one or two of the transformers used no special measures were necessary to prevent oscillation: with others the decoupling resistor in the grid return circuit was necessary to permit full advance of the gain control. The decoupling resistor also served to eliminate a slight power supply hum which was first experienced.

Since any plate by-pass capacity added is effectively in parallel with the power pack filter condenser, the value needed to obtain complete stability may vary somewhat with the values of filtering capacity used in the power pack.

The final circuits are shown in Fig. 25.

—W1TS

3

Transmitter Suggestions

A Simple and Inexpensive QRP Transmitter

WE ALL realize that a large part of the QRM on amateur bands is caused by the use of high-power transmitters for local and other short-distance communication. The average amateur, however, is not financially able to put more than a few dollars into an auxiliary transmitter; he always needs every dollar he can spare for improvements on his main rig. There is one way, however, in which a very inexpensive low-power set suitable for short-distance communication can be built in a few minutes' time. It requires no additional power supply; only the key, crystal and antenna from the main transmitter.

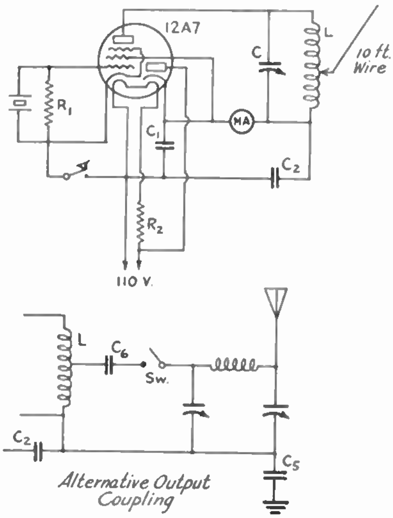

FIG. 1 — SIMPLE AND COMPLETE ONE-TUBE TRANSMITTER FOR LOCAL OR PORTABLE WORK

R_1 — 25,000 ohms.
R_2 — 350 ohms, 50-watt (line cord).
C_1 — 24-μfd. electrolytic, 200-volt or higher rating.
C_2 — 0.002 μfd.
C_3, C_4 — 500-μμfd. variable.
C_5, C_6 — 0.002 μfd.

Plate tank circuit, LC, has usual constants for frequency of crystal employed. The inductance in the pi-section coupler shown as an alternative output circuit likewise should be adjusted for the frequency and type of antenna used. This coil may be provided with taps.

I have built two such transmitters, using the circuits in Fig. 1, and have had very pleasing results with them. Using the simpler antenna system, I contacted a station 407 miles away and received an RST349X report; this was done merely by answering his CQ, not by the usual "low-power" method of contacting a station on high power and then shifting the crystal to a flea-power transmitter.

— *Carl C. Drumeller, W9EHC*

For the benefit of those not familiar with the 12A7, the tube consists of a pentode and power rectifier, with separate cathodes, in one bulb. W9EHC's circuit uses the rectifier to convert the 110 a.c. to half-wave d.c., the filter being condenser C_1. The r.f. part of the circuit is the familiar pentode crystal oscillator. A line cord with built-in 350-ohm resistor drops the 110 volts to the proper value for the heater of the 12A7.

— EDITOR.

110-Volt Transmitter Using 48's

ONE tube which offers possibilities for the low-power transmitter which must operate from a 110-volt d.c. line is the Type 48, a power amplifier tetrode the construction of which is such that it has pentode characteristics. This tube is capable of an output of about 2.5 watts as an audio amplifier, and should give more when operated at the higher efficiency characteristic of r.f. circuits.

A crystal circuit which has been used successfully by Dr. A. L. Russell, W9VOD, is shown in Fig. 2. It is adapted from the transmitter circuit given in *How to Become a Radio Amateur*, with such changes as are necessary to use the 48 tube. Using two tubes, a number of stations were worked on the 7-mc. band with an input of only 11 watts, one of them being 1100 miles distant. The screen voltage was dropped slightly by means of the 15-ohm resistor.

In an attempt to increase power, four 48's were used in push-pull parallel, the circuit diagram being the same as given except that two tubes were used on each side, the elements being connected in parallel. This permits connecting the heaters of all four tubes in series directly across

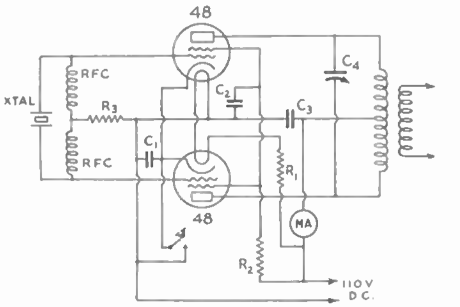

FIG. 2 — A 110-VOLT D.C. TRANSMITTER USING TYPE 48 TUBES

C_1, C_2 — .003 μfd.
C_3 — .005-μfd.
C_4 — 100-μμfd. variable.
R_1 — 200-ohm variable resistor to carry at least 0.4 amp.
R_2 — 15 ohms.
R_3 — 25,000 ohms.
RFC — Short-wave chokes (2.5 mh.)

As suggested in the text, four tubes may be used in push-pull parallel, in which case R_3 should be 15,000 ohms and R_1 may be omitted, the four heaters being connected in series across the line. The plate coil should have the requisite inductance to resonate at the crystal frequency in conjunction with C_4

the 110-volt line, and the resistor R_1 can be omitted. With four tubes the value of the grid leak, R_3, should be reduced to 15,000 ohms. Other constants remain the same. The power increase was found to be worthwhile, since a higher percentage of calls were answered and the transmitter got out better. It should be possible to run the input to 25 watts without much difficulty — a power which is not far from the average of many transmitters using 350- or 400-volt power supplies

W9VOD reports a curious thing in connection with using Type 48 tubes; apparently the tubes require "seasoning" during a few days' operation. At first very loose coupling to the antenna must be used; after the set has been in use for a while the coupling can be increased and more power taken from it. After the "wearing in" process is over, however, the transmitter has been found to be perfectly stable.

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Battery-Operated Portable Transmitter

FIG. 3 is the circuit diagram of crystal-controlled portable transmitter used by Green Giebner, W4CPX, consisting of a crystal-controlled oscillator of the Tri-tet type modelled after the single-tube transmitter described in *QST* for March 1934. The circuit constants are

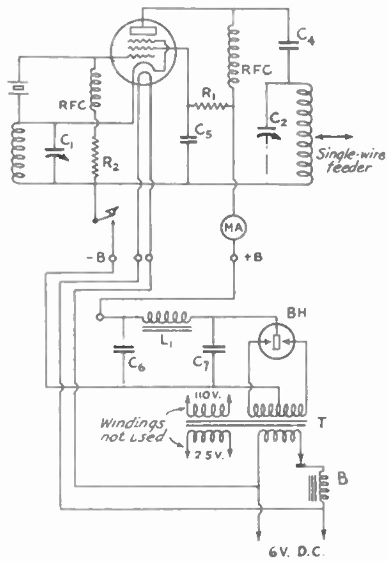

FIG. 3 — CRYSTAL-CONTROLLED PORTABLE TRANSMITTER AND POWER SUPPLY

C_1, C_2 — 100-μμfd. variable.
C_4 — .005 μfd.
C_5 — .002 μfd.
C_6 — 8-μfd. electrolytic.
C_7 — 4-μfd. electrolytic.
L_1 — 30-henry, 50-ma. choke.
T — Midget power transformer.
B — Low-resistance buzzer or vibrator.

similar to those specified in the article mentioned except that the screen voltage is obtained from a 50,000-ohm dropping resistor instead of from a voltage divider. The constants are given under the figure except for the coil data, which will depend upon the crystal frequency. The tube may be either a 41 or 42. For portable work a single-wire fed Hertz antenna cut to the frequency of the crystal is used, the feeder being tapped on the plate coil approximately at its center.

Plate supply for the oscillator may be obtained from an automobile radio "B" eliminator or from an arrangement of the sort diagrammed. This consists of a power transformer of the midget variety, furnishing a few hundred volts each side of the center-tap on the high-voltage winding, working into a Raytheon BH-type gaseous rectifier and a brute-force filter. Direct current from the 6-volt storage battery is fed into the 5-volt rectifier winding on the transformer through a low-resistance buzzer or vibrator. With the particular transformer used by W4CPX the current consumption from the battery was approximately 4 amperes and the output voltage about 275 volts d.c. under the transmitter load. The transformer was rated at 350 volts each side of the center tap

Tuning instructions may be found in the article referred to above.

Portable 75-Meter 'Phone

The circuit diagram of a portable 75-meter 'phone transmitter which has been used with considerable success by Ben C. Brown, W6BZF, is shown in Fig. 4. Four two-volt tubes are used; the r.f. part of the set consists of a 30 crystal oscillator driving a 19 amplifier with the two sets of tube elements arranged in push-pull, and the audio portion has a 30 speech amplifier driving a 19 Class-B amplifier. The input to the r.f. tube is about five watts.

W6BZF's rig is built into an ordinary monitor box, which shows that the outfit can be quite compact. It can be operated either from batteries

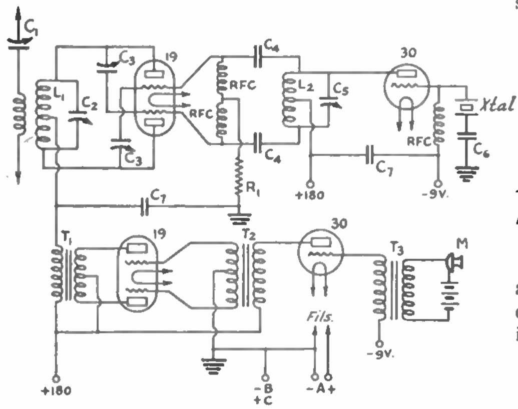

FIG. 4 — BATTERY-OPERATED PORTABLE 75-METER 'PHONE

L_1 — 32 turns No. 20 s.c.c. wire on receiving coil form; antenna coils 5 turns each.
L_2 — 28 turns same. L_1 and L_2 both tapped at center.
C_1 — 500-μμfd. variable.
C_2 — 100-μμfd. midget variable.
C_3 — Neutralizing condensers; low-capacity trimmer or padding condensers.
C_4 — 100-μμfd. fixed mica condensers.
C_5 — 100-μμfd. midget variable.
C_6 — 150-μμfd. fixed. C_7 —.001-μfd. fixed.
R_1 — 20,000 ohms.
T_1 — Class-B output transformer to couple Type 19 tube to load of approximately 6000 ohms (such as Collins 740 Z).
T_2 — Class-B input transformer to couple a Type 30 driver to Type 19 Class-B amplifier (such as Collins 750 X).
T_3 — Single-button microphone transformer.
M — Single-button microphone.
RFC — Short-wave type chokes.

or from a "B" eliminator having an output of 180 volts or less. Tuning adjustments would be the same as with any other oscillator-amplifier and Class-B audio outfits. The neutralizing condensers, C_3, are trimmers of the type used for padding receiving circuits, and should have fairly low capacity (the Hammarlund type EC-35, for example). Midget condensers are used to tune the oscillator and amplifier plate circuits, a standard-size receiving condenser being used for the antenna circuit because of the greater capacity needed. With five watts input the amplifier should be adjusted to draw 28 milliamperes at a plate voltage of 180, representing a modulator load impedance of about 6400 ohms. The Class-B output transformer should be one designed for a load of this order, although the exact value is not critical since the plate input to the r.f. amplifier can be adjusted readily to suit the particular transformer used.

As an interesting commentary on the high-*vs.*-low-power question, W6BZF writes that on several occasions he has asked other stations to stand by for the portable after having raised them on his 500-watt 'phone, the average difference in signal strength between the two being reported as about two points on the S scale. Reports of S7 to S9 have been obtained with the little set from stations up to 250 miles away in late afternoon.

—···—

Vibration in a copper-tubing coil can be squelched by stuffing a rubber bath sponge inside it. The sponge should make a snug fit, of course. — *W7CTN*

—···—

A "Fly-Power" 'Phone Transmitter Using a 6A7

Two circuits suggested by Leonard Tulauskas, W9LKV, for using a 6A7 tube as a crystal oscillator with modulation applied to the inner grid, are shown in Fig. 5. The upper circuit

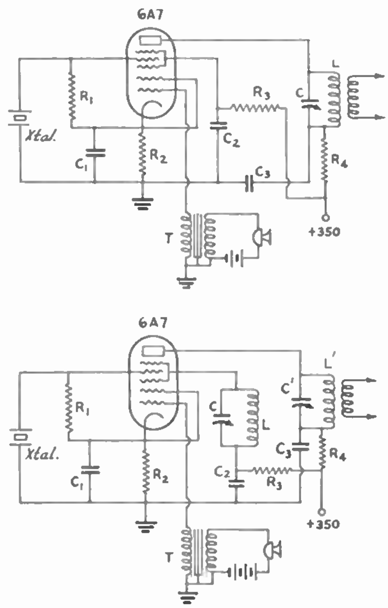

FIG. 5 — SINGLE-TUBE CRYSTAL-CONTROLLED 'PHONE TRANSMITTER USING A 6A7

R_1 — 500,000 ohms. R_2 — 1000 ohms.
R_3 — 10,000 ohms. R_4 — 1000 ohms.
T — Single-button microphone transformer.
C_1 — 1 μfd. C_2, C_3 — .01 μfd.
C, L — To tune to crystal frequency.
C', L' — To tune to second harmonic of crystal.

is for operation at the crystal frequency, while the lower is for obtaining output at the second harmonic of the crystal. In the latter case a circuit tuned to the crystal fundamental is inserted in the screen (grids Nos. 3 and 5) lead, the plate circuit being tuned to twice the crystal frequency. The ordinary single-button mike and transformer will have high enough voltage output to modulate completely the output of the oscillator.

W9LKV writes that no frequency modulation is detectable as long as the plate current of the oscillator does not change with modulation. These circuits have been used very successfully for short-distance work on the 160-meter band, using an input of less than three watts to the tube. They should be of interest to the amateur who wants an inexpensive low-power rig for local work or for portable use.

More on the 6A7 Transmitter

In view of the fact that I have received numerous letters from amateurs who have tried the transmitter using a 6A7 tube asking for more information, I have the following additions to offer to the circuits as shown.

(1) To facilitate easy oscillation, a coupling condenser of 15–25 μμfd. should be added between No. 4 grid and plate.

(2) If the output from the secondary of the microphone transformer is less than 10 volts, an additional stage of speech amplification may be used to give 100% modulation.

Several local amateurs brought their transmitters to me when they failed to make them work properly and in all cases were satisfied with the results obtained after the above changes were made. In one case the tube is used as a driver for a Class-B 59 tube. This seems to be a particularly useful application as a very stable transmitter is obtained with enough output for moderate DX.

— *L. Tulauskas, W9LKV*

Notes on 14-Mc. C.C. Transmitters

From QSO's on the 3.9-mc. 'phone band I find that many hams are having trouble in making crystal controlled rigs work on 14 mc. This was the case at W8HCR, and about three months were wasted in trying to obtain sufficient excitation to a pair of 10's in push-pull on 14 mc. The following points seem to cover the main sources of trouble.

1. In using Type 46 or 47 tubes as doublers, high plate voltage seems to be necessary and desirable. The 47 is used the same as a 46, with the two grids tied together. A plate voltage of 500 to 600 volts is desirable and is safe if the grid bias is kept high on these tubes.

2. Do not use automatic grid bias of the grid leak type on these tubes at plate voltages above 400 volts. If a fixed grid bias of between 50 and 150 volts is used, depending on the plate voltage and the output needed, there is no danger of the grids going positive under any normal load. This fixed bias may be obtained from batteries or from a "C" bias eliminator with a low resistance voltage divider (not over 20,000 ohms for a 250-volt supply).

3. Neutralizing seems to make no appreciable difference in the operation of the frequency doublers.[1] When using the 46's neutralizing is easy and the tubes may then be run as straight buffers at any time. However, 47's are difficult to neutralize and are usually run as doublers only.

4. Capacity coupling between stages is used, the condenser being connected directly to the plate end of the preceding tank coil. Capacity values can be from 40 μμfd. to 100 μμfd. for coupling between the oscillator and the doubler stages. The capacity for coupling from the second doubler to the 210's in the Class-C amplifier may range from 100 μμfd. to 500 μμfd.

5. No series radio-frequency chokes were found necessary in the plate supply leads. These leads were each by-passed to the filament center-tap with a 0.002-μfd. condenser.

6. Shielding between stages was found to be absolutely necessary and was the point that had been causing practically all the trouble. Without shielding, the tuning of the second doubler and final amplifier was extremely critical, and regeneration was being set up in such a way as to counteract a large part of the excitation voltage which was being impressed on the Class-C stage. As a consequence the final amplifier would not load up and the doublers ran extremely hot. The shielding as used consisted of galvanized sheet iron baffles between stages with a height great enough to extend above all apparatus in each stage. Also, a galvanized iron sheet was placed on the sub-base and all parts mounted on top of this. No shielding was needed in front or back of the stages and none on top. The shielding was insulated from all equipment and connected at one spot to the negative "B" lead. This cleared up all the trouble and each stage tuned up as easily on 14 mc. as on 3.9 mc., and sufficient excitation was obtained to drive the final 210's in the modulated stage.

In conclusion I wish to state that the information on shielding and plate voltages was given me by W8DLD and came at a time when it had seemed to be impossible to make the transmitter work properly. I am passing this information

[1] Neutralizing accomplished by feeding r.f. voltage from the plate circuit back to the grid often increases the efficiency of a doubler stage by introducing some beneficial regeneration, although there is no tendency toward oscillation. This effect seems to be more pronounced with low- or medium-μ tubes, however, than with high-μ tubes which inherently are good doublers. — Ed.

along to the rest of the hams in hopes that it may help someone else who has been having the same troubles. — *Weldon B. Sanger, W8HCR*

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If that two-year-old 7-Mc. crystal hasn't the sock it once had, borrow a reading glass and examine the edges for nicks. The output of some 7-Mc. plates is considerably reduced by nicks too small to be observed without magnification unless you have unusually sharp eyes. This effect is noticeable to a lesser extent on 3.5-Mc. plates if X cut; rough edges have no apparent effect on the operation of Y-cut plates. However, the majority of 7-Mc. crystals are X cut and the 7-Mc. plates are the ones affected the most. Refinishing the edges is a simple job and oftentimes will double the output. — *W6BCX*

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TNT "R" Circuit

A VARIATION on the "R" circuit which should be of interest to fellows using locked oscillators, suggested by Fred C. Allen, VE3SA, is

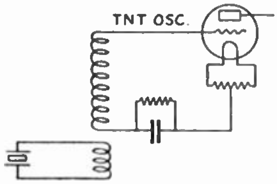

FIG. 6—TNT CIRCUIT WITH CRYSTAL LOCK

shown in Fig. 6. The crystal is simply coupled through a small coil to the cold end of the grid coil of the ordinary TNT oscillator. No changes are required in the oscillator itself.

VE3SA uses a coupling coil of seven turns on a tube base closely coupled to the 60-turn grid coil on the same form (3.5 Mc.). The oscillator is a Type 50 with about forty watts input. The crystal load can be adjusted to a safe value by changing the coupling between the two coils, either through variation of the spacing or by changing the number of turns on the crystal coupling coil.

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Caliper Coupling

MANY who are using link coupling between stages have found it a problem to vary the coupling when using the split-condenser circuit, with both ends of the coil "hot." A satisfactory solution has been found here by using a caliper-like coupling device supported by a standoff insulator at one side of the tank coil.

The coupling caliper consists of a single turn of copper tubing sawn into two semi-circles and flattened at the joint to take a screw. Lock washers and double nuts are used to prevent the adjustment tension from loosening after repeated movements of the two halves. To this center joint a brass right angle is attached, being fastened by the same screw which holds the two halves of the

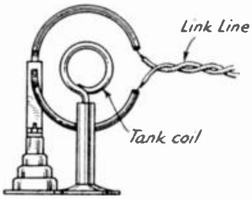

FIG. 7—A "CALIPER COUPLER" FOR GIVING VARIABLE COUPLING IN LINK CIRCUITS WITH BALANCED TANKS

coupler. The assembly in turn is mounted on top of the standoff insulator, as shown in Fig. 7. With plenty of excitation it is rarely necessary to have more than one turn of coupling between the plate of one stage and grid input coil of the stage following. It is possible that on low-power stages more turns will be needed to effect adequate transfer and this is best made in the form of a coil wound at the cold end of the tank coil. The adjustment is not critical, but too close coupling should be watched because of the detuning effect.

In the construction of the caliper coupling device it is wise to bond the two halves with a heavy, well-soldered flexible wire to prevent the possibility of high-resistance connections at the friction joint. The transmission line is best made of solid wire in preference to the stranded kind, and is soldered to the two ends of the caliper. The other end can terminate in a similar coupling device. — *W. H. Hannah, W2US*

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Variable Antenna Coupling

IN FIG. 8 is shown a scheme which I found very helpful in adjusting antenna coupling.

As you can see in the diagram, the adjustable

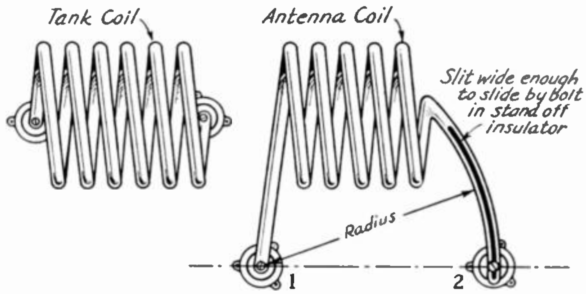

FIG. 8—METHOD OF LOCKING THE COPPER-TUBING ANTENNA COUPLING COIL IN PLACE

arm of the copper-tubing coil is bent so that it is the radius of an arc with standoff insulator No. 1 as the center. The slot may be made by boring holes along the tubing for about ¾ inch and then filing until that part of the slot is smooth on both sides. The remainder of the slot is sawed with a hacksaw, using two blades in the hacksaw to obtain the necessary width. A light filing is necessary to finish the job nicely. In use, the bolts in standoff insulators 1 and 2 are loosened slightly (No. 1 less than No. 2) and the coil is adjusted for desired coupling. Tightening the bolts gives a rigid "job" with desired coupling.

Needless to say, the adjustable arm is flattened before drilling and sawing operations are begun. Quarter-inch copper tubing is used here.

— *King Ramsey, Jr. W5EJS*

It is much cheaper to replace flashlight bulbs than meters or tubes. Put the bulbs in strategic locations in the circuit — in series with tube plates, meters, neutralizing condensers, etc. The 2.5-volt bulbs blow at about 300 mils and can be used in circuits with potentials as high as 80 volts. — *W2AOY*

Adapting Inductive Neutralization to the Low-Power Transmitter

INDUCTIVE neutralization of triode r.f. amplifiers has recently come into use in commerically-manufactured transmitters.[1] A trial of this method has convinced me that it can be easily and profitably adapted to apparatus of the home-grown variety.

Following are some details of its use in the final stage of a portable rig consisting of 59 Tritet, 59 neutralized buffer and two 46's as either push-pull straight amplifier or back-to-back doublers. The plate coils of the last two stages are both wound on the same 7-prong coil form. The diagram, Fig. 9, shows the connections for straight amplication and for doubling. Direct coupling between buffer tank and amplifier grids may be

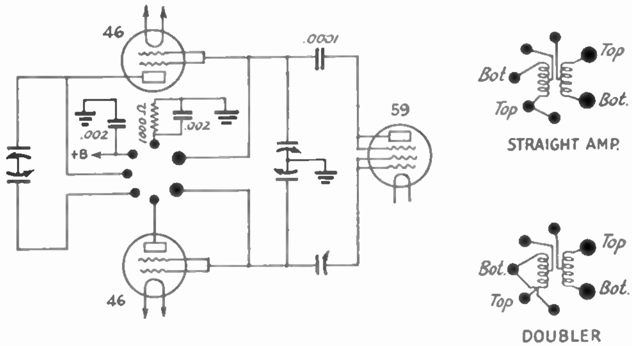

FIG. 9 — CIRCUIT FOR CHANGING FROM INDUCTIVELY-NEUTRALIZED STRAIGHT AMPLIFICATION TO BACK-TO-BACK DOUBLING BY PLUGGING IN APPROPRIATE COILS

The "top" and "bot." refer to the positions of the ends of the windings on the coil form.

unorthodox, but it works and has the advantage of simplicity.

Above are coil specifications for the three main bands, using 100–100 μμfd. split-stator tank condensers in both buffer and final stages.

All coils are wound on ribbed ceramic forms which plug into a small 7-prong socket. For straight amplification the two windings are wound in opposite directions and for doubling they are wound in the same direction. After the coils are wound some adjustment of the spacing between windings is usually necessary to obtain perfect neutralization, and when the correct position is found the windings should be fastened in place with coil dope.

Band	Dia. of Form	Space Between Windings	Size of Wire	No. of Turns	Length of Winding
14,000 Doubler	1¾″	5/16″	Bfr. Pl. 18 d.c.c. Amp. Pl. 18 d.c.c.	14 10	¾″ 1¼″
14,000 Str. Amp.	1¾″	11/16″	Bfr. Pl. 18 d.c.c. Amp. Pl. 18 d.c.c.	7 10	⅜″ 1¼″
7000 Str. Amp.	1¾″	⅞″	Bfr. Pl. 18 d.c.c. Amp. Pl. 18 d.c.c.	14 15	¾″ 13/16″
3500 Str. Amp.	2¼″	1⅛″	Bfr. Pl. 22 d.c.c. Amp. Pl. 18 d.c.c.	21 29	11/16″ 1 9/16″

Coupling to the antenna tuner may be by means of a small coil wound on celluloid and placed so that it slips inside the amplifier tank coil when the form is plugged into its socket. One or two turns wound directly over the ampli-

[1] See Craft and Collins, "Inductive Neutralization of R.F. Amplifiers," July, 1936 *QST*.

fier tank coil when the form is plugged into its socket. One or two turns wound directly over the amplifier tank coil, terminating in flexible leads fitted with G.R. plugs, may also be used.

Estimated outputs, using an 80-meter crystal, range from about 20 watts when doubling to 20 meters in the final stage, up to nearly 50 watts on both the 40- and 80-meter bands. The use of this scheme results in a saving of several pieces of apparatus with their attendant losses and space requirements. It also allows optional doubling in a push-pull stage and facilitates band changing.

— *O. K. Blackburn, W9MB*

Neutralizing the Final

A note from E. A. Krall, W8CKO, points out a reasonable method of neutralizing a final amplifier to make sure that the amplifier is neutralized under the operating conditions — that is, with the antenna coupled — and that no back wave will be emitted. He writes:

"The procedure is quite similar to the regular way of neutralizing except that an indicating device such as a low-range r.f. ammeter or flashlight bulb is inserted in the antenna lead and the final is purposely pushed out of neutralization. Of course the plate voltage is disconnected. The neutralizing condenser is then turned until all indication of radiation disappears and further turning in the same direction causes it to start to rise again. The optimum point is naturally the zero setting between the two settings which show antenna current.

"Using the above method, no trouble is experienced in neutralizing a W.E. 212E on 20 meters. Out of neutralization the 852 buffer pushes over an amp into the antenna, and it's just like rolling off a log to neutralize this high-capacity tube on 20. Similar results were obtained using a 204A in the final. Anyone who has worked me on 40 or 20 will vouch for the fact that I have no back wave."

A Neutralizing Kink

A note from W6IY gives a useful hint on neutralizing buffer stages: "A wrinkle borrowed from Ole Friend Commercial Practice has to do with the neutralization of a stubborn buffer stage in a 47-10-203-A rig. Using an r.f. galvanometer as an indicator it was impossible to remove all traces of r.f. from the buffer tank. The final amplifier, with its split-stator tank, neutralized perfectly. The 10 stage was stable enough to allow its use as a driver to neutralize the final, which was done according to Hoyle. Then plate voltage was removed from the buffer and full plate voltage applied to the final. If the final is biased to cut-off or slightly beyond, any current flowing in its plate circuit is the result of excitation fed through from the unneutralized buffer stage. In my case, this current could be reduced to zero by adjusting the buffer neutralizing condenser, keeping all tank circuits in resonance throughout the operation, of course. A final check made on the buffer tank with the r.f. meter showed just a trace of residual r.f., the source of which is unknown (probably because coupling the r.f. indicator caused a slight unbalance — *Ed.*), but the whole set operates stably at all frequencies and in a perfectly normal manner."

Switching 53 Sections

A note from Vernon S. Parks, W9SZK, points out a simple way of getting around the necessity for neutralizing the second section of a 53 when working straight through in exciters using this type of tube as a crystal oscillator and doubler. The scheme is shown in Fig. 10.

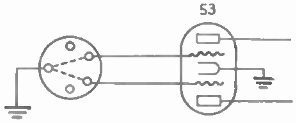

FIG. 10 — SHIFTING THE CRYSTAL FROM ONE 53 SECTION TO THE OTHER FOR EITHER STRAIGHT-THROUGH OR DOUBLING

Since most crystals plug into five-prong sockets, the socket wiring is very easily arranged so that simply by selecting the right pair of socket holes the crystal can be connected to the grid of either 53 section. When working the transmitting on the crystal frequency, the section which is normally the crystal oscillator tube is jumped entirely, the second section taking its place.

Wiping Out the Harmonic

Operating r.f. amplifiers at high efficiency means plenty of harmonic content in the output, usually. R.f. harmonics from the output stage do nobody good and can bring plenty of trouble down on unsuspecting heads. Many signals heard off-frequency are actually from transmitters whose intended output is on some lower-frequency band — which is really no valid excuse for off-frequency operation because it's up to the operator of the station to see that harmonics are suppressed. The following excerpt from a letter from B. P. Hansen, W9KNZ, outlines an inexpensive and satisfyingly simple method of wiping out the harmonic:

"One result of all this going over to crystal control is that the gang are using fairly efficient final amplifiers — high bias and excitation, low-*C* tanks and high plate voltage — with the result that harmonics have been raising the old merry heck. The stunt shown in Fig. 11 is simple and wipes 'em out.

"The idea is simply to feed the harmonic into a trap circuit and let it do the old merry-go-round there instead of going up the flue and blocking somebody's receiver on the harmonic frequency — or getting into some nice AGSX in one of Uncle Samuel's monitoring stations. It works every time, and while in some cases it won't *completely* eliminate the harmonic, it will reduce its strength so much that it no longer bothers anyone. So far as I've been able to determine, low-*C* is better than high-*C* in the trap, probably due to better *Q* or something. An extension insulating handle about a foot long should be put on the trap condenser shaft to get away from body capacity. Also, the trap should be pretty close to the transmitter to prevent radiation of the harmonic from the feeder. Tune in the harmonic on the monitor and, listening closely (with key down of course), tune the trap over the scale. As it passes through resonance, POOF! out goes the harmonic, and out it goes at the other fellow's receiver. That's all there is to it.

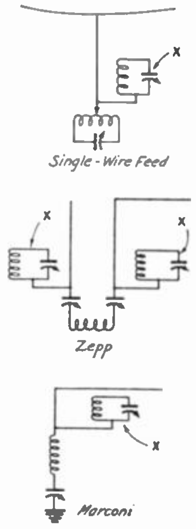

FIG. 11

"Yes, I've heard of traps in series with the feeders and all that, but they invariably introduce losses and most fellows won't stand for that even though it means giving others something of a break. But so far as I've been able to see, this stunt doesn't react on the final amplifier at all — and even if it does the loss is so slight as to be negligible. I've tried tests time after time, while working all bands, with both local and distant stations, and the reports are invariably the same — no change in strength of fundamental signal and complete obliteration of the harmonic. I had a 20-meter harmonic from my 40-meter rig strong enough to get S7 reports from the east coast, and could wipe it out 100% with this stunt."

While you're about it, it might be a good idea to pay some attention to the third as well as the second harmonic, especially if the output stage is a push-pull affair.

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Quick Shift for Amplification or Doubling

HERE's a stunt that worked out a problem for me, and it might be interesting to any of the boys who are using a pair of RK23's or similar screen grid tubes for either a back-to-back doubler or push-pull buffer on a chassis-type rig. What I wanted was a plug-in changeover from doubler to buffer, with link coupling complicating the situation. The solution was a 6-prong jumbo coil form. In either service, the grids are excited push pull, but the 40-meter (buffer) plate tank is so connected to the base prongs as to provide push-pull plate connection, with the link in the middle at low r.f. potential. The 20-meter plate tank is connected to *parallel* the plates of the tubes, and the two sections of the split-stator condenser. Also, the link is wound on the "ground" end of the coil form.

The diagram of Fig. 12 gives the general idea of the circuit arrangement and the connections of the coils. — *M. C. Bartlett, W9JHY*

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Regenerative Doubler

THE cathode regeneration circuit for increasing the output of a 28-mc. doubler shown in Fig. 13 has been used with considerable success by J. P. Veatch, W9CJJ. Its resemblance to the electron-coupled oscillator, the harmonic-generating properties of which are well known, will be remarked. Although an 860, the particular tube to which the circuit is applied in W9CJJ's transmitter, is indicated, any transmitting tetrode or pentode can be used. With types having indirectly-heated cathodes the filament chokes will not be needed, thus simplifying the circuit. For filament-type tubes, the chokes may consist of about 15 turns

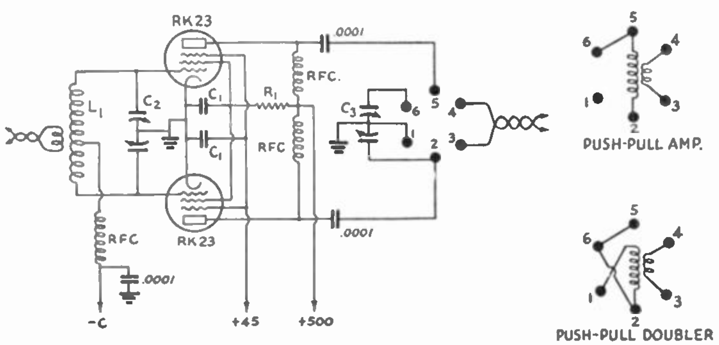

FIG. 12 — PLUG SWITCHING FOR STRAIGHT AMPLICATION AND DOUBLING

C_1 — 0.005 μfd.
C_2 — 50-μμfd. split-stator condenser.
C_3 — 50-μμfd. split-stator condenser, 1000-volt.
R_1 — 4200 ohms.
L_1 — Grid tank coil (plug-in if desired).
RFC — Sectional chokes (National type 100).

of No. 14 wire on a two- or three-inch form, close wound, with one coil on top of the other. The inductance should not be particularly critical (see Romander, "The Inverted Ultraudion Amplifier," September 1933 *QST*). At lower frequencies more turns should be used. The cathode tap

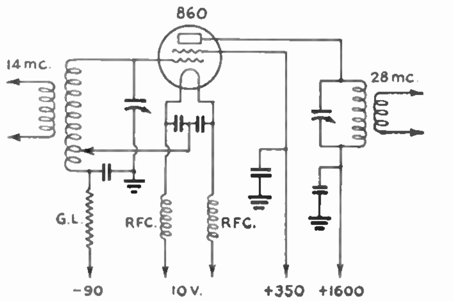

FIG. 13 — A REGENERATIVE DOUBLER CIRCUIT FOR USE WITH SCREEN-GRID TUBES

Used by W9CJJ with an 860 for 28-mc. output, this circuit is readily adaptable to other bands and other types of tubes, especially those having indirectly-heated cathodes.

on the grid coil should be set so that the tube will not quite self-oscillate.

W9CJJ uses the same circuit in the 28-mc. and 56-mc. doubler stages in a low-power crystal-controlled transmitter on five meters, and writes that he has obtained enough 2.5-meter output from an 89 in the same circuit to excite a 6D6 for suppressor modulation on 120 mc.

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Automatic Protection with Grid-Leak Bias

PHONE men in particular will be interested in this bias scheme after reading Mr. Lent's excellent article on modulated Class-C amplifiers in *QST*, August, 1935. As stated by Mr. Lent, linear performance of the Class-C stage can only be secured when grid-leak bias is used and the grid is operated at the saturation point. Every amateur knows, however, that the bias voltage drops to zero when the grid excitation stops if a grid leak is used alone. The result often is a burned-out tube unless fuses or circuit breakers are employed.

The circuit shown in Fig. 14 has been used by the writer in a 1-kw. transmitter for over a year with excellent results. In operation pure grid-leak bias is used, and if the excitation fails or a buffer stage is keyed for telegraph, cathode bias is automatically cut into the circuit, making it impossible for the amplifier to draw excessive plate current.

The proper value for R_1, the grid leak, can be determined by Ohm's law. For example, if the bias voltage required for Class-C operation is 150 volts and the grid current required is 50 ma., E divided by I gives 3000 ohms. The value of R_2, which develops the cathode bias for tube protection when the amplifier is not delivering power, cannot be calculated quite as simply. Cathode bias is dependent on the amount of plate current flowing, so the plate power which the tube can dissipate safely must be used as a guiding factor. If we take a 203A as an example, the maximum safe dissipation is 100 watts. Then if the plate voltage is 1000, the maximum safe plate current is 100 ma. If we reduce the plate current to 50 ma. we then have a conservative dissipation of 50 watts when the tube is idling. Since the bias voltage required to reduce the plate current to 50 ma. is approximately 50 volts, as shown by the tube characteristic curves, by Ohm's law R_2 should be 1000 ohms.

The relay employed to short-circuit the cathode bias resistor should be adjusted so that the contacts will close on approximately 70% of the normal grid current. This adjustment can be made before the plate voltage is applied. Sufficient spring tension must be used so that the relay follows the keying perfectly. In operation, bias is secured from the voltage drop across R_1; the rectified grid current actuates the relay, short-

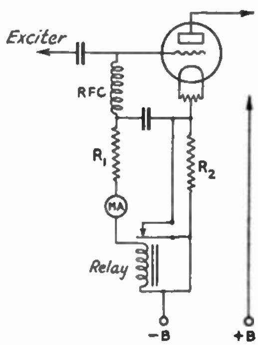

FIG. 14 — PROTECTIVE CIRCUIT FOR GRID-LEAK BIASED R.F. AMPLIFIERS

R_1 is the regular grid leak, R_2 a cathode resistor to limit the plate current under no-excitation conditions. When grid current flows through R_1 and the relay winding, R_2 is shorted out, but is cut into the circuit should grid current cease. The condenser between R_1 and R_2 is the ordinary r.f. bypass.

circuiting the cathode-bias resistor, R_2. With no excitation no bias is secured from R_1, but the plate current flowing through R_2 provides a limiting bias for tube protection, with the plate input held down to a safe value.

— *D. A. Griffin, W2AOE*

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Harmonic Suppression

THE following note from M. W. Mitchell, W9IQZ, offers a cure for a condition that is likely to cause the unknowing operator some embarrassment:

"While QSO with W9JZJ recently, I was asked to listen on 38 meters for his 75-meter 'phone harmonic. We did and picked up the harmonic about S4 on loud speaker. JZJ was quite worried and was wondering what to do about it when I

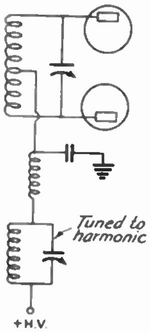


FIG. 15 — WAVE TRAP IN PLATE SUPPLY LEAD TO ELIMINATE HARMONIC RADIATION

remembered a stunt that is used in broadcast stations quite often, told to me by W9PLF some time ago. We tried it on this QSO and it eliminated the 38-meter harmonic completely.

"The thing consists merely of inserting a wavetrap tuned to the undesired harmonic in series with the positive plate supply lead to the final amplifier. (See Fig. 15.) The wire of the coil must, of course, be heavy enough to carry the plate current of the amplifier. This system will work equally well with a self-excited oscillator coupled directly to the antenna as the wavetrap does not affect the tuning.

"For the 38-meter band, a coil of ten or twelve turns on a small form shunted by a 140-$\mu\mu$fd. midget variable condenser will do the trick very nicely. A neon lamp cannot usually be used as there isn't enough power on that harmonic to start it, but in a high-power rig one should be able to get it to light up. On low-power transmitters, a monitor tuned to the undesired frequency must be used, and the wavetrap tuned till the harmonic either disappears entirely or is much weaker, depending on the power of the transmitter.

"I might add that while testing with W9JZJ we both listened on 38 meters and it sounded very much like the 20-meter band. All kinds of ham signals were heard, with c.w. on the low-frequency end, 'phones on the high end, and commercials interspersed throughout!"

— *M. W. Mitchell, W9IQZ*

Milliammeter Switching for Grid and Plate Currents

Although many amateurs use plugs and jacks for transferring a meter from one circuit to another, it is often more convenient to use a switch for the purpose when the meter is to do only two jobs, such as reading grid and plate currents in a single stage. Bob Hayward, W9HDI, suggests the arrangement shown at Fig. 16A, making use of a single-pole double-throw switch to shift a milliammeter from grid to plate. With the switch thrown to the upper position the meter reads grid current; on the lower position a shunt is connected in to extend the meter range and the meter reads plate and grid currents combined. The shunt idea permits using a low-range meter of a value suitable for grid-current readings.

The circuit of Fig. 16B, used by Robert E. Foltz, W9GBT, makes possible separate readings of plate and grid currents, requiring, however, the use of a double-pole double-throw switch. With the switch thrown to the left, the milliammeter is connected to read plate current alone, a shunt also being connected in to extend the meter

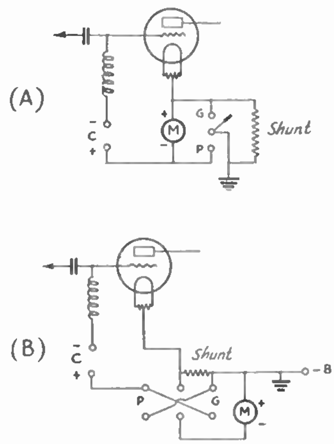


FIG. 16 — SWITCHING THE MILLIAMMETER FROM PLATE TO GRID

range. With the switch thrown to the right, grid current is measured. W9GBT uses a d.p.d.t. toggle switch for the purpose.

In both diagrams the shunt may be omitted if the milliammeter range is sufficient to take care of the plate current taken by the tube or tubes.

Link-Coupled TNT Amplifiers

Nearly everyone who has tried link-coupling between stages, and between the transmitter output and the antenna tuning unit, is aware of its advantages over other methods of coupling.

The only real disadvantage, as I see it, is the necessity for adding tuning controls and the expense for extra variable condensers. Why not a TNT amplifier instead of t.p.t.g.? The TNT oscillators seemed to work as well as t.p.t.g. rigs so why wouldn't the same reasoning apply to a neutralized amplifier? If it worked the only disadvantage to link-coupling would be overcome.

I tried it on my rig and it sure did "perk." I got every bit as much excitation, the note seemed to *improve* and neutralization was more complete. What's more, there is no more apparatus used than with capacity coupling.

The TNT grid coil from an old self-controlled job was connected in place of the tuned condenser-coil combination and while it is doubtful if the coil was the proper size of the tube used, the rig performed perfectly. I have not as yet had time to experiment with different coil sizes but what little I have done has assured me that my new rig will be link-coupled throughout with TNT amplifiers in every stage.

— *Tom J. Boland, W6AJP*

Twenty-Meter Crystals

THE following extract from a letter from R. N. McCord, W9MYX, is worthy of consideration by those contemplating using the new 20-meter crystals, or who may have been having trouble with them:

"Recently I purchased a crystal for fundamental operation in the 14-mc. band, using a 47 tube in the familiar pentode oscillator circuit. The circuit and constants used were exactly according to the bulletin furnished with the crystal. Several hours were consumed in attempting to make the crystal function, during which time I changed all of the circuit constants and even went to the extent of building a separate oscillator, but the crystal refused to oscillate. It was not until after a tank coil with spaced turns had been made up, that oscillation was finally obtained. A tank capacity of 50 μμfd., with a coil consisting of eight spaced turns of No. 14 wire on a 1½-inch form, were used. The rather heavy wire was found to be necessary because the crystal actually was a powerful oscillator, and the use of smaller wire caused the coil to heat considerably. The introduction of a winding form for the wire undoubtedly adds to the heating effect, and I would advise anyone building a similar oscillator to use self-supporting coils. With a plate voltage of 400 and screen voltage of 150 a power output of six watts was obtained."

Tube-Base Crystal Holders

THE drawing of Fig. 17 gives the details of a tube-base crystal holder which, as its builder, Wilson Oliver, 53 Smith St., Detroit, Mich., says, "is simple to make and may be of use to somebody as a spare, if not as the one-and-only."

Continuing his description: "A standard-size four-prong tube base is used. Cut a piece of sheet copper or brass to fit inside the base as shown in Fig. 17. This forms the stationary plate. A wire is soldered to this and connected to both the grid and plate prongs. The part of the base between the brass plate and the shell is filled with melted sealing wax, in which is embedded a small bolt to hold the cover.

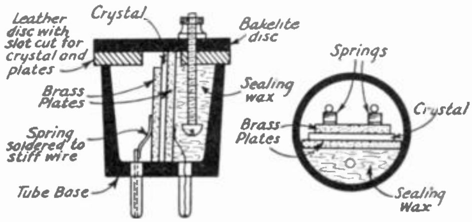


FIG. 17 — CRYSTAL HOLDER MADE FROM AN OLD TUBE BASE

"The top plate is made of another piece of brass or copper, held in place by brass springs soldered to small pieces of stiff wire projecting from both filament prongs. Both plates are ground flat.

"The cover is made from a disk of fibre or bakelite. The tube base I used was not quite one inch deep, so a piece of leather about ⅛-inch thick was cut as shown in drawing and glued to the back of the fibre disk. This keeps the cover from touching the crystal, which is one-inch square. A nut holds the cover in place.

"The holder is held in an ordinary tube socket, mounted vertically."

Another tube-base crystal holder, this one used by C. L. Tice, W7BEE, is shown in Fig. 18. It is intended to be used with a silvered crystal. W7BEE says this about it:

"This holder . . . should be FB for the ham who uses crystal control on a portable. No packing of the electrodes is necessary and shocks cannot do any damage unless they are hard enough to damage the tube base.

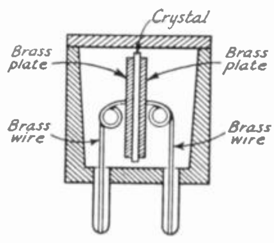


FIG. 18 — A TUBE-BASE CRYSTAL HOLDER FOR USE WITH SILVERED CRYSTALS

The spring mounting makes the holder especially useful for the portable transmitter, since the crystal will be cushioned from mechanical shocks.

"The holder is one of the old 01-A tube bases, which are longer than the present bases — long enough to hold a 1$\frac{1}{16}$" crystal. The springs are brass wire, about 24 gauge. A single turn to the coil will give flexibility so the plates will make firm contact all along the crystal, and the end soldered to the plate is turned at right angles so as to make more contact surface to hold the solder. The plate can be anything thin: copper, brass or monel metal, about 0.015″ thick. The cover is cemented on with Dupont Household Cement. Four springs are used, one in each prong, and the tension can be adjusted to a certain extent in the process of soldering the spring in the tube prong."

Speeding Up Rough Grinding

The following kink, one which assists in cutting down quartz crystals with rapidity and economy, may be of interest to amateurs who do not have complete metallurgical equipment. In rough grinding, the usual home method is to grind on glass with a course abrasive. Since ordinary window glass is not satisfactory, the more expensive plate glass must be used, and after a little use must be discarded because of the concave surface left by grinding.

It is possible to make a rapid job of cutting down a thick crystal to the approximate finished thickness by grinding it on a sheet of Wetordry Trimite paper. A half or quarter sheet of grit 150-C taped down on all edges to a flat surface forms a rough but level base on which to grind. The actual grinding is done with water in the usual way, adding a little 280 mineral (silicon carbide) to the surface when cutting slows up. Thus the sandpaper replaces the plate glass for most of the work. The finishing touches should be done with 400 mineral on the plate glass to insure perfect flatness.

The sandpaper also serves as an excellent abrasive for rounding off corners or smoothing the edges.

— *T. J. Miller, ex-W9OYC*

"Locked" Amplifiers

A variant of the oscillating amplifier known as the Geyder "lock-system" has attained considerable popularity in Europe, according to a letter from J. Fleurbaey, ON4ZA. Described briefly, the amplifier is simply a TNT oscillator with its grid coil loosely coupled to a

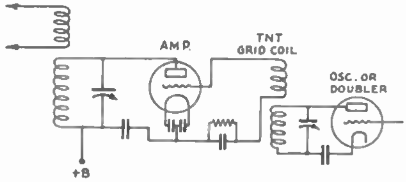


FIG. 19 — TNT OSCILLATING AMPLIFIER

Values may be those ordinarily used for TNT circuits. The crystal oscillator and doublers do not differ in any way from those which have been described previously in QST.

crystal oscillator or doubler tank; to get crystal control the oscillating amplifier is tuned to the same frequency as the crystal oscillator or doubler and because of the well-known tendency of two coupled oscillators to "lock" at the same frequency the crystal tube takes control. The result is a signal with all the characteristics of crystal control but obtained without neutralization and without worry of getting adequate excitation for the amplifier, since it supplies its own excitation. A simplified diagram is shown in Fig. 19.

ON4ZA gives the following as the tuning routine:

1. With the power amplifier switched off, adjust the crystal oscillator (and doubler, if one is used) for maximum stability. Pick up the crystal signal in the monitor and adjust to zero beat.
2. With the crystal oscillator switched off, tune the TNT oscillator so that zero beat is obtained at exactly the same spot on the monitor dial.
3. Couple the grid coil of the TNT oscillator to the tank of the crystal-controlled driver and turn on the latter.
4. Retune, if necessary, until *only* a crystal-controlled signal is heard in the monitor, all tubes being "on." When this condition is reached the two oscillators are "locked" and the crystal has control.

At ON4ZA the oscillating amplifier is a European-type 203-A with about 100 watts input. The oscillator tube is a 47, used with a crystal having a fundamental frequency in the 7-mc. band. The input to the oscillator is 7 or 8 watts, and the oscillator tank is coupled to the TNT grid coil for 7-mc. work. On 14 mc. a 46 doubler, running with about the same input as the crystal oscillator, is used, its output being coupled to the amplifier grid.

It should not be necessary to point out that a transmitter of this sort should be monitored *constantly*, and that it should be carefully checked every time it goes on the air after having been idle for a time. Frequency creep caused by tube heating often is enough to allow the tubes to get out of synchronism, which not only destroys the crystal-like character of the signal but may result in off-frequency operation.

Partial Application of Crystal-Lock System

Since the publication of my article on "Low Cost Crystal Control for High Power" in June 1934 *QST*, I have received numerous letters indicating an extensive interest in this type of crystal control. Since link coupling is fast becoming universal in its application another phase of the crystal-lock system is worthy of consideration.

In the present-day link coupling system, in which the grid circuit is tuned, it is seen that the final amplifier can readily be converted to a self-excited t.p.t.g. unit by de-neutralizing the amplifier merely by rotating the neutralizing condenser. If the final amplifier is of husky proportions and the doubler or pre-amplifier stage is of modest output power, a distressing condition may exist. This distressing condition is none other than insufficient excitation to the final amplifier. The transmitter can be converted to a partial lock-crystal system without any change at all except changes in adjustment. By partially de-neutralizing the final stage feeble regeneration will set up, which may not be enough to let the unit oscillate by its own excitation, but will be enough to furnish the added excitation required for increased output power. The coupling from the previous doubler or amplifier stage and stages farther back, including the crystal stage, can all be decreased, as little power is required of these units in crystal lock stages. Two 212-D's are used in push-pull at W5VU at present instead of the single 212-D that was in use when the article was sent to *QST* and the same 112 crystal oscillator and 46 doubler unit shown in *QST* is in use.

It will probably be found that the whole transmitter will function better as the tubes in the preliminary stages will have a chance to "cool off" and operate somewhere near their intended operating conditions. Incidentally, this should cut down the number of trips to the tube store.

—*Durward J. Tucker, W5VU*

Crystal-Locked Hartley Oscillator

In recent issues of *QST* I have noticed several references to the Goyder Lock system, or oscillating amplifier. All have asserted that the Hartley circuit would not work satisfactorily, and for that reason I made several attempts to get my old 852 Hartley rig to work that way before changing it into a neutralized amplifier. I hit upon one scheme which worked perfectly and actually gave 15% more antenna current for the same input of 180 watts than with the straight Hartley.

The method is to use link coupling to the tank of the exciting amplifier and direct coupling to the amplifier, as shown in Fig. 20. I used a three-turn pickup on the exciter end and tapped about one-third of a turn at the amplifier end on a 7-turn coil.

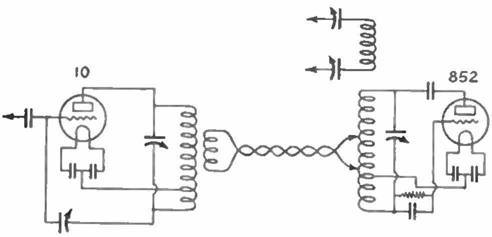


FIG. 20 — CRYSTAL-LOCKED HARTLEY OSCILLATOR

The low power stages are the same as used in the present arrangement. A 59 Tri-tet doubling to 7-mc., a 46 buffer, and a 10 with 820 volts on plate and 200 volts bias, running cold, as the exciter to the 852. With straight crystal control, the 852 as a neutralized amplifier now takes 260 watts at 1800 volts compared with the 180-watt maximum as an oscillating amplifier.

— *Will A. Shaw, W5ARV*

More Locked Oscillator Circuits

Fig. 21 shows several versions of a different type of locked oscillator circuit, originated by Carl C. Drumeller, W9EHC. A novel feature of these circuits is the use of a common tank circuit for the crystal oscillator and

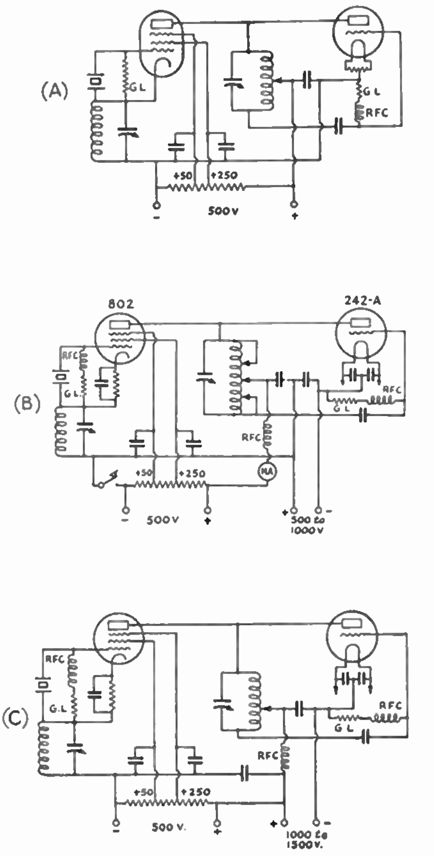


FIG. 21 — TRI-TET-CONTROLLED LOCKED OSCILLATOR CIRCUITS

Three variations of one fundamental arrangement. In each circuit the plate circuit of the Tri-tet oscillator and tank of the locked Hartley oscillator are common.

locked stage. The crystal oscillator is a Tri-tet, using a pentode of the 802 type; the amplifier or locked oscillator may be any type of triode, depending upon the plate voltage to be used. The tube used by W9EHC was a 242-A, with plate voltages up to 1750. Needless to say, a considerable amount of power can be taken from the tube under these conditions.

Although the circuits of Fig. 21 show the locked oscillator as a Hartley, all of the other familiar oscillator circuits have been tried and found to work satisfactorily. The Hartley has the advantage of requiring fewer parts than most, however, and the excitation is readily adjustable. W9EHC writes: "Results have been uniformly satisfactory. We put as high as 1750 or 2000 volts on the 242-A and it still locked perfectly under load on both the fundamental and second harmonic. When we tried to load the circuit on the fourth harmonic it did not lock any too well, however. The circuit shown at B seems to be the best. With over 200 watts into the 242-A, it locks as steady as a rock on both eighty and forty meters.

"Tuning is simple. One cuts the filament voltage on the 242-A and tunes up the 802 Tri-tet in the conventional manner, then one cuts the 802 filament voltage, turns on the 242-A, and juggles the filament tap on the Hartley for best output exactly as if you were using a self-excited rig. With filament and plate voltage on both tubes, the rig can be tuned by the plate current dips as with any Tri-tet.

"In circuit C we used a separate power supply for each tube (this was the best system, disregarding power supply cost and keying difficulties) and the whole rig could be tuned up, after the Hartley tap had been set, by the 802's plate meter. The rig acted exactly like a Tri-tet except that the output was very much greater.

"It is important to use very low *C* in the plate tank so that the Hartley will be unstable and pull into lock readily. The Hartley is always exactly in tune with the Tri-tet, since both plate circuits are common."

At this distance the only disadvantage to the circuit that we can see is that the full r.f. tank voltage from the high-power oscillator appears at the plate of the low-power crystal oscillator tube. No bad effects have resulted from this in W9EHC's experiments with the circuit, however.

Improving Crystal Stability

HERE are a few hints for eliminating frequency "creep" due to generation of heat by the crystal itself.

With the tuned-plate type oscillators, work with as low a plate voltage as practical on the oscillator tube. Triodes preferably should not have more than 150 volts on the plate, pentodes not over 250 volts. These plate voltages should be sufficient to excite any of the ordinary tubes used as buffers or doublers, such as the Types 10, 65, 47 and 46. If more output is required add another r.f. amplifier and let it take the load; not the

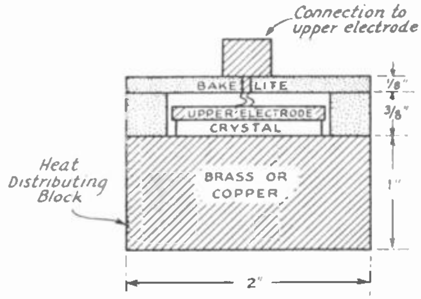


FIG. 22 — CONSTRUCTION OF THE CRYSTAL MOUNTING, WHICH MAY BE ROUND OR SQUARE

It is important that the electrode surfaces contacting the crystal be perfectly flat.

crystal. Under any conditions never work the tube to the point where the crystal gives off a corona discharge or the electrodes "burn."

Do not tune the tank circuit for maximum output — work it considerably off-tune of the crystal frequency, on the high frequency side, of course.

With the Tri-tet type circuit the important adjustment to minimize creeping is in the tuned cathode circuit. As this circuit is tuned to lower its resonant frequency (tuning capacity increased) the excitation increases. With the circuit tuned near resonance creeping is likely to be bad, as the result of excessive r.f. excitation and heating of the crystal, and the output is likely to be less than that obtainable with the capacity considerably reduced. Therefore this circuit should be resonant to a frequency considerably higher than the crystal frequency, as has been pointed out in recent *QST* articles. With the Tri-tet the screen (or screen and suppressor) voltage should be adjusted for stability, about 100 volts being best with Type 59 tubes. Plate voltages considerably higher than recommended for tuned-plate type oscillators may be used — 400 to 500 volts on the 59 oscillator, for instance — and even higher voltages on screen-grid tubes having really small grid-plate capacity.

Use a crystal holder properly designed for good heat transfer and distribution. This can be done best by employing a mounting having a large mass of copper or brass for the bottom plate of the holder. The action is briefly this: Heat generated by the oscillation of the crystal is dissipated rapidly by the metal bottom plate of the holder due to the high thermo-conductivity of the metal used and the fact that the quartz rests directly on the metal with its greatest surface area contacting it. Therefore, the bottom plate resists any sudden change in temperature of the crystal; and the quartz, because it does contact the metal, will tend to remain at the same temperature as the metal. Because of its mass of metal, the lower plate temperature will tend to be the same as the average room temperature. The temperature of the metal may actually be more constant than the room temperature.

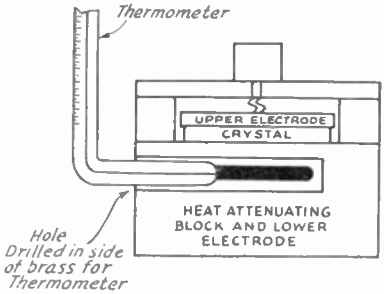


FIG. 23 — THE ADDITION OF THE THERMOMETER FOR TEMPERATURE CHECKING

A comparatively large upper plate made of brass may also be used to good advantage, provided that the weight of this upper electrode is not so great as to materially dampen the oscillation of the crystal. High-frequency crystals, however, are as a general rule quite vigorous oscillators and they will stand considerable pressure from the electrodes before their oscillations are seriously dampened.

With the type of crystal holder shown in Fig. 22 the writer has eliminated any noticeable frequency shift in the carrier of W9BKO on the 14-mc. band, even after several hours of intermittent transmitter operation, provided that the room temperature stays constant within two or three degrees Fahrenheit — which it does most of the time.

Where an amateur must park on the very edge of the band (why is it that some fellows are serious in their belief, and will argue for hours, that they do not get out half as well on 7020 as on 7000.5 kc.?) it is suggested that in addition to the holder precautions given above, the scheme shown in Fig. 23 be followed. This shows a hole drilled in the side of the bottom plate of the holder just large enough to insert the thermometer immediately under that portion of the plate upon which the crystal rests. The thermometer now gives us a good comparative check on the temperature of the crystal from one operating period to the next. Then, if the temperature reading is considerably different from that previously determined by test to give operation sufficiently within the band for safety's sake, the operator will have a satisfactory visual warning to *stay off the air* until the temperature reading returns to that value where he can start up without worrying about whether or not he is in the band. Either straight or right-angle thermometers can be used, and it makes no difference whether the thermometer is calibrated in Centigrade or Fahrenheit — all we are interested in is a comparison of readings.

It is evident that, whether the crystal is to be used in an oven or without one, the use of a large quantity of brass or copper in its holder construction will be found extremely beneficial in stabilizing its temperature.

Good frequency stability is entirely possible and practical in crystal-controlled amateur transmitters without the use of expensive accessory apparatus, provided that the transmitter is in a room subject only to normal room temperature variations, that the circuit is properly adjusted and the crystal oscillator run at low excitation, and that the holder in which the crystal is mounted is designed for good heat conductivity and attenuation. Frequency stability exceeding that required for amateur work is possible under these conditions. — *E. L. Dillard, W9BKO*

More on Silvering Crystals

RECENTLY I came into the possession of a 160-meter crystal which was supposed to double into the 80-meter c.w. band. But for some of those reasons that we can't account for, it didn't.

Past numbers of *QST*[1] had said that the frequency of crystals could be lowered by silvering, so a formula was found that sounded good and the process started. *QST* said that 20- and 40-meter crystals had been done successfully, but no one has handed out anything on 160-meter crystals that I have seen. Anyway, we put on five coats and tried her out. From scratch of 3935 kc., a perceptible but small change was noticed; maybe 5 kc. What a bright outlook, when some of our 20-meter friends had made 20 kc. per coat! Circumstance called for it, therefore we kept on; and after about twenty-five coats we pushed her over for a touchdown, and no more QRM to the noble 'phones! It is my idea that the ratio of the thickness of the coat of silver to the thickness of the crystal is the answer to why one coat here makes so little progress as compared to that made by one coat on a 20-meter crystal.

It is not as bad as it sounds, however, for the formula used would put a coat on in about three minutes, and in another minute the next coat was being applied. This formula was cut down from a five-gallon job, but works nicely:

SOLUTION NO. 1

A — Dissolve NaOH (sodium hydroxide)	1.13 gm.
Distilled water	180 c.c.
B — Dissolve $AgNO_3$ (silver nitrate)	1.13 gm.
NH_4OH (ammonia)	120 c.c.

Add *A* to *B*, then add 2.5 c.c. NH_4OH more to clear solution.

SOLUTION NO. 2

A — Distilled water	23.6 c.c.
Sulphuric acid	2.0 c.c.

[1] *QST*, March, 1932; February, 1933.

B — Distilled water		95.4 c.c.
Cane sugar		17.8 gm.

Bring B to a boil, add 2.25 c.c. of A and boil 15 min. Filter out precipitate and this is Solution No. 2.

PROCEDURE

Add 2 c.c. of No. 2 to 20 c.c. of No. 1, and as soon as it is a good amber color pour over the crystal (which we suspended in an evaporating dish on ivory pointed tweezers) and leave until the solution turns a muddy brown and looks thick. Remove, wash in distilled water, and put on another coat.

Before silvering, a third solution called "tin stock" was applied to the crystal after it had been thoroughly cleaned. This was washed off with distilled water before the first application of silvering solution. I suppose it was a filler. It was made up of 1 gm. $SnCl_2$ (tin muriate) to 200 c.c. of distilled water. It does not keep well, but is only used in starting to silver.

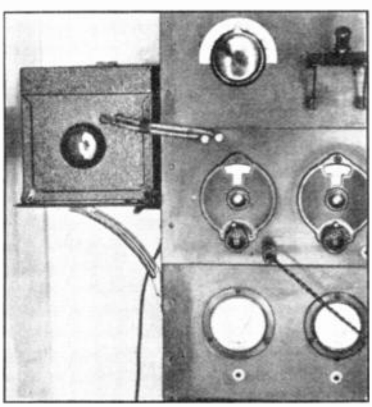
After the silvering was finished the edges of the crystal were ground down with fine grinding compound and cleaned with carbon tetrachloride. All results seem to be equally as good as those obtained with the bare crystal, and if ever we are fortunate enough to get into 80-meter 'phone a little nitric acid will clean it with far less effort than it took to put it on.

— Fred D. Armes, W1GMD

An Inexpensive Temperature-Control Oven

The temperature-control oven shown in the accompanying photograph has been in use at W9AA for more than eight months and has proven satisfactory in every respect. The entire cost, excluding the crystal holders and the three-way switch, was under six dollars.

The outer case of the oven is a black crystalline-finish metal tool box which can be purchased for about a dollar. Remove the leather handle and inner tool tray and line the box with three layers of half-inch insulating Masonite Presdwood or similar soft fibrous composition which can be secured from any good lumber dealer. Cut pieces of the lining to fit the bottom and sides snugly and force them into place. They will need no other fastening. Arrange the top pieces so they can be removed without too much trouble. After lining the box the metal tool tray can be cut with a hacksaw to make a base for the apparatus inside.



THE CRYSTAL OVEN MOUNTED IN PLACE ON THE TRANSMITTER

The selector-switch knob and the crystal leads come through the front.

The thermostat and heater unit can be bought from any dealer in tropical fish and aquarium supplies. The heater unit is encased in a glass tube filled with sand and can be placed directly on the bottom of the tray. Remove the glass tube

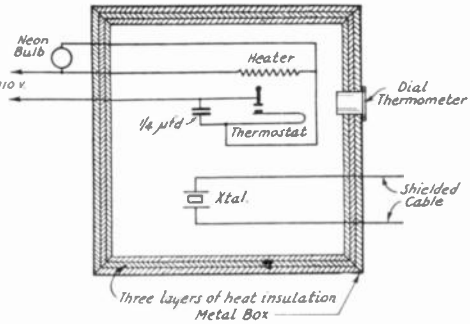


FIG. 24 — WIRING OF THE TEMPERATURE-CONTROL OVEN

The selector switch and additional crystals used by W9AA are not shown. The switch is desirable if more than one crystal is to be used.

from the thermostat and mount it upright so that the adjusting screw can be reached by a screw driver through a small hole in the inner top insulation.

A cheap dial type thermometer can be mounted in a hole in the inner top insulating piece. The intermediate insulating piece should have a small hole cut over the thermometer dial and a hole should also be cut over the thermostat screw, so that in reading and adjusting the temperature it is only necessary to open the cover and lift out the top layer of insulation.

This oven contains three crystals mounted in standard plug-in holders, selected by a Yaxley two-pole three-position switch. The switch is mounted inside with an extension handle through the front of the oven. Leads to the switch and crystals are made of auto ignition cable, also run through the front.

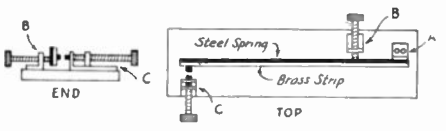
Be sure to include the 1/4-μfd. (or larger) condenser shown in the diagram, Fig. 24, to prevent sparking at the contacts, or you will be unable to hear anything less than an S9 signal. A neon bulb connected across the heater is a convenience to show that the oven is working properly. A temperature of 100 degrees Fahrenheit can be maintained continuously and economically as the heater costs not more than a few cents per month to operate.

—C. T. Read, W9AA

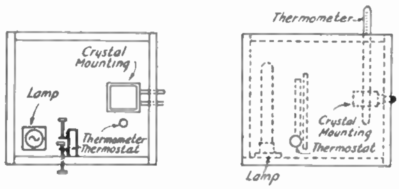
Home-Made Temperature Control Box

FIG. 25 shows the details of construction of an inexpensive heater box for crystal control as used by Fred Mueller, ex-W6EHO.

The box is 6¾ x 8¼ x 8¼ inches, and is constructed of Celotex. Screws are used for holding



Detail of Thermostat



Arrangement of Box

FIG. 25

the sides together, and all joints must be tightly closed to prevent heat leakage.

Perhaps the most interesting feature of the box is the homemade bi-metallic thermostat. A six-inch piece of steel spring taken from an old alarm clock and a piece of strip brass of the same size are held together by brass rivets spaced a quarter inch apart along the length of the two pieces, forming the expansion strip. As shown in the top view of the thermostat in Fig. 25, one end of the strip is held to a suitable base by the brass angle *A*; at the other end of the strip a

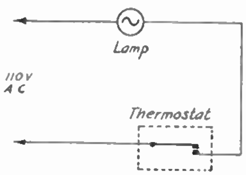


FIG. 26

contact point (points from ignition coils will do very well) is rivited on the brass side. A second contact point is riveted on a spring brass angle, *C*, which also is fitted up with a machine screw as shown in the end view to vary the gap between the points. A third angle, *B*, holds another machine screw which adjusts the position of the thermo-strip in relation to the contact *C*.

The lower part of Fig. 25 shows how the parts are arranged inside the box. The thermostat is mounted vertically on one side of the box with the screw *C* projecting through so adjustments may be made from outside. The lamp which furnishes the heat is one of the type used in music racks or show cases, and is mounted so that the thermostat is between it and the crystal mounting. A 0–100 degree Centigrade thermometer is mounted near the crystal as shown in the drawing. The wiring diagram is shown in Fig. 26.

In adjusting the thermostat the screw *B* is first set so the contact points are not quite touching (this adjustment may need to be changed slightly after the strip has been heated). Screw *C* is then set so the box operates at the desired temperature, a procedure which may take a little time since the air inside the box does not reach a steady temperature immediately.

A box of this type, while not capable of maintaining the crystal temperature within the small limits allowable for precision frequency work, is adequate for general amateur work where the chief job of the oven is to compensate for variations in room temperature so that the crystal will not wander kilocycles from its nominal frequency.

—...—

Those fancy "tune for greatest swing" meters which have a moving shadow for an indicator and sell for about six bits really set off the small transmitter whose owner cannot afford a flock of Westons. They can be used to measure relative amounts of excitation when put in series with the grid bias of each amplifier stage. Several different full-scale deflections are available. They can be adapted to tubes drawing heavy grid current by providing them with shunts. — *W6BCX*

4

'Phone Working

Grid Leak Modulation

MODULATION by varying the grid-leak resistance (using a vacuum tube as the leak) while occasionally mentioned in radio literature, is not generally used because in inexperienced hands it is prone to give non-linear modulation. However, once the proper operating conditions are found, good results are possible. O. H. Huston, W9BUZ, has worked out a good com-

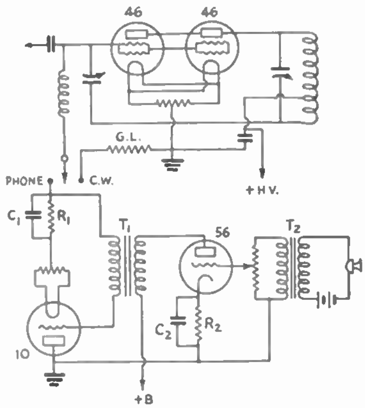


FIG. 1 — GRID-LEAK MODULATION OF 46s

The method of operation is described in the text.
C_1, C_2 — 1 µfd.
R_1 — 1500 ohms, 5-watt.
R_2 — 2500 ohms, 1-watt.
T_1 — Audio transformer, 3:1.
T_2 — Microphone transformer.

bination for grid-leak modulation of 46's, and writes as follows concerning it:

"This system has an advantage over the usual grid-bias modulation system because it requires no bias supply and eliminates one transformer. It is very simple to adjust and the quality is excellent.

"The r.f. section is the usual c.w. rig using parallel 46's in the last stage, but with the grid resistor replaced by the modulator tube and its biasing resistor, as shown in Fig. 1. After considerable experimenting it was found that the only tube which would give more than mediocre quality as a modulator for 46's was a 10. The characteristics of the two tubes apparently complement each other in such a way that, while neither is linear by itself under these conditions, the resultant antenna current plotted against grid voltage on the modulator forms a straight line which is very nearly perfect.

"To put the rig into operation only two steps are necessary. First: With the s.p.d.t. switch in the c.w. position tune the set for *maximum possible* antenna current and note its value. The output obtained at this point represents the power on the positive peaks of modulation and may be well in excess of the capabilities of the tubes for c.w. operation. Plenty of excitation will be required. Second: With the switch in the 'phone position adjust the excitation until the antenna current is one-half its former value. Turn up the gain control and start talking."

As always, the plate current of the modulated stage should be steady with modulation. A slight flicker on the modulation peaks is all that should be tolerated. W9BUZ uses a 5000-ohm variable resistor as a grid leak in the driver stage (a single 46) as the excitation control.

Those interested in modulating other types of tubes (W9BUZ has found the zero-bias types best for this sort of service) should follow the same procedure to determine proper operating conditions; that is, a curve of antenna current against modulator grid voltage should be plotted to determine the linearity of the tube combination used. Modulation should be confined to the straight portion of such a curve.

—···—

Plate Modulation With Tapped Choke

AN INTERESTING suggestion in connection with Heising modulation is offered in the following letter from D. T. Broadhead, W8CXI, of Jamestown, N. Y. It may prove of value to 'phone men using Class-A modulators, especially when confronted with Class-C amplifier plate-voltage problems such as W8CXI describes.

"I have worked out a modification of the conventional Heising modulation circuit which I believe will be helpful to many who are using this system.

"The idea is simply to convert or build a choke to act as an auto transformer by taking out a tap for the modulator plate at a point 30% to 50% down from the end of the coil, as shown in Fig. 2. The proper location of the tap (in turns from the

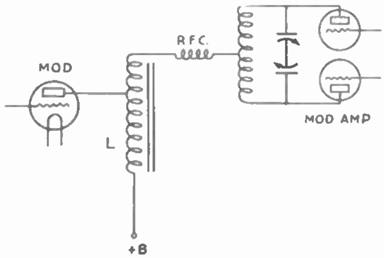


FIG. 2 — THE CHOKE, L, IS TAPPED TO WORK AS AN AUTO-TRANSFORMER SO THAT BOTH MODULATOR AND MODULATED AMPLIFIER CAN OPERATE AT THE SAME D.C. PLATE VOLTAGE

plate-supply end of the choke) may be found as follows: Tap turns=

$$\frac{\text{Modulator plate swing volts (peak)}}{\text{total plate voltage}} \times$$

total turns.

"The modulator plate swing can be found from the load line plotted on the familiar plate-current plate-voltage curves for the tube in use, using the formula:

$$\text{Plate swing volts} = \frac{E_{max} - E_{min}}{2}$$

"If the maximum undistorted output of the modulator at the operating voltage and current have been ascertained, then the plate current to the final r.f. amplifier is simply:

$$\frac{\text{Watts (audio)} \times 2}{\text{plate voltage}}$$

"Several advantages result from the use of this method. It eliminates nuisance of the dropping resistor, which wastes from 35% to 50% of the d.c. power supplied to the modulated amplifier; the drain on the high voltage plate supply is reduced; and finally, it permits the operation of high-voltage low-current tubes such as the 852 at full voltage.

"The modulator here is an 851, which at 2500 volts and 240 ma. has an output of 165 watts audio power. The plate swing is 1375 volts, hardly enough to operate a pair of 852's at good efficiency, and requiring a plate current of 240 ma., using the dropping resistor method. Now with 2300 volts audio swing the 852's may be operated at full voltage and only require about 140 mils for the same carrier. The total plate current requirement has been reduced from 480 to 380 ma., making the use of an 866 bridge rectifier practical.

"It is usually preferable to allow the carrier power to be a little more than twice the audio output, then if the gain is held below the point where the modulator kicks up there is little danger of overmodulation, provided the r.f. amplifier is properly excited."

Choke-Coupled Modulation of R.F. Pentodes

SIMULTANEOUS plate and screen modulation of an r.f. pentode, can be applied to Class-A choke-coupled modulation systems by the use of an appropriately-tapped modulation choke or two chokes in series. This method, suggested by A. D. Mayo, Jr., W4CBD, is shown in Fig. 3.

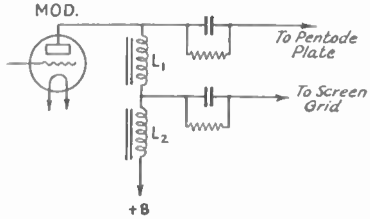


FIG. 3 — CLASS-A CHOKE-COUPLED SCREEN AND PLATE MODULATION OF AN R.F. PENTODE

The audio-frequency voltage divides across the two chokes, L_1 and L_2, in proportion to their inductances. The resistor and condenser in series with the pentode plate are the usual dropping resistor and by-pass to adjust the operating plate voltage in accordance with the modulator requirements, as described often in *QST* and in the *Handbook*. The dropping resistor in series with the screen grid performs a similar function; its resistance should be such that under operating conditions the proper voltage is applied to the screen. The by-pass condenser may be in the neighborhood of 2 μfd.

With most screen-grid pentodes, where the ratio of d.c. plate and screen voltages is approximately four to one, the ratio of choke inductances, L_1 to L_2, should be the same or higher. That is, if L_1 is 30 henrys, for example, L_2 should be between 5 and 8 henrys.

—•••—

Suppressor Modulation With Linear Amplification

AS A means for getting on 'phone with a minimum of equipment, Charles Lober, W8ICO, has found the arrangement shown in Fig. 4 to be highly effective. The transmitter is a typical 100-watt (nominal) c.w. layout using a 47 crystal oscillator, RK23 buffer, and heavy-duty 203-A final. Ordinarily in such a rig the final would be modulated either with Class-B audio or by the grid-bias system. In this case, however, the pentode driver tube is suppressor-modulated, the final stage being used as a Class-B linear amplifier. The carrier output is about equivalent to that obtainable with grid-bias modulation of the final, but with less rigorous biasing and audio power requirements.

In connection with adjusting the set for 'phone, W8ICO writes:

"The transmitter is tuned up in the ordinary manner. Grid current will be much lower for the final than with the usual Class-C amplifier. Input should be adjusted so as to be about 30% more than the rated tube dissipation. The higher the tube plate dissipation, the greater the input that can be used.

"Then negative suppressor voltage, which may be obtained from a 'B' eliminator or bias batteries, is applied. Then, while watching the antenna ammeter, the variable resistor R_5 is swung to make the suppressor negative (a potentiometer should be used to give smooth adjustment of grid voltage). Set the bias so that the antenna current drops 50%.

"Some minor adjustments of excitation may have to be made, hence the variable condenser C_5. If antenna current does not show normal modulation increase, this probably will mean the buffer isn't being modulated heavily enough so excitation should be increased. This in turn will require more negative voltage to be used to cut down antenna current; making the buffer easier to modulate.

"The modulator used here is a double-button microphone with a 24 speech amplifier and a 56 modulator.

"A carrier of approximately 55–60 watts can be realized with 1250 volts at 190 ma. on the plate of the final."

In the adjustment of such a system the aim should be to attain normal operating plate currents and biases simultaneously on both modulated stage and linear amplifier. The operating data furnished with the tubes should be consulted. An alternative method of adjustment is as follows: Disconnect the final from the pentode driver, apply rated plate and suppressor voltages for suppressor modulation, and couple a dummy antenna to the pentode tank circuit, adjusting the coupling until the tube draws the specified plate current. A modulation test will show whether or not this stage is working properly. When satisfactory operation is secured, apply plate voltage and rated bias for Class-B r.f. amplification to the final stage, couple on the driver, and adjust the interstage coupling to make the pentode draw the proper plate current. Then adjust antenna coupling to obtain rated plate current (for Class-B conditions) on the final stage. If the excitation is correct, the antenna current will show an upward kick of five to ten percent with modulation and the final stage plate current will be steady. Should the plate current kick downward when modulating, the excitation must be reduced to the point where there is no change in plate current or, at most, a very slight upward kick. As excitation is reduced, the antenna coupling must be adjusted to keep the final plate current at the same value. Should the driver plate current drop when these changes are made, some resistance should be connected across its tank circuit to bring the plate current back to its normal value. A non-inductive resistor is preferable; it need be rated at only five watts or so and should have a value in the vicinity of a few hundred ohms. The loading can be adjusted by varying the number of tank turns across which the resistor is connected. The additional loading not only provides a means for reaching the proper operating conditions on both modulated stage and amplifier, but also improves the operation of the circuit as a whole by improving the r.f. regulation in the grid circuit.

It is advisable to connect a by-pass condenser (1 μfd. or more) between the movable arm of R_5 and ground to shunt out the potentiometer resistance for audio in the suppressor circuit.

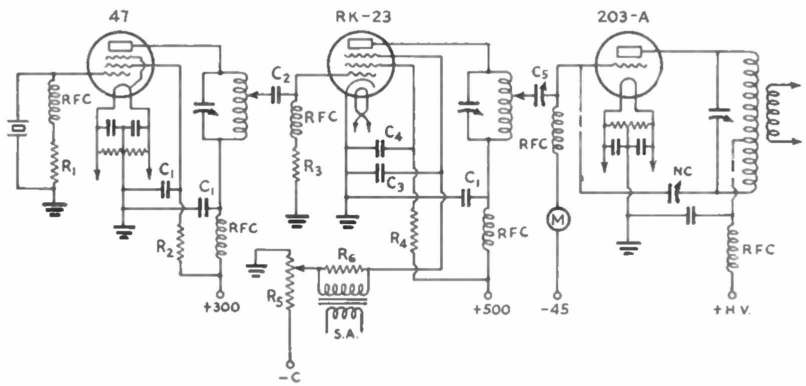


FIG. 4 — THREE-STAGE 'PHONE TRANSMITTER WITH SUPPRESSOR MODULATION AND LINEAR AMPLIFICATION

C_1 — 0.004 μfd.
C_2 — 250 μμfd.
C_3 — 0.002 μfd.
C_4 — 0.001 μfd.
C_5 — 350-μμfd. variable.
R_1 — 7000 ohms.
R_2 — 50,000 ohms.
R_3 — 2000 ohms.
R_4 — 20,000 ohms, 10 watts.
R_5 — 50,000 ohms, variable.
R_6 — Load resistor for modulator.

Preventing Oscillation in R.C. Amplifiers

S. J. Preston, B.A., writing in "World-Radio," points out that a resistance-coupled audio amplifier can give trouble from motorboating even when decoupling resistors and condensers are used. This trouble can be eliminated by choosing a grid blocking condenser and grid leak for the following stage such that their time constant is equal to that of the plate resistor and by-pass condenser. If this is not done, there is a chance that the gain at low frequencies will rise to such an extent that regeneration and oscillation can take place.

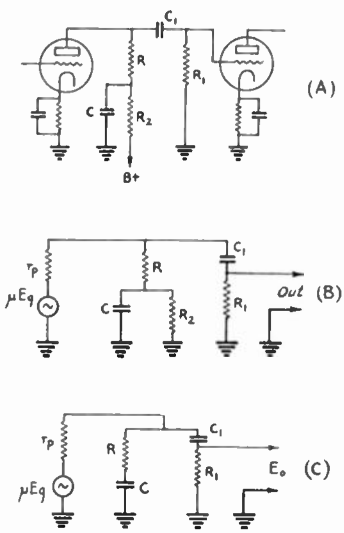


FIG. 5 — RESISTANCE-COUPLED AMPLIFIER EQUIVALENT CIRCUITS

Fig. 5A is the usual resistance-capacity arrangement when a decoupling resistor, R_2, is used. Now R_2 is usually high enough not to affect the by-passing operation of C. We then have a plate load consisting of R and C in series, the impedance of which combination varies inversely with frequency (see Fig. 5B) so that at low frequencies the gain becomes so great that if there is positive feedback, even though small, the amplifier starts to motorboat. This tendency could be eliminated by making C very large or by reducing R_2, but doing the latter would affect the decoupling and get one into more feedback trouble.

When R_2 is large enough to be neglected the equivalent circuit will be as in Fig. 5C and E_0 will be equal to

$$\frac{\mu\, C_1\, R_1}{r_p\, C} \times \frac{1 + j\omega CR}{1 + j\omega C_1 R_1} \times E_{input}$$

so that if C_1R_1 and CR are equal, E_0 will be constant at all frequencies.

Now, the trick is to make them equal. If R is 250,000 ohms and C is 0.5 μfd., CR is .125, and if C_1 is .06 μfd. and R_1 2 megohms, C_1R_1 is also about .125, and you can use as big a decoupling resistance as other considerations will allow, without getting boominess or motorboating.

Decoupling circuits are likely to cause undue low-frequency gain in choke- or transformer-coupled circuits unless something else causes a loss of low-frequency gain at the same time.

— *H. S. Gowan, Stratford, Ont.*

Single-Tube Head Amplifier for Condenser Microphone

The single-tube condenser-microphone head amplifier shown in Fig. 6 has been used with success by R. G. Sceli of Hartford. The gain is at least equivalent to that obtainable from the usual cascaded resistance-coupled 30's, a large voltage step-up being secured through the use of a 32 screen-grid tube. A novel feature of the circuit is the output coupling device, which is simply a single-button microphone transformer reversed so that the secondary is connected in the plate circuit and the primary used as an output winding to work into a low-impedance line. To avoid having the plate current flow through the secondary, with a consequent reduction in inductance, the plate voltage is fed to the tube through a 250,000-ohm resistor, the transformer being coupled to the plate through a 0.1-μfd. condenser. The 1-volt drop across a 16-ohm resistor in series with the filament of the tube is utilized as grid bias.

An amplifier of this type offers savings in both space and cost.

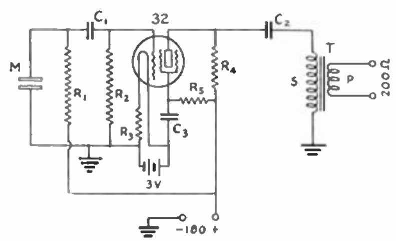


FIG. 6 — SINGLE-TUBE HEAD AMPLIFIER FOR CONDENSER MICROPHONE

C_1 — 0.01 μfd.
C_2 — 0.1 μfd.
C_3 — 0.25 μfd.
R_1, R_2 — 5 megohms.
R_3 — 16 ohms.
R_4 — 250,000 ohms.
R_5 — 75,000 ohms.
T — Single-button microphone transformer.
M — Condenser microphone head.

A.C.-Operated Pre-Amplifier

The circuit shown in Fig. 7 is not original at all, but inasmuch as it has served to operate both dynamic and condenser-type micro-

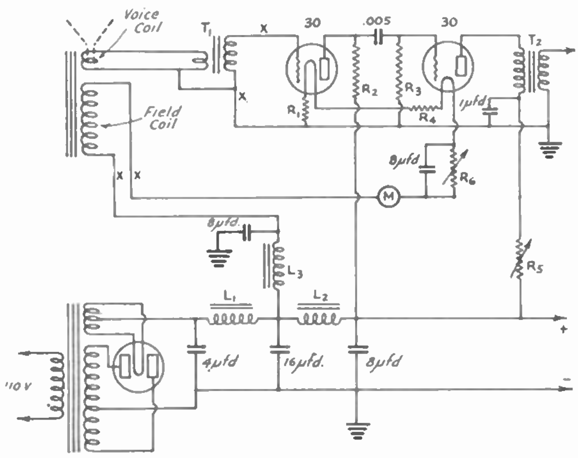


FIG. 7 — A.C.-OPERATED PRE-AMPLIFIER WITH DYNAMIC MICROPHONE

R_1 — 75 ohms.
R_2 — 100,000 ohms.
R_3 — 250,000 ohms.
R_4 — 40 ohms.
R_5 — 250,000-ohm variable resistor.
R_6 — 5000-ohm variable resistor, wire-wound.
L_1 — 15-henry, 125-ma. choke.
L_2 — 15-henry, 40-ma. choke.
L_3 — 30-henry, 85-ma. choke.
M — 0-100 d.c. milliammeter.
T_1 — Microphone transformer.
T_2 — Output transformer to 500-ohm line.

phones "all a.c." — with ridiculously low hum — I offer it for what value it may have to "ye hamme." Use can be made of the power supply already operating the main speech amplifier.

The idea is simply this: Rectified and filtered

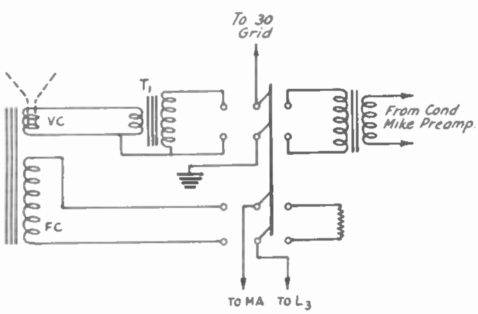


FIG. 8 — A SWITCHING ARRANGEMENT TO USE THE AMPLIFIER OF FIG. 7 WITH A CONDENSER MICROPHONE HAVING AN ADDITIONAL STAGE OF PRE-AMPLIFICATION

d.c. from the plate supply is reduced in voltage by suitable resistors to furnish power for the filaments of Type 30 or other low-voltage pre-amplifier tubes. Filament current is adjusted by varying R_6 until the milliammeter, M, reads the correct value for the tube filaments — in the case of 30's, 60 mils. Since the filaments are in series, R_6 always should be adjusted for rated current flow of *one* tube; furthermore, the tubes in the amplifier should all be rated to take the same filament current. Resistors R_1 and R_4 provide the grid bias for the two tubes; L_3 is a decoupling choke. The other circuit values are those usually to be expected in similar amplifiers.

If a twin d.p.d.t. switch is inserted at the points marked "X", arranged so that a resistor of 1800 ohms replaces the field coil of the dynamic speaker (or a resistor having the same value as the field coil resistance), a condenser microphone can be used in place of the dynamic. Fig. 8 shows this more clearly. A single stage of condenser mike pre-amplifier is all that is required in addition to the two stages shown. If the condenser mike is sensitive enough it might be used directly, with suitable switching of the head connections. If the filament of the condenser mike pre-amplifier is also in series with the other filaments, the milliammeter should still read 60 mils.

An arrangement of this sort reduces materially the cost of operating and maintaining a condenser or dynamic microphone. It has been used by W9BHM and W9AAI for a number of years. Its recent inauguration at W9JHY has sold me 100% on the idea.

— *M. C. Bartlett, W9JHY*

A.C. Pre-Amplifier for Condenser Mike

The circuit diagram of Fig. 9, an all a.c.-operated head amplifier for a condenser microphone, has been used very successfully by Fay Harwood, W6BHO, Santa Paula, Calif. Standard 2.5-volt tubes are used, and humless amplification is secured with a well-filtered power pack. W6BHO uses a regular National type 5880 supply.

The first tube is a 2A6, which is combination tube having a triode with an amplification factor of 100 and a pair of diode plates, the latter being unused in this case. The second tube is a 56. Resistance coupling is used from the microphone up to the output of the 56, where a transformer couples the amplifier to a 500-ohm line.

The entire amplifier is enclosed in a metal box, with a metal shelf inside for mounting the tubes. Grid leads should be as short as possible. The a.c. leads inside the box are in shielded cable with the shields grounded; the four external power-supply leads are in a single cable, also shielded. A good grade of resistors and mica coupling condensers must be used to prevent noise. It should be noted

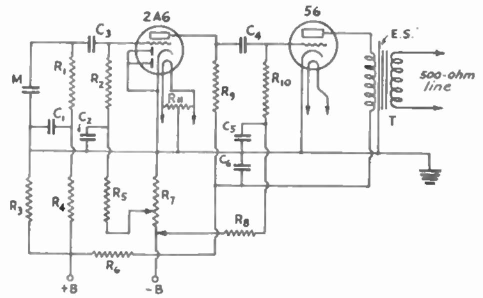


FIG. 9 — AN A.C.-OPERATED HEAD AMPLIFIER FOR A CONDENSER MICROPHONE

M — Microphone.
C_1, C_2 — 0.5 μfd.
C_3 — 0.005-μfd. mica condenser.
C_4 — 0.01μfd. mica condenser.
C_5, C_6 — .5 μfd.
R_1, R_2 — 250,000 ohms.
R_3 — 20,000 ohms.
R_4 — 1 megohm.
R_5 — 250,000 ohms.
R_6 — 20,000 ohms.
R_7 — 1000-ohm semi-variable resistor.
R_8, R_9 — 250,000 ohms.
R_{10} — 1 megohm.
R_{11} — 20 ohms, center-tapped.
T — Tube-to-line transformer, 500-ohm output, with electrostatic shield.

that the negative "B" lead should not be grounded, since there is a potential difference of several volts between it and the common ground for the amplifier, which is attached to the tube cathodes.

The 1000-ohm bias resistor, R_7, should be of the semi-variable type. W6BHO uses a 25-watt Electrad resistor with the sliders set to put 1.3 volts bias on the 2A6 grid, and 13 volts on the 56 grid. The bias adjustment should be made with the aid of a high-resistance voltmeter.

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Volume Control in Terms of Decibels

In most amateur 'phone transmitters the voltage-divider type of volume control is used. A simple method of graduating this type of volume control in terms of decibels is as follows:

It is known that attenuation varies according to the following formula:

$$\text{db} = 20 \log_{10} \frac{E_1}{E_2}$$

But since the voltage drop across a resistance is directly proportional to the resistance we may write:

$$\text{db} = 20 \log_{10} \frac{R_1}{R_2}$$

where R_1 and R_2 are as shown in the diagram, Fig. 10.

For example, suppose we wish to make a voltage-divider type volume control which has steps of 2 db for a type 56 or 27 tube. The total resistance, R, is usually around 100,000 ohms. Transposing we get

$$\text{db}/20 = \log_{10} R_1 - \log_{10} R_2$$

$$\text{or, } \log_{10} R_2 = \log_{10} R_1 - \frac{\text{db}}{20}$$

Substituting in this last formula the known values of 2 db attenuation and R of 100,000 ohms we get:

$$\log_{10} R_2 = \log_{10} 100{,}000 - \frac{2}{20}$$

$$\log_{10} R_2 = 5 - 0.1 = 4.9$$

The antilog of 4.9 is 79,430 ohms (from a log table). For the 4 db loss:

$$\log_{10} R_2 = \log_{10} 100{,}000 - \frac{4}{20}$$

$$\log_{10} R_2 = 5 - 0.2 = 4.8$$

The antilog of 4.8 is 63,090 ohms. This process is repeated on down till the required loss is a maximum. Usually a 20-db loss is more than sufficient. The results tabulated for a 20-db loss are as follows:

DB loss	*R_2*
2	79,430 ohms
4	63,090 "
6	51,900 "
8	39,810 "
10	31,620 "
12	25,110 "
14	19,950 "
16	15,840 "
18	12,580 "
20	10,000 "

Thus if we take a wire-wound resistor and bring out taps at the designated points, uniform steps of loss will be obtained when the volume control is used. The advantage of this is that we know just how much loss is introduced and we can turn to that loss at any time so that the excitation does not vary every time one goes on the air. If music is to be faded in and out, the taps will have to be right on the resistor so that the grid will not be free between taps. However, the slider can run directly on the resistor and stops be stationed so that the pointer arm stops at the right value of resistance. If a value of resistance other than 100,000 ohms is used the process is re-

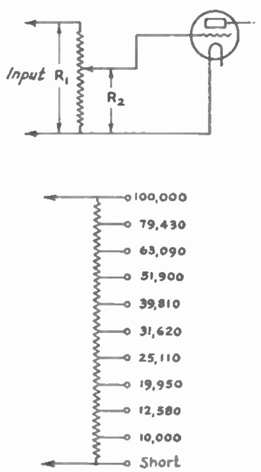

FIG. 10 — THE VOLUME-CONTROL CIRCUIT AND THE TAPPED RESISTOR WHICH GIVES A TOTAL OF 20 DB ATTENUATION IN STEPS OF 2 DB

peated, using the new value of resistance in the place of 100,000. — *Walter Fliegner, W6AST*

EDITOR'S NOTE — The values given in the table can be used as percentages to determine the correct point at which to place taps on resistors having a total resistance other than 100,000 ohms. For example, to get 2 db loss the tap should be placed at 79.4% of the total resistance; for 4 db loss the tap would be at 63% of the total resistance, etc. A chart giving a calibration for any voltage divider is shown in the article, "What is This Thing Called Decibel?", in August, 1931, *QST*.

Mixing System

THE circuit of Fig. 11, for mixing inputs from various sources, is contributed by Charles M. Dibrell, W5BLW, with the thought that it will be of interest to hams doing P.A. work and possibly also to 'phone men. He writes, "With this method . . . several sources, such as microphones and phono pickups, can be mixed without the necessity for expensive constant-impedance volume controls for each channel. Ordinary 500,000-ohm potentiometers are used in each grid circuit, and the variation of any one control has no noticeable effect on volume or frequency characteristics of the others regardless of their settings. Thus a music background for speech is easily obtained. Any number of channels could be used, as well as other types of tubes. One of the twin tubes like the 53 might be used with two channels."

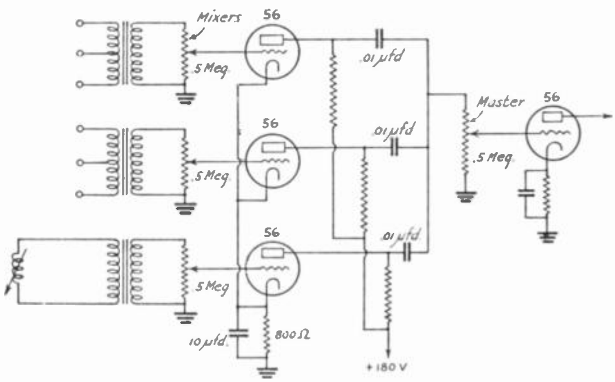

FIG. 11 — AN INEXPENSIVE MIXING SYSTEM FOR AUDIO AMPLIFIERS
The plate resistors are each 100,000 ohms.

Another possibility is the use of a 6F7 tube for a two-channel mixer when it is necessary to provide more gain for one tube than the other.

Automatic Microphone Battery Switch

L. A. STAFFORD, W2DIB, has a good suggestion for those fellows prone to forget to turn off the mike battery when the station goes off the air. The idea is shown diagrammatically in Fig. 12. A relay is arranged with its contacts in series with the microphone battery circuit and the winding in series with the plate supply for the modulator (if Class A) or the modulated amplifier. The battery circuit is thus automatically closed when the transmitter is in operation, but opens as soon as the plate supply is cut off.

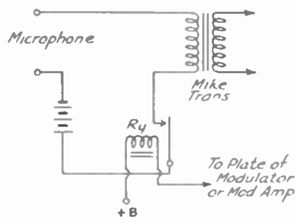

FIG. 12 — RELAY CIRCUIT FOR AUTOMATICALLY CUTTING THE MICROPHONE BATTERY CIRCUIT WHEN TRANSMITTER IS INOPERATIVE

The relay itself must be one which will operate on the plate current taken by the stage to which it is connected, and its characteristics naturally will vary with the type of transmitter in use. It is desirable that it should not introduce too much resistance in the circuit.

Magnets for the Velocity Microphone

WHERE to get permanent magnets for home-made velocity microphones? Here is one answer, supplied by Paul R. Smith, W8FHB, Bradner, Ohio:

"A recent issue of *QST*[1] gave data concerning the construction and operation of a ham-built velocity microphone of the permanent magnet type. This was the very thing I had been looking for, but upon invoicing my stock of parts I found nothing that would be of any value. One day, quite by accident, I found a substitute which is easy to construct and at the same time very rugged. It is the last word in simplicity since there is no machining of parts.

"The drawing of Fig. 13 shows the construction of a microphone using a permanent magnet of a special type — a drag-magnet taken from a watt-hour meter. Magnets of this type should be easily obtained by hams who are on good terms with a power company. The spacing between the poles is originally about one-eighth inch, which is not wide enough for the ribbon. Therefore the poles

[1] Velocity Microphones—The Permanent Magnet Type February, 1933, *QST*.

must be separated far enough to admit a ¼-inch bakelite strip to which the ribbon is fastened by the washer-nut combinations at each end. The mechanical tension of the magnet is ample to hold the strip permanently in position.

"An improvement can be made by drilling the strip full of holes to allow free passage of air past

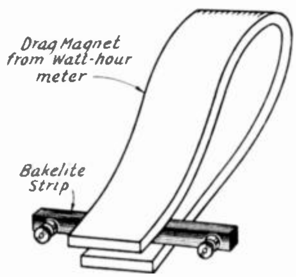

FIG. 13—SIMPLE VELOCITY MICROPHONE USING A DRAG-MAGNET FROM A WATT-HOUR METER

The ribbon, not shown, is suspended between the machine screws at the ends of the bakelite strip.

the ribbon. These should be as large and as close together as possible without endangering the mechanical strength of the strip. A tinfoil ribbon is in use at W8FHB. It can be made quite accurately if a little time and patience are used in shaping it.

"No means of checking the quality is available here except the usual ham method of hooking it up and listening. However, on various musical tones, all appear to register equally well. The mike-to-grid transformer described in a former *QST* is used in this rig."

A similar use for another type of watt-hour meter magnet was suggested independently by E. R. Patchen, of Lakeville, Conn. A sketch of a magnet of this type is shown in Fig. 14. These measure approximately 2½ inches by 2 inches, and the bar is about 5/16-inch thick. The gap is too small to accommodate a ribbon of ordinary construction and must be widened to ¼-inch by

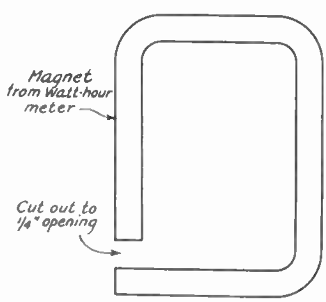

FIG. 14—A SECOND FORM OF WATT-HOUR METER MAGNET WHICH ALSO CAN BE USED IN THE CONSTRUCTION OF HOME-MADE VELOCITY MICROPHONES

cutting off a small portion of the vertical arm. This may be done with a carborundum wheel.

In making the microphone a number of the magnets are stacked to take care of the ribbon length used. They may be clamped together in any convenient fashion. It is necessary to check the polarities, since the magnets are furnished in pairs for each watt-hour meter and the individual magnets of each pair are oppositely polarized. Mr. Patchen states that most power companies have plenty of these magnets on hand, since they are frequently removed from meters brought in for checking and recalibration.

—···—

The Absorption Condenser Microphone

A MODIFIED version of the absorption condenser microphone,[1] in which the inherent stability of the electron-coupled oscillator is utilized, is shown in Fig. 15. This circuit was adopted in an effort to eliminate the critical tuning and unstable operation of most types of absorption circuits, and meets the requirements admirably.

Little need be said about the circuit components. The condenser microphone capacity *CM* is in the control grid circuit, while the plate circuit

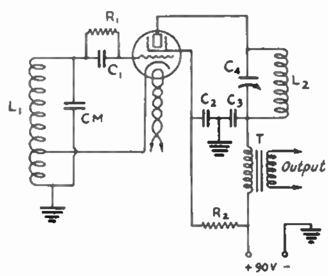

FIG. 15—THE CONDENSER MICROPHONE VARIES THE OSCILLATOR FREQUENCY, CAUSING AUDIO-FREQUENCY VARIATIONS IN PLATE CURRENT

An oscillator frequency outside an amateur band should be chosen to avoid heterodyning. W6BJE uses 6000 kc. The inductance of the coils L_1 and L_2 will depend upon the frequency chosen.

CM — Condenser microphone head.
C_1 — 250 μμfd.
C_2 — 0.001 μfd.
C_3 — 100 μμfd.
C_4 — 50-μμfd. midget variable.
R_1 — 50,000 ohms.
R_2 — 10,000 ohms.
T — Tube-to-line output transformer, input impedance 18,000 ohms.

is tuned slightly off resonance. When a sound wave strikes the microphone diaphragm the fluctuating capacity of *CM* causes the radio frequency of the control circuit to vary at the applied audio frequency, and this in turn pro-

[1] Experimenters' Section, July, 1932, *QST*.

duces corresponding audio frequency variations of the plate current by reason of the fluctuating resonance point. The output equals or exceeds that of a double-button microphone.

Either an a.c. or d.c. filament type tube may be used, and well-filtered r.a.c. is thoroughly satisfactory as the plate supply. A frequency in the vicinity of 6000 kc. is used to avoid heterodyning with transmitter frequencies or incoming signals. I am unable to say how nearly linear the plate-current curve is, but the quality obtainable sounds excellent, while the ease and stability of operation is a relief after experiencing the annoyances associated with other types.

— *Cecil Lynch, W6BJE*

A Simple Volume Indicator

Those of us who are looking for a simple but effective volume-level indicator may find the one described here, developed for a public address system, of interest. Use is made of a 56 tube biased to cut-off, with a 0-1 milliammeter in the plate circuit as an indicator, as shown in the diagram, Fig. 16. The system takes its heater and plate power from the amplifier on which it is used.

The design shown uses capacity-resistance input to cut down space requirements and to minimize pickup and interaction with the amplifier circuit. A better method from the response angle, however, is to use an audio transformer. It may either be connected step-up for sensitivity

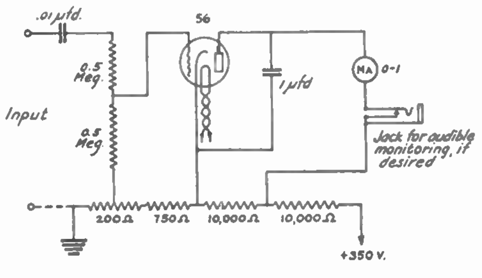

FIG. 16 — CIRCUIT OF THE SIMPLE VOLUME INDICATOR

when the comparatively-low impedance of the primary can be tolerated in the circuit, or step-down when the circuit on which it is used must not be appreciably shunted. Using a 3:1 audio transformer as a step-down (secondary as input, primary to indicator grid), 9 volts, 60 cycles, produced a half-scale deflection.

In the hookup shown, the divider system across the input presents a high impedance to the exciting circuit and a reasonably low impedance to the grid-cathode circuit — the latter feature prevents "floating" of the indicator meter. The condenser in the plate circuit is not necessary, but helps show up the peaks and, in case the indicator is used on high audio frequencies or radio frequencies, bypasses the meter. The values shown work out nicely in my case, but should not be considered sacred.

To operate, disconnect or short-circuit the input, adjust the meter to zero or some convenient low reading by means of the potentiometer supplying the grid bias (it might be well to add that this potentiometer should be set for maximum bias at the ground end to begin with, to protect the meter), and connect the input back to the point at which the level is to be measured — or disconnect your short circuit, as the case may be.

—*P. C. Tait, W6AEA*

'Phone Monitor—V.T. Voltmeter

A combination 'phone monitor and vacuum-tube voltmeter using a single tube of the duo-diode—hi-µ triode type is shown in Fig. 17, the circuit being suggested by Wolcott Smith of the F. W. Sickles Co., Springfield, Mass. The input circuit is arranged so that the diode rectifier portion may be cut in or out of the circuit by means of the switch S_1; with the diodes cut in for monitoring, the triode section of the tube is used as an audio amplifier. Switch S_2, in the plate circuit, cuts in either the headphones, for monitoring, or the 0-1 milliammeter, for voltage measurement.

For voltage measurement the "B" supply should be 100 to 135 volts from a source having good regulation — 3% or better — such as batteries or a "B" supply of ample current capacity. Since the maximum current change is small — not over 1 milliampere — it should not be difficult to maintain sufficiently good voltage regulation with a "B" power pack. To use the tube as a

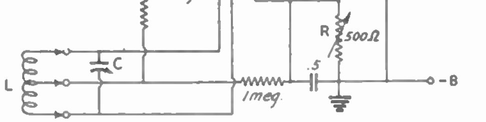

FIG. 17 — COMBINED V.T. VOLTMETER AND 'PHONE MONITOR USING DUAL-PURPOSE TUBE

For best results the lead to the triode grid should have low capacity to ground and other parts of the circuit. The milliammeter M is a 0–1 mil instrument. The 0.01-µfd. condenser shown dotted at the input terminals is used as an insulating condenser when a.c. measurements are being taken from a source which also has a d.c. potential across it.

voltmeter the 500-ohm variable cathode resistor, *R*, should be adjusted so that the plate current is 0.1 ma. with the input terminals shorted. With 90 volts on the plate, the milliammeter will read full scale when a signal of approximately 2.5 volts is applied to the input terminals. With 135 volts on the plate the full-scale reading will be obtained with a signal of approximately 2.0 volts. The voltmeter may be calibrated in comparison with a known source of voltage.

For monitoring, a pickup coil of suitable inductance is plugged across the tuning condenser *C*, the circuit being designed to resonate at the operating frequency. Constants are not critical, a 100-μμfd. tuning condenser and coils having sufficient inductance to tune to the operating frequency being suggested. A coil consisting of 40 turns of No. 24 d.s.c. or s.c.c. wire on a 1-inch form, tapped at the center, will be suitable for the 3900 to 4000-kc. band with a 100-μμfd. tuning condenser.

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'Phone Monitor and Modulation Meter

THE circuit diagram of the modulation meter and audio monitor used by R.C.A. in their one-kilowatt broadcast transmitters, shown in Fig. 18, should be of interest to 'phone men, since the apparatus is quite simple and inexpensive — exclusive of meters it can be built for less than five dollars. It uses two Type 80 tubes, one as an audio rectifier and the other as a modified form of volume-level indicator. The circuit constants are given under the diagram.

To put the unit into operation, couple the pickup coil L_1 to the final amplifier tank, adjusting the coupling until a reading of 26 milliamperes is obtained on M_1. The exact value of current is important and must be observed if the modulation percentage is to be read correctly on M_2. At 100% modulation (steady state conditions, constant tone input) M_2 will read 5 milliamperes.

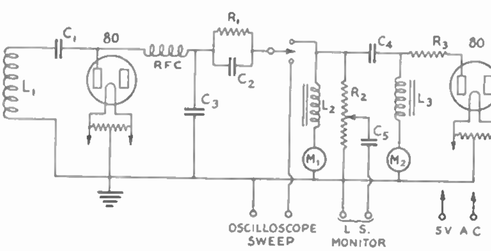

FIG. 18 — MODULATION METER AND AUDIO MONITOR

Only one plate used in each Type 80 tube.

L_1 — Pickup coil.	R_1 — 350 ohms, 3-watt.
C_1 — .002 μfd.	R_2 — 10,000-ohm.
C_2 — .05 μfd.	R_3 — 2500 ohms, 3-watt.
C_3 — .001 μfd.	L_2, L_3 — 30-henry chokes.
C_4 — 2 μfd.	R.F.C. — Short-wave choke.
C_5 — 1 μfd.	M_1 — 0-50 ma. d.c.
	M_2 — 0-5 ma. d.c.

This meter can be calibrated directly in percentage modulation, since its reading is proportional to the amplitude of the audio-frequency carrier variations.

The size of the pickup coil is not critical. Anything will do so long as the rectified current as read by M_1 can be set to the correct value. The whole instrument may be built into a small box and made readily portable. The terminals marked "oscilloscope sweep" may be connected to that part of an oscilloscope if one is available. If not, the s.p.d.t. switch may be omitted.

—*J. E. Pitts, Jr., W6CQK*

EDITOR'S NOTE. — As a modulation-percentage indicator, this type of instrument is subject to the defect that its readings are dependent upon the average amplitude of the modulation envelope, whereas the *peak* amplitude is the important quantity in modulation depth measurements. The relation between the reading of M_2 and the modulation percentage will hold only when the modulation envelope is a sine wave. If harmonics are present or the modulation is complex, as with voice input, the meter reading may indicate either a higher or lower percentage of modulation than the actual. The same applies to volume-level indicators whose readings are proportional to r.m.s. values, such as current-squared galvanometers.

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Automatic Carrier Switching

'PHONE operators who have fairly good superhet receivers can, by the addition of a relay or two, easily fix up an automatic switching arrangement by means of which the transmitter is put on the air as soon as the other party to a QSO cuts off his carrier. A diagram of the scheme, suggested by Fred L. Seufert, W2AOG, is given in Fig. 19. The chief essential of the control circuit is the relay Ry_1, which must

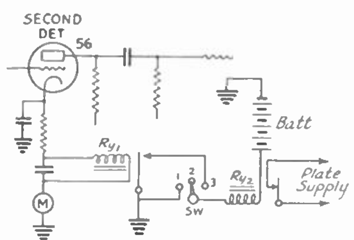

FIG. 19 — AUTOMATIC SWITCHING CIRCUIT BY WHICH A RECEIVED CARRIER CONTROLS THE TRANSMITTER

be capable of operating on about .7 ma. and releasing on .5 ma. — in other words, remaining idle under normal detector plate current conditions when no carrier is being received, and operating as soon as a carrier of appreciable strength causes the detector plate current to rise. W2AOG finds a W.E. type B145 relay to be quite satisfactory.

The operation of the system is as follows: With the switch Sw set at position 2, tune in a signal which causes the detector plate current to rise appreciably — say to 1 ma. Next set the switch in position 3; the power relay, Ry_2, is now in the circuit but does not operate because the control-relay armature is held open. As soon as the received carrier goes off, however, the detector plate current drops and the relay armature is released, closing the contacts and actuating the power relay, thus putting the transmitter on the air. To cut off the transmitter, move the switch to position 2. When the other fellow's carrier comes on again, the switch can be moved to position 3 and the process repeated.

For complete manual operation, the switch is moved between positions 1 and 2.

The 6E5 for Checking Overmodulation

A METHOD for checking overmodulation by the use of the 6E5 electron ray tube — the "magic eye" — is suggested by Clarence C. Moore, W9LZX. Overmodulation in either the upward or downward direction can be detected, and the gadget can be used to check incoming signals as well as one's own transmitter.

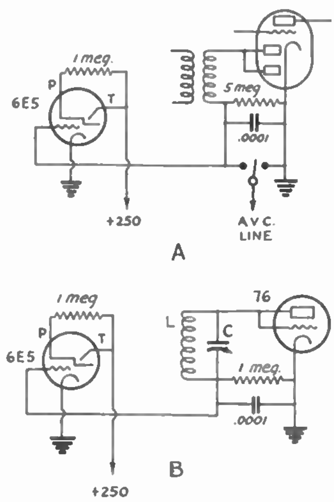

FIG. 20 — CIRCUITS FOR USING THE 6E5 FOR CHECKING OVERMODULATION

A typical application to an AVC-equipped superhet receiver is shown at A. An overmodulation indicator for transmitting is given at B.

Typical circuits for both receiving and transmitting are indicated in Fig. 20. Circuit A shows how the 6E5 can be connected into a superhet receiver using a diode rectifier. The grid of the 6E5 is connected to the a.v.c. side of the rectifier load resistor. Audio coupling is omitted in the interests of simplification although the connections in the receiver would not be disturbed. The width of the shaded area on the target is dependent upon the voltage developed across the diode load resistor and hence upon the received signal strength. On the method of using the tube W9LZX writes: "The 'magic eye,' when nearly closed on a strong carrier, has light yellowish-green edges on the two sides of the opening. With modulation there is a fuzzy appearance between these edges, but with overmodulation the two bright edges themselves will shift closer together. With downward modulation the opposite occurs. The most accurate reading is obtained when the eye is open about 40 degrees. The a.v.c. on the super cannot be used at the same time because it would compensate for any carrier shift. The audio gain control may need to be turned down while the i.f. gain is brought up high enough to get proper readings on weak stations."

Incidentally, the 6E5 can be used as a tuning meter when the a.v.c. is connected in.

For transmitting, the circuit shown at Fig. 1-B is suggested. It is equivalent to that at A except that a triode with grid and plate connected together is used as a rectifier. The tuned circuit is adjusted to resonance at the transmitting frequency. The circuit must be well shielded so that the only signal pickup is through the tuned circuit.

Duplex 'Phone

THERE comes a time in every ham's life when he feels the urge to have a two-way QSO for test purposes. There are so many details when reporting through a test transmission that most of the substance is forgotten. Regular duplex operation is not very desirable in our present crowded 'phone bands, however, especially when the transmitter is left on continuously, hence I suggest the following method to be used for test purposes only. A direct reply is obtained on each test and much time is saved.

Dig down in that old junk box and get a pair of 250- or 350-$\mu\mu$fd. variable receiving condensers of the broadcast type, also two dials and a 1½-inch diameter coil form for the plug-in coil. The system is, no doubt, applicable to any band, the frequency being about proportional to the number of turns for other bands, hence the plug-in coil. The specifications given under Fig. 21 apply to the 160-meter 'phone band.

Two turns of No. 20 rubber-covered wire are used for the pick-up coil, L_2, placed one-third of the way down from the antenna on L_1. Connections from L_2 run through a shielded two-wire cable to the antenna coil of the receiver. The antenna coil on the receiver should be disconnected from ground. Good shielding of both receiver and duplex system is essential; the shielded cable connects the common grounds. The length of the antenna is more or less optional, depending upon working conditions of the transmitter and duplex system in general. In my particular case a five-foot vertical wire was used, affording excellent selectivity without much decrease in signal level. However, up to twenty feet of antenna has been used without trouble from transmitter blocking.

The system is tuned by using the regular long receiving antenna connected directly to one side of the open antenna coil of the receiver. After the desirable station has been tuned in,


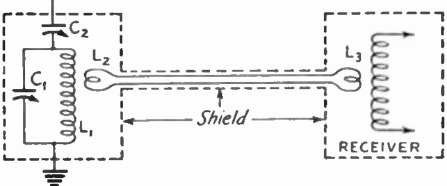

FIG. 21 — SHIELDED INPUT TUNING CIRCUIT FOR WORKING 'PHONE DUPLEX

C_1, C_2 — 250- to 350-μμfd. variable condensers.
L_1 — 35 turns No. 30 d.c.c. wire, double spaced, on 1½ plug-in form.
L_2 — 2 turns No. 26 rubber-covered wire wound over L_1.
L_3 — Antenna input coil on receiver (must be disconnected from chassis).
The connection between L_2 and L_3 is made through a two-wire shielded cable about a foot long.

the gain control of the receiver is advanced slightly and the long antenna disconnected, leaving the duplex system in operation. The condenser C_1, across L_1, is rotated slowly until maximum signal strength is obtained. C_2 is set at approximately half capacity and tuned for sharpest signal after desired frequency is obtained. No cutting and trying is necessary for specifications given herewith. It really works!

— *Art Miller, W9CPW*

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Note on Decoupling Circuits

Circuit decoupling has caused many designers and builders of amplifiers considerable trouble. The author himself had not a little grief with one particular circuit, and as we know several others having had the same trouble, we feel a few words on the subject might be valuable. This is especially true as the circuit has appeared in most technical radio publications. To get down to cases, the guilty circuit is that shown in Fig. 22-A. The so-called "decoupling network," composed of R_d and C_d, is supposed to keep the grid bias constant over an audio cycle and, by this filtering out of the voltage appearing across R_k, prevent degeneration. To this end, the product R_dC_d is made large compared to the period of the lowest frequency to be passed, and as R_d may be made large, a fairly small capacity is supposed to suffice at C_d. We built an amplifier using this circuit, and were quite chagrined to find that

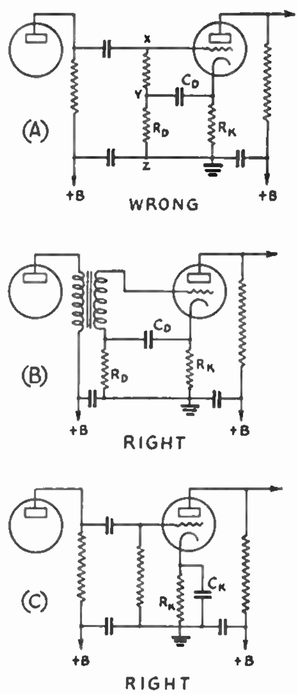

FIG. 22 — THE WRONG AND RIGHT OF DECOUPLING CIRCUITS

there was no noticeable effect upon removing C_d completely! Then the light dawned. Although the network evidently keeps the point Y (Fig. 22) at cathode potential (for a.c.), to avoid degeneration we must *apply the signal* between the grid and a point at cathode potential — but here the signal is being applied between X and Z, and Z has the whole degenerative voltage developed across R_k between it and the cathode. (Anyone not satisfied with this proof can work out the circuit equation, which will be found to give the same result.) If the signal were applied between X and Z, everything would be fine, but to accomplish this, we must use transformer coupling (Fig. 22-B). However, if we wish to keep resistance coupling and cathode resistor bias we must by-pass R_k directly, as at Fig. 22-C. C_k should be large enough to keep the cathode at ground a.c. potential, for the signal is effectively being applied between grid and ground. In general, 5 to 25 μfd. is adequate for good low-frequency response in audio amplifiers. —*W9FTO*

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The foil wrapper on Kodak films makes a fairly good diaphragm for a condenser mike when no diaphragm material is available. —*W5AUA*

'Phone Monitor Using 55

The circuit shown in Fig. 23 has been found to be very satisfactory for audio monitoring of an amateur 'phone transmitter. It utilizes a Type 55 duplex-diode-triode tube. The diode is used as a rectifier or detector and the triode as an audio amplifier. The diodes may be connected either for half- or full-wave rectification; the necessity for carrier frequency filtering

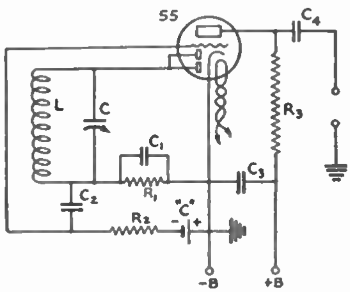

FIG. 23 — MODULATION MONITOR USING A TYPE 55 TUBE

C_1 — 250 μμfd.
C_2 — .01 μfd.
C_3 — .002 μfd.
C_4 — 1 μfd.
R_1 — .5 megohm.
R_2 — 2 megohms.
R_3 — .1 megohm.

can be eliminated by the use of full-wave rectification, the circuit being balanced so that the carrier frequency is not applied to the grid of the triode. When the diode is used as a half-wave rectifier (diode plates in parallel) the output will be approximately twice that of the full-wave rectifier, but theoretically carrier-frequency filtering will be required. Experiments carried out here indicate a decided increase in signal level when the half-wave rectifier is used, with no noticeable differences in other respects between the two systems. Methods of output coupling other than that shown may be used; for instance, an output transformer can be coupled to a 200- or 500-ohm line for remote monitoring, etc. The pickup coil is placed in inductive relation to the tank inductance of the modulated amplifier or the antenna inductance, the degree of coupling depending on the signal level desired.

A simple monitor of this type together with a dummy antenna will provide an adequate means of monitoring the modulation quality as well as indicating the character of the carrier. Hum, ripple and other extraneous noises due to improper filtering in the various r.f. and a.f. stages of the transmitter or other causes may be discerned readily and can be remedied without the usual interminable testing while the transmitter is on the air. The component parts of the monitor are shown below the diagram. The values of C and L will depend on the operating frequency. For the 75-meter 'phone band, 12 turns of No. 18 d.c.c. on a three-inch form, tuned by a 50 μμfd. condenser, have been found satisfactory.

— *S. E. Newman, W3IIN*

Checking Hum or Modulation Quality

A monitoring arrangement which requires very few parts is shown in Fig. 24. It has been used for a considerable length of time with excellent results by Seiler Brothers, W8PK. A glance at the diagram will show that the system functions by picking up a small amount of audio voltage from the filament center-tap of the final amplifier and feeding it into a pair of headphones, utilizing an ordinary output transformer of the type used to feed a dynamic speaker for the purpose.

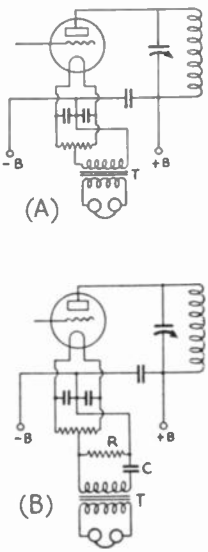

FIG. 24 — METHOD OF CHECKING CARRIER HUM OR MODULATION

T — Speaker output transformer, 10 or 15 ohms to tube plate. Low impedance winding connected in center tap; high-impedance winding to 'phones.
R — 10 to 15 ohms.
C — 2 μfd.

The diagram at A can be used with transmitters of moderate power, while that at B is recommended for high-power rigs. The resistance-condenser coupling will prevent burning out the transformer winding if the plate current of the stage exceeds 300 or 400 milliamperes. The transformer used should have good frequency response.

The signal level in the 'phones is high even with a low-power 'phone rig. This sensitivity makes the system useful for detecting hum in the signal, a feature which will make it appreciated by c.w. as well as 'phone operators.

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If your dynamic microphone sounds too "boomy," try putting a condenser in series with the voice coil and mike transformer primary. W9EQZ finds that a 1-μfd. condenser does a good job in his installation. The amount of capacity needed will depend upon the impedance of the microphone, of course, so it would be advisable to experiment a bit.

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'Phone men who cause interference with neighbors' telephones might try placing a .002-μfd. fixed condenser across the mike button in the telephone, suggests W9TE. Such a condenser is already incorporated in the handsets. (Some telephone companies are rather prejudiced against unauthorized alterations in their circuits. — Ed.)

5

Keying Systems—Keying Monitors—Break-In—Interference Elimination

Blocked-Grid Keying

THIS keying system should be of interest to those who wish to use grid-leak bias on a medium- or high-power final amplifier stage and yet retain the advantages of keying in a low-power circuit. It is a combination of blocked-grid and center-tap keying that requires only one resistor to furnish the grid-blocking voltage. However, its development by the writer was to gain an entirely different end — to prevent the preceding amplifier from feeding through the final amplifier into the antenna, in an unshielded transmitter, by cutting down the power output of the preceding stage. The scheme shown in Fig. 1 was finally hit upon.

The transmitter in question consists of a 47 crystal oscillator, 46 buffer and 203-A final amplifier. Only enough of the apparatus to illustrate the point is shown in the diagram. A 40,000-ohm resistor, R_1, was inserted in series with the grid leak in the final stage, then the center-tap of the 46 stage was opened and the center-tap connected to the negative of the final stage. The negative of the 46 stage was connected to the grid end of the 40,000-ohm resistor. The key or relay is connected across the resistor. In this case a voltage drop of approximately 180 volts was secured across the resistor and the 46's plate current was reduced to about 4.5 mills. Therefore, we have 180 volts of bias on the grid of the 203-A and the power input to the 46 is reduced to about two watts with the key open. When the key is closed the circuits are normal with their negatives common.

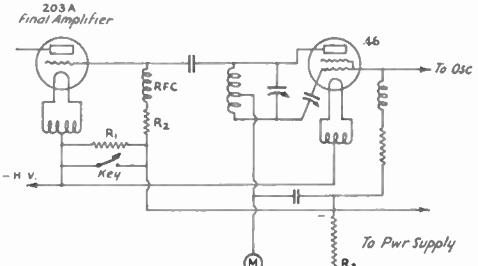

FIG. 1 — BLOCK-GRID KEYING

The blocking voltage, which is applied to the grids of both exciter and final amplifier, is obtained by causing the plate current of the exciter stage to flow through the auxiliary resistor, R_1.

Different setups will, of course, require different values for resistor R_1, and a variable resistor such as the Bradleyohm or its equivalent would be very convenient for adjusting to the proper value. Separate power supplies are necessary for the final and preceding amplifier stages. This system has been in use here only a short time but has proven very satisfactory so far.

— *Wm. B. Hann, W8GBC-INC*

Chirpless Keying With Pentodes

FELLOWS who have been having trouble with chirps in keying pentode crystal oscillators should find a kink contributed by Roy H. Raguse, W6FKZ, of value. W6FKZ says that his first attempt at keying a 47 oscillator brought plenty of chirps until he installed a voltage divider to supply voltage to the screen instead of using a simple dropping resistor. This required no

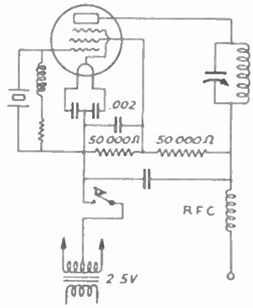

FIG. 2 — PENTODE CRYSTAL OSCILLATOR CIRCUIT FOR CHIRPLESS KEYING

The important point is the use of a voltage divider instead of a series resistor for supplying screen voltage.

change in the oscillator except the addition of a 50,000-ohm resistor between the screen and negative B, as shown in Fig. 2. With the screen voltage tied down the chirps disappeared.

The value of the extra resistance needed does not seem to be critical, a 20,000-ohm resistance having been installed by the editor in an oscillator similarly afflicted with chirps without changing the output from that obtained with the ordinary 50,000-ohm series resistor. The voltage divider also cured the chirp.

Keying the Link Circuit to Prevent Clicks

The keying arrangement shown in Fig. 3 is being used successfully by Bob Potter, VE3TO, to eliminate key clicks from an m.o.p.a.

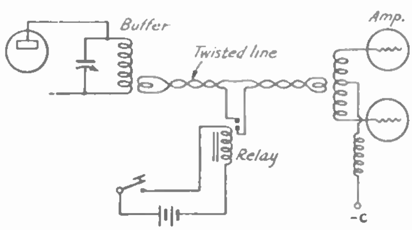

FIG. 3 — KEYED LINK BETWEEN DRIVER AND AMPLIFIER

transmitter with a pair of 10's in the final stage. The keying relay is simply inserted in the twisted-pair coupling line between the final stage and its exciter. The keying is as clean as with other systems, and its efficacy in preventing clicks is demonstrated by the fact that VE3TO's transmitter causes no interference in a b.c. receiver whose antenna is parallel to and only seven feet away from the transmitting antenna.

The final amplifier must, of course, be provided with fixed bias to cut off the plate current when the excitation circuit is open. VE3TO also says that it is necessary to neutralize the amplifier carefully, otherwise the signals are likely to have "tails."

RK-20 Keying Circuits

Two circuits for keying the suppressor of a transmitting pentode such as the RK-20, suggested by Herbert Hoover, Jr., W6ZH, are shown in Fig. 4. Both operate on much the same principle — that of cutting off plate current by means of negative bias on the suppressor grid — the first being for direct keying and the second keying through a small triode.

An auxiliary supply of about 400 volts, used both for control-grid and suppressor bias, is required. In circuit *A* with the key closed the suppressor is 45 volts positive with respect to the cathode, the positive voltage being obtained from a tap on the plate-supply bleeder. With the key open, however, the suppressor becomes 400 volts negative with respect to the cathode, the plate current being blocked off completely under these conditions. The 50,000-ohm resistor has no effect on the negative bias voltage, being in the circuit simply to limit the current flow through the key circuit when the key is closed.

In circuit *B* the positive suppressor potential is supplied through the plate-cathode circuit of a triode such as the 56. The cathode circuit of the 56 is completed through a 50,000-ohm resistor and the tap on the bias supply, the tap being adjusted to give plate-current cut-off on both the 56 and the RK-20 with the key open. When the key is closed, the grid potential of the 56 becomes positive, the plate resistance of the keyer tube drops to a low value and the voltage applied to the suppressor or the RK-20 is approximately 45 volts positive. The value of the resistance *R* in series with the key can be adjusted to give the necessary positive grid bias to the 56 under key-down conditions. It may not be needed at all, although some resistance at *R* will be helpful in preventing flow of grid current in the 56. The advantage of the tube-keying circuit is that the suppressor circuit is not interrupted by the key itself with the result that keying transients are reduced. The time-lag in the keying can be made almost any value desired by proper proportioning of resistors and condensers, since the keyed current is practically zero.

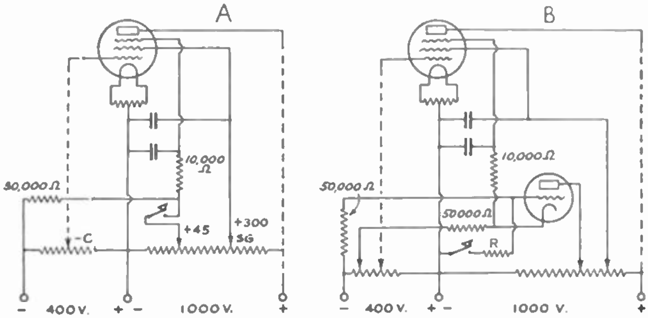

FIG. 4 — SUPPRESSOR-KEYING CIRCUITS FOR TRANSMITTING PENTODES

Grid Keying With Bias Supply

Using a four-stage transmitter, the bias problem is something to worry about, along with the usual ham trouble, key clicks and thumps. With a separate bias supply of about 400 volts, it is a simple matter to get cut-off bias for an 852 at 2000 volts. But using the common voltage divider caused the bias on the 852 to increase to as much as 425 volts under key-down conditions, when it should be around 180.

The scheme shown in Fig. 5 is self-explanatory. The two 10 stages are biased about the same as the 852 (190 volts). In the grid lead of each tube

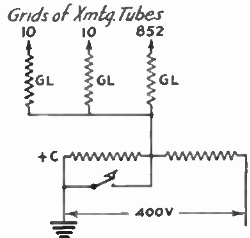

FIG. 5

is a leak of the proper value, assuming resistor bias is being used. When the key is closed, it shorts out the fixed bias from the pack and falls back upon the resistor bias. The voltage divider used is 30,000 ohms, and shorting out about half of it throws no particular load on the bias supply.

This arrangement is used here to control three stages of my transmitter and it works FB. The key clicks are gone, and no thump filter is used on the bug. No hot key, no strong back-wave, and bias always on the tubes with the key open.

— *Theron Darrow, W8AZQ*

More Blocked-Grid Keying

If separate power supplies are used for the exciter and final amplifier stages, blocked-grid keying of the final can be accomplished quite easily without any auxiliary equipment except an inexpensive resistor and possibly a by-pass condenser. The idea is simply to use the exciter plate supply to furnish blocking bias for the amplifier.

An arrangement used by Peter Fakkema, W7AJ, with a two-stage transmitter consisting of a 59 Tri-tet oscillator and 10 amplifier, is shown in the upper diagram of Fig. 6. With the key open, the 300 volts from the oscillator supply is connected in series with the amplifier grid return to filament center-tap through the high resistance R. R is 100,000 ohms or more; its value is not critical, but it should be high. R acts in the combined capacity of a very high-resistance grid leak for the amplifier when the key is open and as a current-limiting resistor for the 300-volt supply when the key is closed. With the key closed, the amplifier grid bias is supplied solely by the regular grid leak. The filament by-pass condensers, C, should be capable of standing the oscillator plate-supply voltage.

A somewhat similar scheme has been used by the editor for some time with the general-purpose transmitter described in January 1935 *QST*. In this case the low-voltage supply for the oscillator and buffer tubes supplies both operating and blocking bias for the final stage. The lower circuit diagram of Fig. 6 shows the essential details. With the key open, the grids of the 801 amplifier tubes get the full 450 volts of the low-voltage supply through R_1, a 50,000-ohm 2-watt resistor. With the key closed, that part of the low-voltage bleeder between negative and the tap to which the key is connected serves as a combined grid leak and bias supply. A few slight changes are necessary in the circuit diagram given on page 17 of January 1935 *QST*. The grid leak, R_3, should be removed and a separate bias terminal brought out. For insulating purposes a fixed condenser should be connected in the common r.f. line between the final and exciter stages, as shown at C_1 in Fig. 6 herewith. In operation, the tap on the low-voltage bleeder should be set to cut off the amplifier plate current with excitation removed; when excitation is applied the bias will increase beyond cut-off because of the flow of grid current

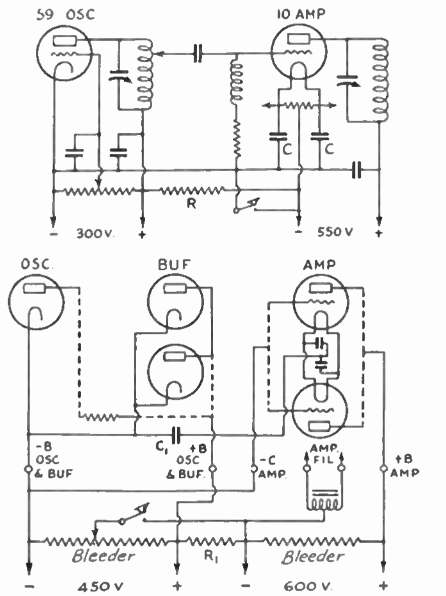

FIG. 6 — BLOCKED-GRID KEYING SYSTEMS USING EXCITER PLATE SUPPLY FOR BLOCKING BIAS

R and R_1 are high resistances of the order of 50,000 to 250,000 ohms. C and C_1 are insulating condensers having a rating of about 1000 volts for low-power transmitters.

through the biasing portion of the low-voltage bleeder.

Key thumps can be eliminated quite readily with these keying arrangements. A filter consisting of two air-core chokes, connected in series with each key terminal, with a 1-μfd. by-pass condenser across the chokes on the line side, has been very successful. The chokes were simply windings from some old 30-kc. i.f. transformers, or some 80-mh. chokes of the type used in receivers.

Oscillator Keying With Grid Leak Bias On Amplifiers

It is well known that oscillator keying offers many advantages. But lack of a bias supply for the buffer and final grids had me stumped until I cooked up the scheme here presented. The only requisite (for two reasons) is a separate power supply for the oscillator stage. In

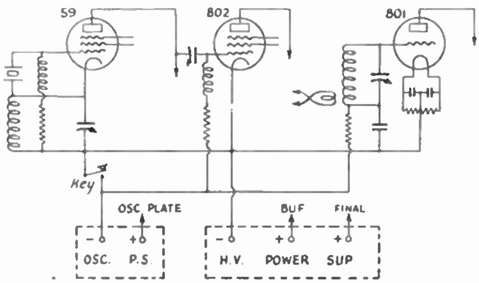

FIG. 7 — THIS CIRCUIT ELIMINATES THE NEED FOR FIXED BIAS ON AMPLIFIER STAGES FOLLOWING A KEYED OSCILLATOR

The blocking bias available is about 200 volts, which will take care of all low- and most medium-power tubes at normal plate voltages.

the first place, the plate voltage of a keyed oscillator (even with c.c.) should have good regulation, which it will not have if a tap on a voltage divider across a high voltage supply is used. The other reason will be obvious after a glance at Fig. 7, which shows the essentials of the circuit.

The negative terminals of the two power supplies must *not* be connected together. The cathodes and filament center taps of all stages are connected together and to one side of the key and negative of the high-voltage power supply. The d.c. grid return leads of the buffer and final are not connected directly to cathode and filament center tap, but are tied to the other side of the key at A and B and to the negative terminal of the oscillator pack. But don't move the grid leaks!

The system depends on the fact that when the key is open, a considerable voltage appears across it. (With 300 volts on my 59 Tri-tet, there are about 200 volts across the open key.) This voltage is used as negative bias on the amplifier grids to replace the grid-leak bias which exists when the key is closed. Incidentally, the key not only breaks the oscillator cathode current but also the grid current of the amplifier stages. But there seem to be no key clicks, and plate current to the buffer and final cuts off completely when the key is open.

— *L. V. Blake, W5FFZ, ex-W1IAT*

Crystal Oscillator Keying

Fig. 8 shows two crystal keying circuits which operate entirely on the r.f. portion of the circuit and break no d.c. contacts. That shown at A is used by Nat C. Smith, ex-W9UJ-W2CZU, who writes:

"This method eliminates the key clicks so that it is impossible to tell when the transmitter is keyed when listening to the receiver; no clicks, just a shushing sound, is the result.

"A relay is required. The contacts need not be very husky as no sparking is evident. The back contact of a s.p.d.t. relay is used.

"Pressing the key removes the ground from the crystal and the plate milliammeter will show normal current for the crystal in oscillation. When the key is released, the relay grounds the crystal and plate current rises about 25%. My oscillator with 375 volts on the plate has the following currents:

Crystal grounded — 40 ma.
Crystal oscillating — 25 ma.

"Naturally the stages following the crystal must be biased to practically cut off to prevent tube damage when excitation is removed."

A system operating on much the same principle

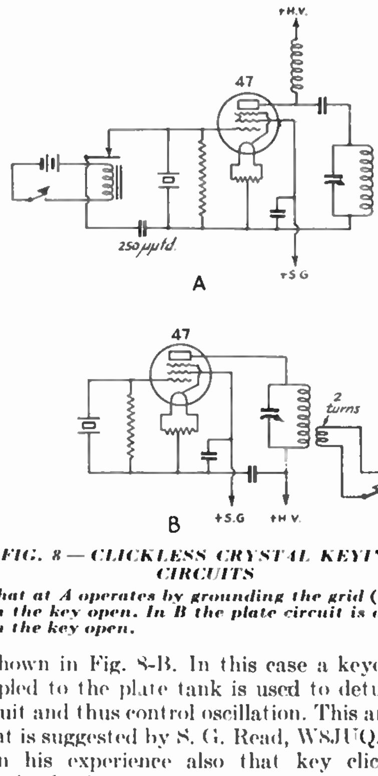

FIG. 8 — CLICKLESS CRYSTAL KEYING CIRCUITS

That at A operates by grounding the grid (for r.f.) with the key open. In B the plate circuit is detuned with the key open.

is shown in Fig. 8-B. In this case a keyed loop coupled to the plate tank is used to detune the circuit and thus control oscillation. This arrangement is suggested by S. G. Read, W8JUQ. It has been his experience also that key clicks are completely absent on a receiver in the same room.

The keying loop need have only about two turns, closely coupled to the plate coil. To tune, close the key and adjust the plate tuning for oscillation, tuning far enough on the high-frequency side of resonance to give clean-cut keying. When the key is opened the circuit is detuned and oscillations cease.

Keying the E.C. or Tri-tet Oscillator

In an attempt to get clickless and chirpless keying of an electron-coupled oscillator, the circuit of Fig. 9 was worked out by H. C. Cooper, W4CUW. Trials of other systems, such as straight cathode keying, breaking the −B lead, and so on gave plenty of clicks, but these were eliminated by keying across a high-resistance cathode resistor as shown in the diagram.

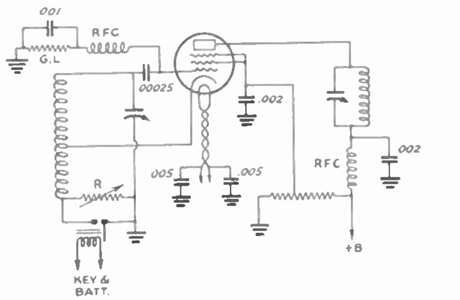

FIG. 9 — CLICKLESS AND CHIRPLESS KEYING SYSTEM FOR THE ELECTRON-COUPLED OR TRI-TET OSCILLATOR

The value of resistor R is discussed in the text.

With oscillator inputs up to ten watts there is no sign of a click in a b.c. receiver only a few feet away from the transmitter, which consists of a 59 e.c. oscillator (the keyed tube) and an RK-20 amplifier.

The value of resistor *R* should be adjusted, with the key open, to reduce the plate current practically to zero. W4CUW found a resistance of about 100,000 ohms to be satisfactory; the actual resistor used was an adjustable carbon-pile type taken from an old Majestic "B" eliminator. Somewhat more resistance was required with the oscillator converted to a Tri-tet; the actual value will depend somewhat on the particular crystal used, since some tend to "hang on" more than others.

The rig at W4CUW is keyed through a relay, as indicated in the diagram. The connections to the relay contacts should be short, since these contacts form part of the tuned circuit when closed. It should be possible, however, to connect a mica by-pass (about 0.001 μfd.) across *R* and use leads of any convenient length to the key. Should this be done, the relay may be omitted, the key itself being connected across *R*. There is no sparking at the contacts, and no thump filter is needed, at least up to the aforementioned 10 watts input.

—···—

Suppressor-Grid Keying

No doubt one of the simplest ways to achieve break-in operation with a multi-stage transmitter is to key the cathode circuit of the crystal oscillator and bias the following stages to cut-off. Many stations use this system and, while it does permit break-in operation, it often gives a somewhat chirpy note that isn't much of an improvement over a self-excited oscillator.

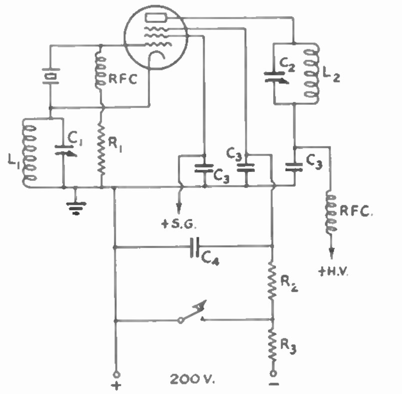

FIG. 10 — SUPPRESSOR KEYING OF A TRI-TET OSCILLATOR

C_1 — 150–250 μμfd. variable.
C_2 — 50–100 μμfd. variable.
C_3 — 0.005 μfd.
C_4 — see text.
R_1 — 50,000 ohms.
R_2 — see text.
R_3 — Bleeder resistor, 30,000–50,000 ohms, 2-watt.
L_1, L_2 — Suitable to tune to desired frequency.

Even if it doesn't chirp, the thumps and clicks are often difficult to eliminate.

One method of keying that will allow break-in operation right up to the frequency of the crystal is that shown in Fig. 10. A Tri-tet oscillator is used, with suppressor-grid keying as outlined previously.[1] Using a blocking voltage of 200 volts or so (which may be obtained from an old receiver power pack, or your present bias supply), perfect cut-off of output is obtained. There is the advantage that, since the crystal is running all of the time, there is no chirp with keying. The receiver will pick up the radiation from the cathode circuit of the oscillator, but ordinarily this will be no stronger than an S8 or S9 signal, when the transmitter is in the same room as the receiver. By shielding the oscillator this signal will be greatly reduced.

R_2 and C_4 constitute a lag circuit that eliminates any thumps. The resistor and condenser can have practically any value, so long as their product (ohms times micro-farads) is around 5000. It is not wise to have the value of resistance too high, especially if the suppressor-grid has a positive voltage impressed on it when the key is down, as shown in the article referred to; 5000 or 10,000 ohms is about right.

This circuit has been tried using an RK-25 and also an 89. Both gave clean keying with the output circuit tuned to either the crystal or to the second harmonic.

— *W1JPE, ex-W6CAL*

[1] Grammer, A Medium Powered Transmitter for 7, 14, and 28 Mc. *QST*, October, 1936, page 17.

A Different Keying-Tube Circuit

The circuit shown in Fig. 11 was devised by the writer for W4BAT, who uses a single 10 Hartley drawing 60 mils at 550 volts. I believe it is about the ultimate in simplicity and

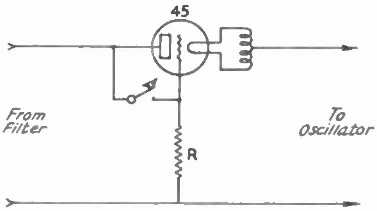

FIG. 11 — A VACUUM-TUBE KEYING CIRCUIT FOR ELIMINATING CLICKS

The resistor R may have any value which makes the current drain through it small when the key is closed. For a 500-volt plate supply W4IS used 225,000 ohms with success.

effectiveness. The tube drop is nearly negligible when a single 45 of normal characteristics is used to key the load mentioned. The cut-off is complete even though it would not appear so at first glance at the circuit. Actually the current is so low as to be scarcely perceptible on the milliammeter. The tube drop is very low because the grid is tied to the plate when the key is down, and there is no interfering (bias producing) resistor in the grid circuit when the key is pressed. The resistor *R* is nothing more than three solid carbon 75,000-ohm resistors in series which gives more than the necessary dissipation. There is no objection to tying the grid and plate together as under the conditions which exist the grid current is not dangerous to the grid structure. It is only when the grid is more positive than the plate that a damaging grid current would flow and this is not the condition in the circuit shown. Since W4BAT already had an extra 2½-volt winding on the power transformer, the cost at net prices was less than $1.00.

The key breaks the current which flows through the resistor, and since this current is of the order of a mil or so and is in shunt with the power supply, not in series with the load, any spark has negligible effect on the output of the oscillator. As a matter of fact the spark produced was not perceptible in daylight and was of no noticeable effect. A single 45 will suffice to key a load of 60 mils or more with small voltage loss. Without changing any constants two or more 45's or other types could be paralleled to key heavier loads. The keyer tube obviously will run cool as its internal resistance is made very low when the grid and plate are tied together. It is obvious also that the tube has less internal resistance than a rectifier or two-element tube of similar construction, as a result of the fact that the grid neutralizes the space charge with some degree of completeness when it is tied to the plate.

Of course the simple circuit shown can be applied to loads of greater current and voltage by using different constants. In any case the resistor *R* should be high and of sufficient size to dissipate the necessary heat. The formula $W = E^2/R$ will give the watts to be dissipated by the resistor when E is the voltage of the power pack and R is the resistance in ohms.

— *J. D. Blitch, W4IS*

Improved Keying-Tube Circuit

The circuit of Fig. 12, utilizing keying tubes with a fixed-bias supply for blocking, is suggested by J. O. Sales, W6HFF. He writes:

"An examination of the circuit will show that the internal resistance of the keying tube is in

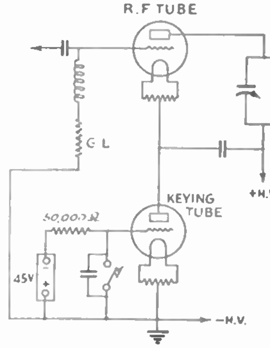

FIG. 12 — TUBE KEYING CIRCUIT

Values are for a Type 45 tube, to handle an r.f. tube comparable to the 10.

series with the center-tap return. This resistance is high with the key open, thereby giving very high bias and low-effective plate voltage on the tube being keyed. The bias on the keying tube need not be as great as in usual tube keying systems; the effective bias on the two tubes in series in the high voltage circuit blocks the plate current. The operation of the system is more positive than either grid-block or tube keying alone, and the current broken by the key is less. A slightly lower value of grid bias or leak than usual should be used because the plate resistance of the keying tube at zero bias is in series with the c.t. return (cathode bias) with the key down. This system works excellently with the crystal oscillator and allows break-in operation without any click in your own receiver."

Eliminating the Keying Relay Battery

In casting about for some cheap means of eliminating the one remaining battery in the shack — i.e., the 6-volt hot-shot to deliver 40 mils or so to the 150-ohm keying relay — the writer hit upon the simple but effective stunt shown in Fig. 13. The idea is to make the bleeder current (in this case that of the power pack supplying a 47 crystal oscillator and 46 buffer) do

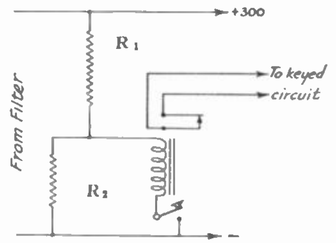

FIG. 13 — POWER SUPPLY FOR THE KEYING RELAY FROM THE LOW-VOLTAGE POWER PACK

R_1 is the regular bleeder resistor, 12,000 to 15,000 ohms. R_2 is 1000 ohms, 1-watt size. The keying relay is a 150-ohm telegraph relay. Any relay capable of working on 15 to 20 ma. d. c. can be used successfully.

something more toward the general cause besides generating BTU's in the resistor. With the key up, the bleeder resistance is 13,000 ohms, drawing 23 ma. With the key down, the resistance is 12,130 ohms, and, contrary to expectations, the current is within ¼ mil of 23 ma., since, although the resistance is lowered, the keyed load goes on the pack and pulls the voltage down to around 275 v.

The relation between R_2 and the resistance of the relay coil of course determines the amount of current flowing in the latter, and with the values shown this current is ample to actuate the relay (an ordinary telegraph relay is used here) at high "bug" speeds. The generally accepted current value for a 150-ohm instrument of this type is 40 mils, but the writer finds that this can be reduced to 20 mils and still give enough "range" for an application of this sort. The value of R_2 is not at all critical within a few hundred ohms. As low as 300 ohms will still allow enough current to flow through the relay to energize the windings, but the operation becomes feeble and the dots "light." The maximum power to be handled by R_2 (1,000 ohms) is 0.5 watt with key up — with key down it is negligible — and a 1-watt resistor is ample.

— *Arnold W. Lewis, VE4IY*

Keying-Relay Circuit Clicks

ANOTHER note on the old problem of clicks is sounded in the following dope from A. J. Thompkins, W6FBE:

"Am running a 650-watt c.w. job, crystal-controlled, on 7280 kc. in a full apartment building. As the rig is in a Westinghouse cabinet, the possibilities of slipping it into the building unnoticed were about as remote as bringing in a refrigerator under my vest. As a result I was blamed for all the radio interference in the place. That was not strange since I was causing a lot of it, especially in one museum piece.

"The problem was one of either changing my keying system or making it noiseless. This rig is keyed in the primary of the plate transformer which supplies the two final stages. By-passing the 110-volt line strangely did not end the difficulty, though it did stop blanketing. Tests showed that the arc at the key which in turn actuated the relay was causing the grief.

"A good friend who knows his engineering better than I made the remark that in the keying circuit I had introduced a lot of inductance, the coil of the relay. The good book tells us that this condition causes a current lag. Also if the voltage and current are out of phase there is more spark on the make and break of the key than if we have unity power factor. 'Well,' says the friend, 'put some capacity across the coil of your relay and balance up the circuit.' He suggested placing an a.c. milliammeter in the key-to-relay circuit and substituting condensers until a minimum reading was attained, which would indicate unity power factor. However, not having the prescribed meter, I took a chance on putting a mike of capacity across the coil. That must have been about what the doctor ordered, as the spark is cut to nearly no spark at all and now it is possible for me to run my broadcast receiver without interruption, and it is only about three feet from the transmitter and key.

"It may be argued that the trouble was coming from the arc on the relay but that was not the case as the interference was experienced when the relay was operated whether the transmitter was running or cold."

A Clickless Keying System

IN TRYING to eliminate key clicks entirely from the receivers of neighboring hams who were working on the same band, as well as to keep peace with the BCL's, I worked out a keying system which has undoubtedly been used before, but which deserves more general acceptance.

The scheme consists of keying the primary of a small B-eliminator power transformer, the rectified and filtered output of which furnishes the positive voltage for the shield and suppressor of the 59 doubler tube, as shown in Fig. 14. To make cut-off complete, a negative voltage from the regular bias supply is furnished to the two grids through a resistor. Since the primary of the transformer is keyed, it is necessary to supply the filament of the rectifier tube from a separate source.

Thus, when the key is open, the grids are made sufficiently negative to give cut-off — in my case about — 40 volts, while the control grid was being excited, and with 550 volts on the plate. When the key is closed, the grids go positive by an amount determined by the size of the transformer and the desired operating voltage. The filter on this supply should be not larger than necessary, since too much filter introduces lag.

The advantages of this system are: (1) Better keying due to the elimination of keying relays,

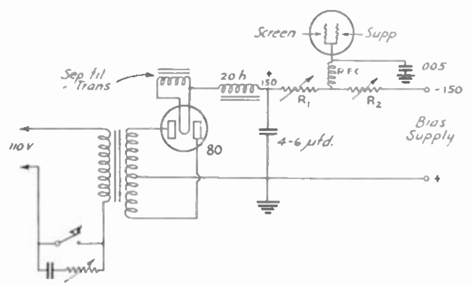

FIG. 14 — CLICKLESS KEYING SYSTEM FOR PENTODES R_1, R_2 ARE 0–1000 AND 0–5000 OHM VARIABLE RESISTORS, RESPECTIVELY

since the small current in the primary of the transformer can be broken directly by the key; (2) less BCL QRM because the noise caused by breaking the small transformer primary is much more readily filtered out than the racket caused by breaking half a kilowatt.

— *W. N. Lambert, W9TBX, ex-9CSC*

— • • • —

Key-Thump Kinks

THE diagram of Fig. 15, showing the arrangement used to eliminate key clicks and thumps at W1AUN, is submitted in the hope that it may be of help to other amateurs who are bothered by the same trouble. It has taken a long period of experimenting here with all sorts of arrangements to find that the trouble was being caused by the high-frequency surges getting into the *110-volt supply line*, and being *wired* to most of the neighboring BCL sets, causing anything from an ordinary click to complete blocking of the receivers.

In common with the average operator, I was very much against any arrangement which would decrease the power of my transmitter, but the circuit shown in Fig. 15 had not the slightest noticeable effect on the efficiency.

The parts were obtained from an old "B" eliminator, except for the condenser and resistance across the key. C_1 and C_2 are simply the condenser block from the eliminator, and L_1 and L_2 are the chokes. The 110-volt line to the power transformers should be run in BX cable with the metal covering grounded.

One thing seems to be very important in regard to the key connections. The wires from the key to L_1 and L_2 *must* be as short as possible. Wires only a foot long will radiate enough energy to be heard in a neighboring BCL set. Shielded cable with the shield grounded may be of help although I have not tried it. However, by locating the chokes directly at the key, and with the parts arranged as in the diagram, no interference is

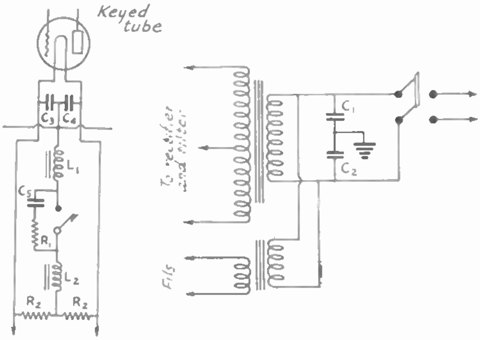

FIG. 15 — KEY-CLICK ELIMINATOR

C_1, C_2 — Filter condensers from "B" eliminator (p.5 μfd. or more each should be sufficient).
C_3, C_4 — Oscillator filament by-pass condensers (.002 or larger).
C_5 — 1 μfd.
R_1 — 10,000 ohms.
R_2 — Center-tap resistor.
L_1, L_2 — Chokes from "B" eliminator.

caused in a nine-tube superheterodyne located in the same house and having its aerial connected to the same pole as my transmitting antenna.

— *Gordon Wiley, W1AUN*

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A Cure for Blanketing

BCL trouble among about twenty-four b.c. receivers located in the same apartment building with my transmitter had refused to respond to traps, "broom-handle" chokes, filters, new antennas or changes in the operating frequency. This condition had caused self-imposed quiet hours for about two years. Key clicks and thumps were eliminated by conventional methods but blanketing remained very serious, especially in an old t.r.f. relic. The finally-discovered cure — and an absolute cure at that — was the insertion of one "pie" of a National R100 choke right at the antenna post of the BCL receiver. The cure was so complete that the owner of the aforementioned set, whose antenna is about ten feet from mine, does not know when this station is on the air, either with 'phone or c.w.

A word of instruction: Insert all four pies of the choke first, and tune the receiver to the highest-frequency b.c. station audible at the time. Cut out pies as necessary until the b.c. station maximum volume is slightly attenuated — not more than 25% by ear. One pie does the trick on most jobs, but in the case of an indoor antenna it is sometimes necessary to pull a few turns off even one pie. Save the other three pies — they are OK for the same purpose when mounted on a burned-out resistor.

— *J. Stanley Brown, W3EHE*

Washing Out the B.C. Interference

THE following note from C. W. Roth, ex-W9DOU, may prove of value in cases where keying interference is caused in nearby broadcast receivers — especially when investigation shows that the trouble is caused by overloading of the receiver:

"Here at W9DOU we had some trouble with slight clicks in our own broadcast receiver, and complete blocking of a neighbor's receiver. The description of the effect on our own set was that it was 'clicking,' but a careful check revealed that it was very slight blocking, fading the signals being received on the set when the key was pressed. Someone's seemingly foolish suggestion was followed, and a radio-frequency choke of the receiver type was connected in the antenna lead of the b.c. set, with the result that nothing was

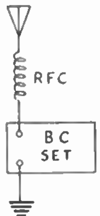

FIG. 16 — CHOKE IN SERIES WITH RECEIVING ANTENNA TO REDUCE INTERFERENCE TO B.C. RECEIVERS

received. Next a choke consisting of No. 26 enamel wound solid for about 3 inches on a piece of broomstick was tried, connected as shown in Fig. 16, and the difficulty was cured. This was on 80 meters.

"Finally the neighbors got tired of having holes chopped in their programs so they spoke up, and investigation showed that the 160-meter transmitter was causing their trouble. Accordingly a choke was again wound on a broomstick with No. 26 enamel, but between four and five inches long; it was tried close to the receiver in the antenna lead and everything was jake.

"No investigation has been made to determine whether or not the length of the choke is critical, but it apparently is not, for other hams having this same trouble, identified as 'clicks,' have cured it by winding chokes of the approximate dimensions given, with no case of failure to date."

—•••—

Parasitics and Interference

HERE'S a new angle on the ever-present key-click problem: the relation between key clicks (and 'phone interference as well) and parasitic oscillations. The following dope from B. P. Hansen, W9KNZ, tells the story:

"The new transmitter here has a pair of W.E. 242-A's in push-pull in the final, running up around 750 watts on c.w. and about 400 input on 'phone. Keying is accomplished by a d.p.s.t. Dunco a.c. relay. One pair of contacts closes the oscillator center tap. A split second later, the other one closes all high-voltage primaries. Thus the make click is taken care of by straight primary keying, since the primaries are closed with full load. On the break, the primary contacts break first, making elimination of this click easy also. Straight primary keying would give tails, but this is licked by the oscillator center-tap contacts opening a fraction of a second after the primary contacts have opened, thus cutting off the tails before they get a start.

"Now then, I've used this same relay, along with the same customary click filters, for a couple of years on a half-dozen rigs, including the bread-board version of the present one, and never had a squawk on clicks unless the margining of the relay got out of whack due to contact wear. This could always be corrected by re-margining the relay. But when I put this new rig into its steel cabinet and built the parts up on metal chassis, there were the clicks. There was also a nice batch of 'phone QRM to the BCL sets around the neighborhood. Bias to the final is obtained through a 10,000-ohm grid leak only — no fixed bias. One day, was re-neutralizing the thing after having made some changes and happened to put the plate voltage on the final with no excitation on it. The darn thing went right to town, oscillating merrily although the neutralization was perfect. Parasitics, of course. Slapped on a little fixed bias just to see, and sure enough, it took just a little fixed bias to make the final as stable as a rock. Well, a choke made of four turns of hookup wire, wound around a pencil and stuck in the socket grid lead, ahead of neutralizing condensers and everything else, cured that trouble completely. But, to my great surprise, it also cured the key-click trouble, every trace of it. And a hurried test on 'phone showed a remarkable improvement there. Many of the neighborhood cases simply cleared themselves, although of course there are still a few antiques that have some QRM. But, whereas wave traps had no effect before, they now effectively cleaned up the last trace of trouble.

"As it looks to me, it took a split second for the oscillator to start when the key closed. During the interval, there was no bias on the final because there was no excitation and the parasitic had a good chance to get going and put in a few dirty licks. Then, the oscillator got under way, excitation came through, bias resulted, and the thing may or may not have stopped. Probably didn't, because there was always trouble when I modulated. That parasitic may have had a half dozen or more different frequency components — it certainly had a honey in the five-meter band. This could give the effect of a transient resulting from the more common causes of clicks. I'm satisfied that it did.

"Then the hash from the 866's. After I got the clicks cleaned up I called W9KI who lives exactly across the alley from me. He gave me a clean slate on the clicks and the 'phone QRM but said there was some hash at several spots where he picked up my sigs. I closed the steel door of the cabinet that houses the transmitter and practically wiped that out. Also wiped out the harmonics from S7 to 8 to a mere trace of a signal. So it does seem that a completely enclosed, shielded rig has its merits, if only from the standpoint of local QRM."

Neon-Bulb Audio Oscillators

HERE is a neon bulb audio oscillator for monitoring keying and for code practice which can be assembled for less than $1.00. But let no mistaken ideas develop as a result of this neon oscillator being called a keying monitor. *It does not monitor the transmitted signal.* It has nothing to do with the frequency drift or shift or character (if any) of the emitted wave-form, such

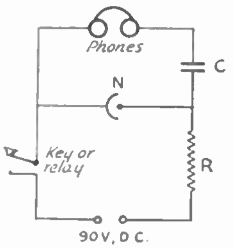

FIG. 17 — THE OSCILLATOR USED AT W9UZ
N — Westinghouse N-1 neon bulb.
C — 0.002 μfd.
R — 1.5 megohm.
Supply, 90 to 110 volts, d.c.

as it may be. Therefore, it does not replace the regular station monitor.

For monitoring keying during transmission the oscillator ought to be connected to the keying system in such a way that it may be used without putting the transmitter on the air. The output of the audio oscillator is supplied directly to the headphones or loud speaker, providing a means of continuously observing the manipulation of the key or bug, or whatever else it is that some amateurs use to splash out what is alleged to be International Morse. Since the oscillator can be keyed without cranking up the transmitter for code practice, by its use idle "air practice" may be reduced considerably.

The keying monitor in use at W9UZ is represented by the circuit shown in Fig. 17. The monitor is keyed with a small relay which is connected in parallel with the regular transmitter relay so that both can be keyed without putting the transmitter on the air. A changeover switch is used to switch the headphones from the receiver to the monitor. The neon bulb is a Westinghouse N-1, although any small neon bulb will oscillate. Several different types were tried. The applied voltage must be direct current, either from the receiver power supply or from batteries. If batteries are used, they may be the smallest size because the current flow is less than 100 microamperes (1/10th of a milliampere) and the batteries will last many, many months.

The mounting base is a piece of bakelite, 1/16th of an inch thick, 2½ inches wide and 4½ inches long. A grid-leak type of holder supports the re-

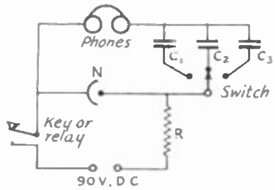

FIG. 18 — A THREE-FREQUENCY CIRCUIT
N — Neon bulb.
C_1 — 0.001 μfd.
C_2 — 0.002 μfd.
C_3 — 0.003 μfd.
R — 1.0 megohm.

sistor and makes possible a quick change when another audio frequency is to be used.

There may be some variation in characteristics of the neon bulbs; therefore, each oscillator should be adjusted to the desired frequency accordingly. Changing bulbs may cause the frequency to shift as much as 200 cycles per second. Varying the voltage by means of a potentiometer, or some other method which will permit small voltage changes, gives corresponding changes in the frequency of the note. An increase in voltage will increase the frequency, while reducing the amount of resistance or of capacitance also increases the frequency — and vice-versa. Normally, the neon bulbs break down (that is, they commence to glow) at about 100 to 115 volts. Relatively, this is unimportant because if some particular bulb does require as much as 105 volts, the desired frequency can be obtained by selection of the proper values of the condenser and resistor. Some bulbs will start to oscillate with 75 or 80 volts. It isn't necessary that the orange glow of the bulb be as bright as an airport beacon — the output does not increase materially with increase

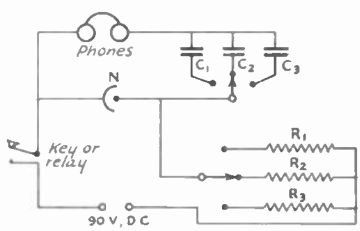

FIG. 19 — THIS ONE GIVES A WIDE RANGE OF TONES

N — Neon bulb.
C_1 — 0.001 μfd.
C_2 — 0.002 μfd.
C_3 — 0.003 μfd.
R_1 — 0.5 megohm.
R_2 — 1.0 megohm.
R_3 — 2.0 megohms.
E — 90 to 110 volts, d.c.

in brilliance of the glow. The Westinghouse N-1 neon bulb may be identified by the two spiral conductors inside the glass envelope. It fits the standard candelabra socket.

Numerous combinations are possible, giving circuits which are very flexible. The circuit of Fig. 18 provides three frequencies, three condensers of different values being connected together at one terminal while their other terminals are connected to a three-point switch. By switching from one condenser to another, different notes are selected. Another possible combination would be to arrange several condensers which could be connected in parallel by means of a switch. The circuit of Fig. 19 represents a selection of a greater number of frequencies, since each combination of condenser and resistor will generate a different frequency. To this, add a means of voltage variation, and every reasonable audible frequency is at the command of the operator. This is one of the most satisfactory devices for code practice— which, taken occasionally, doesn't do any harm at all.

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Neon-Bulb Oscillator for Tone Modulator

THE above article, covering the use of neon-tube audio oscillator as a keying monitor or code practice device, suggested another use for this simple and inexpensive equipment, to wit: tone modulator for i.c.w. on the 56-megacycle rig.

The writer, being an old-timer recently returned to amateur fold via the ultra-high frequency route, rather tires of 'phone at times, and has a hankering to oil up the old bug and have some QSO's in

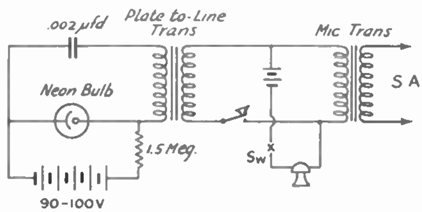

FIG. 20—NEON-BULB OSCILLATOR FOR TONE MODULATION OF THE 56-MC. TRANSMITTER

Condenser C and resistor R are 0.002 µfd., and 1.5 megohms, respectively. The microphone switch should be open when the tone modulation is used.

code. He debated between buzzer tone and a triode oscillator, until Mr. Schnell's timely suggestion came forth. The neon tube settled the question.

A few minor changes in the circuit were made as shown in Fig. 20 and the old-timer was on the air, with FB reports from all parties contacted.

Keying the output instead of the battery circuit resulted in a more constant frequency.

— *Ralph E. Henry, W6MXC*

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Relayless Monitoring

MANY keying monitors and oscillators have been described in these pages, but never one which has satisfied the needs of this station, as well as others who are operating under the same conditions.

We wanted a system requiring no batteries or relays, to go with the 59 Tri-tet exciter unit, keyed in the oscillator negative lead, in use here. The circuit finally used is shown in Fig. 21. Most of the apparatus can be fished out of the old junk box.

It makes a difference which way the leads to the audio transformer are connected. If it fails to oscillate the first time reverse the leads on one

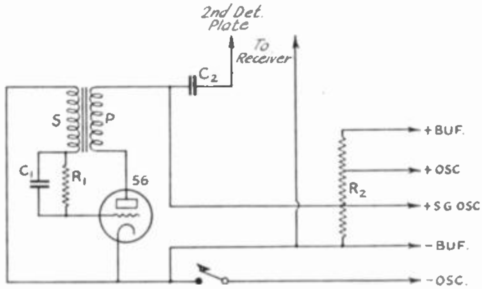

FIG. 21—KEYING MONITOR, USING AN AUDIO OSCILLATOR, WHICH REQUIRES NO RELAYS FOR SIMULTANEOUS KEYING OF AUDIO OSCILLATOR AND TRANSMITTER

C_1 — 250 µµfd.
C_2 — 0.003 µfd.
R_1 — 1-3 megohms.
R_2 — Crystal oscillator voltage divider.

side. Be sure to get the negative lead to the audio oscillator on the proper side of the key or bug in order to make and break the contact to the oscillator.

As shown in the diagram, the audio oscillator gets its plate voltage from the screen grid tap on the exciter voltage divider, the negative lead on both audio oscillator and crystal oscillator being keyed simultaneously. Incidentally the rig works well on voltages down to ten volts.

The signal from the keying oscillator is fed to the 'phones on the plate side of the second detector and keying can be monitored right up to your own frequency. A change in the note to suit the operator's fancy can be obtained by using various values of grid leak, although we found around one or two megs the best.

— *D. C. Strawn, W6AXN*

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Monitoring Audio Oscillator With Keyer Tubes

FIG. 22 shows a keying system which needs no relays but will key both the transmitter and a monitoring oscillator. An audio oscillator and a set of keyer tubes with their filament transformer are all that are necessary. As shown in the diagram, the audio oscillator is used as a grid leak for the keyer tubes, the output of the oscillator being fed through C_1 to the headphones or speaker used for reception. A standby switch may be necessary if the receiver clicks badly. At the other end of the circuit the keyer tubes are connected in parallel. The key is connected to the grids and to one side of the filaments. A center-tapped resistor is not necessary. A by-pass condenser or r.f. choke should be inserted in the keying line to keep r.f. out of the keyer tubes

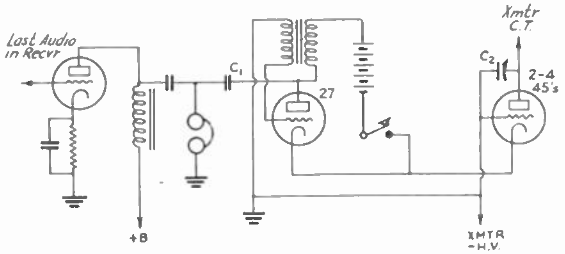

FIG. 22 — AUDIO OSCILLATOR FOR KEYING MONITORING COMBINED WITH TUBE KEYING

C_1 — 0.0025 to 0.05 μfd., mica.
C_2 — 0.002 to 0.06 μfd., mica.

and the oscillator. The plates of the keyer tubes go to the cathode of the stage to be keyed and the grids go to ground (B negative). If the crystal oscillator is keyed, break-in operation is possible and the system is very smooth, since one pair of 'phones handles both receiving and monitoring.

— *Jack Allen, W7ELG*

"B" Power for the Keying Oscillator

A SIMPLE method of supplying plate voltage for an audio keying oscillator — and incidentally keying the oscillator as well — is shown in Fig. 23. It is a suggestion of J. C. Nelson, W8FU, who is using it with a single 46 in the final stage.

The resistor *R* is a variable having a value of about 400 ohms. It is simply adjusted to give

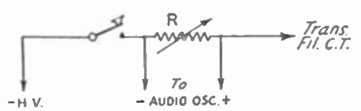

FIG. 23 — A CIRCUIT FOR OBTAINING PLATE VOLTAGE FOR AN AUDIO KEYING OSCILLATOR

Besides eliminating the necessity for a plate supply for the oscillator, this system requires no keying relays.

sufficient plate voltage for the audio oscillator. Since the resistor acts as a cathode biasing resistor, it is desirable that the voltage drop across it be kept as low as possible. Since the audio oscillator should not require more than 20 or 30 volts, the drop in plate voltage can be considered negligible.

One advantage of the system is that no keying relays are required to take care of the audio oscillator.

Break-in Plus Monitored Keying

THE idea contributed by W8FU suggests the further possibility of a complete break-in system without any relays or other moving parts.

The circuit is shown in Fig. 24. The receiver and transmitter negative terminals are grounded at a common point. When the key is pressed three operations occur simultaneously: The receiver output is grounded; the transmitter is put into operation, and the audio oscillator puts a signal into the 'phones.

When the key is released the transmitter and audio oscillator cease to work, and the receiver output is connected to the 'phones.

Several precautions should be observed. The leads carrying audio frequencies should be kept short. The key should have as little capacity as possible, otherwise the received signal may be by-passed to ground through this capacity when the key is open. A navy type key, i.e., without a metal base, is satisfactory. The two

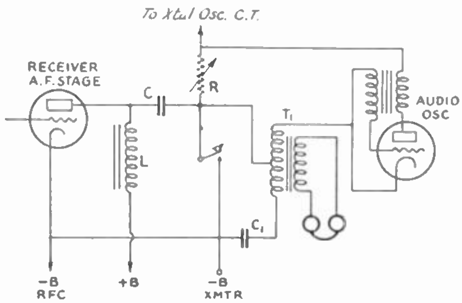

FIG. 24 — COMBINED MONITORING AND BREAK-IN SYSTEM WITHOUT RELAYS

L — 30-henry choke.
C — 0.5-μfd.
C_1 — 0.5-μfd.
R — 400-ohm variable resistor.
T — Audio transformer.
T_1 — Push-pull output transformer.

wires going to the key should be placed several inches apart and kept short.

For break-in operation the crystal oscillator should be keyed. Since the oscillator takes a small current, sparking will be negligible.

The idea is presented for what it is worth, because the writer has been unable to get the equipment to see if it is practicable.

— *Richard Libertucci*

Simple Keying Oscillator

THE audio oscillator described here is the height of simplicity and has been in use at W2DBQ for a number of years. It makes use of a dynatron audio oscillator which is keyed simultaneously with the transmitter. No relays are used. Power is supplied from taps on the receiver "B" supply. A small bakelite panel on the operating table holds the double-pole double-throw switch for the 'phones.

The only pitfall to watch out for is to be sure that negative sides of both the "B" supply and

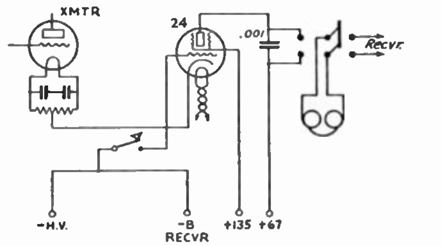

FIG. 25 — A DYNATRON AUDIO OSCILLATOR FOR MONITORING KEYING

The audio tone obtained will vary with different types of headsets and with the capacity of the fixed condenser in the plate circuit. It should be possible to change the tone over a fair range with a given headset by varying the capacity.

the transmitter power supply are on the same side of the key. If they are put on opposite sides, the dynatron oscillator will act as a high resistance in the center tap of the keyed transmitter stage, and will permit the tube to draw low plate current. It will be seen that this system can only be installed where center tap keying is utilized; no experiments have been conducted in regard to using it with grid block or other keying systems.

— *Richard E. Nebel, W2DBQ*

The newer screen-grid tubes are treated to reduce secondary emission from the plate, essential to dynatron operation. An old tube from the junk box may do a better job than a new one. — ED.

Break-in and Monitoring System

A COMBINED break-in and monitoring system which has given good results for about eight months on c.w., and which is now being applied to 'phone work at this station, is shown in Fig. 26.

Two relays are used, one taken from an old "B" eliminator unit, and the other being an a.c. telephone relay. If the system is to be used for c.w. alone, the contacts shown for the mike battery can be connected to the oscillator keying circuit, and the winding of Relay 1 connected to 3 volts d.c. When used for 'phone, the connections are as shown in the diagram.

In the transmitter there is a small Dunco 2.5-volt a.c. relay, with contacts in series with the high-voltage transformer. If the key is left closed, manipulating the a.c. relay in the transmitter will cause the relay system shown to operate automatically. Of course if a type of microphone requiring no current is used, the contacts shown for the mike battery circuit will not be needed except as mentioned above.

The system operates as follows:

When current passes through Relay 1, it closes the contacts to the grid circuit of the 112A, and puts about 50 volts positive on the grid. When the contacts are open, there is −22.5 volts on the grid. With the contacts closed, and the positive difference between −22.5 and 50 volts on the

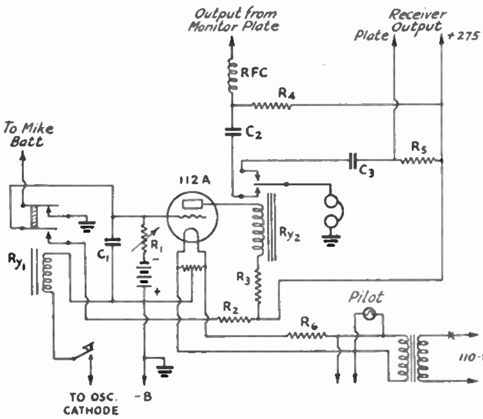

FIG. 26 — CIRCUIT FOR AUTOMATIC MONITORING WITH BREAK-IN

C_1 — 4-μfd. paper (not electrolytic) condenser, 300-volt rating.
C_2, C_3 — 0.1 μfd.
R_1 — 50,000-ohm potentiometer.
R_2 — 100,000 ohms.
R_3, R_4, R_5 — 25,000 ohms.
R_6 — 4 ohms.
Ry_1 — D.p.d.t. relay taken from "B" eliminator control unit, rewound to 75 ohms.
Ry_2 — Telephone relay, s.p.d.t., 100-volt, 20-cycle. The relay used has a d.c. resistance of 1000 ohms.

grid, the 4-μfd. condenser holds the charge, which leaks off at a rate governed by the 50,000-ohm potentiometer. The delay can be adjusted from 0 to about 1½ minutes, depending upon the adjustments of the relays, which, by the way, are quite critical for quick operation. Next, the plate current of the 112A operates the plate circuit relay, the contact arm of which is connected to one side of the 'phones. The other side of the 'phones is grounded. When the relays are open, the arm of Relay 2 rests on the receiver output side. When closed the arm rests on the monitor side, and will stay there after Relay 1 has been opened, depending upon the setting of the grid potentiometer. All voltages, except for the filaments, are supplied by the receiver, and the output of the receiver and monitor are resistance coupled against ground. Of course any type of coupling from receiver and monitor could be used so long as there is a common return for the 'phones, otherwise a d.p.d.t. relay would be required in the plate circuit of the 112A.

One can work virtual duplex with this system on 'phone by using the key and leaving the high voltage on. All that is necessary is to depress the key while speaking, and let it up when not speaking, the grid potentiometer being adjusted so that the 'phones will come back to the receiver, immediately the key is opened. Regardless of the switching method used, the system enables one to listen to what is being transmitted, whether c.w. or 'phone.

The only difficulty experienced at all was in adjusting the relays for operating at such low currents — 15 to 20 ma. oscillator plate current through Relay 1 and 6 to 10 ma. 112A plate current through Relay 2. All resistors, with the exception of the 112A filament resistor and the 50,000-ohm potentiometer, are of the 1-watt type, and all condensers shown are rated at 600 volts (working) d.c. The output tube of the receiver is a 56 and the monitor a 76. The plate resistors should be changed to suit any other type tube used. — *J. P. Neil, VE3PX*

Continuous Monitoring With the Regenerative S.S. Super

A method of monitoring transmissions which requires no switching, relays, or in fact any extra apparatus except the receiver and the regular heterodyne frequency meter has been devised by J. Stanley Brown, W3EHE. The transmitter is heard whenever the key is touched, the operation of the receiver being unaffected in any way. W3EHE writes as follows:

"Some good schemes of continuous monitoring have come out, but it is seldom that they made use of only essential apparatus and did not require a lot of relays, additional click filters, etc. A method of accomplishing the desired result is in use here and working OK within a few feet of a transmitter with 100 to 125 watts keyed input.

"The receiver used is a variation of James Lamb's regenerative single-signal job with an r.f. stage added. Except for a separate single wire receiving antenna, at right angles to the regular transmitting Zepp, the only other piece of equipment used is the station freqmeter. A front-of-panel pin jack is connected to the cathode end of the r.f. regeneration control resistor, and a 'phone cord connects this jack to the output jack on the freqmeter or monitor. The freqmeter is tuned to intermediate frequency higher or lower than the transmitting frequency and the signal comes out of the usual receiver output circuits.

"If it is too loud, coupling to the transmitter can be changed or, better still, just turn the regeneration control and shunt some of the signal voltage to ground. With all of the resistance cut out the signal goes to zero. This circuit arrangement also makes a good 'phone monitor.

"A few points about the operation: The strength and stability of the monitored signal is independent of the r.f. tuning adjustments of the receiver. It works up to within two or three kc. of the transmitting frequency before being blocked out, and can be used at the transmitting frequency if the plate voltage on the r.f. stage is cut off with a switch. The r.f. gain control can be used for similar results.

"Keying of the crystal oscillator in the cathode is one of the best ways of getting rid of key clicks, although even then some click filter usually is necessary. This system of monitoring and break-in is at its best only when key clicks are practically eliminated."

More on Switchless Monitoring

The monitoring scheme outlined by W3EHE has the hearty endorsement of Roy A. Jenkins, W6RB, who worked out the same type of system independently for use with the regular non-regenerative type of superhet. W6RB makes no provision for introducing the transmitter signal into the receiver, depending upon stray pickup for the purpose. He writes:

"The method allows break-in, provides a constant check on actual signal transmission, requires no relays, no extra phones are needed, nor is any switching whatever used. The fact that the monitoring signal is the same strength regardless of the receiver setting is in itself enough to make this scheme desirable.

"To put it into operation, the receiver, transmitter and frequency meter are all allowed to warm up a bit. If the oscillator is not keyed, rotate the freqmeter dial until the beat against the transmitter is heard in the receiver. Turn the receiver dial just a bit and see if the beat disappears. If it does, turn the freqmeter dial until another beat, one which does not disappear when the receiver is tuned, is heard. The beat is then on the intermediate frequency of the receiver and must necessarily remain unchanged when the receiver is tuned. When the oscillator is keyed, the key must be closed but the succeeding stages need not be operating unless a louder signal is desired. It should not take longer than five minutes to make the whole test; after that changes can be made to secure proper signal strength in the receiver.

"One point worth mentioning is that the receiver is equipped with a crystal filter, only the two transformers of which are shielded. Since the phasing condenser, shorting switch, crystal holder and socket are all unshielded there may be more signal picked up in this receiver than in one with the intermediate stages fully shielded. It may be necessary in some cases to leave the shield cap off the first i.f. tube, couple a short wire to the grid leak and stick it out through the cabinet, or even couple the grid of the tube fairly tightly to the output of the freqmeter. Individual station equipment will require different adjustments.

"The oscillator here is keyed and perfect break-in can be used by holding the signal from the transmitter down to a level comparable to the received signal. This system was sought after primarily for listening to my sending while using a bug, but its other advantages are also important."

Monitoring Without a Monitor

HAMS using regenerative receivers have right at hand a means of monitoring their transmissions without providing any auxiliary apparatus except a tuning condenser and a switch. It can be done quite easily by following the diagram of Fig. 27, suggested and used

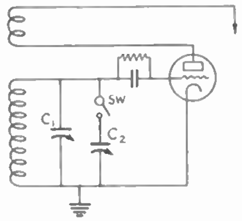

FIG. 27 — AN AUXILIARY TUNING CONDENSER AND SWITCH ADDED TO THE REGENERATIVE DETECTOR MAKE MONITORING OF TRANSMITTED SIGNALS POSSIBLE

by Dougall Whitburn, VK5BY. In this circuit — any regenerative circuit can be used instead of the tickler arrangement shown — the regular tuning condenser is represented by C_1 and the auxiliary condenser by C_2. For reception, switch *Sw* is open, cutting C_2 out of the circuit. When transmitting, *Sw* is closed, connecting C_2 in parallel with C_1, and the circuit is then tuned by means of C_2 to half the transmitter frequency so that the transmitted signal can be picked up on the second harmonic of the oscillating detector. Since the setting of C_1 is not disturbed, opening *Sw* again for reception leaves the receiver tuned to the station being worked.

The capacity required at C_2 will depend upon the constants of the tuned circuit. If C_1 is very small, a 150-μμfd. condenser at C_2 will be large enough to give the requisite tuning range. If the actual capacity used at C_1 to tune about to the center of a band is fairly large — say 50 or 100 μμfd. — C_2 should have a maximum capacity of three or four times the C_1 capacity in use.

Break-in Monitoring

A METHOD of continuous monitoring which works as instantaneously as the transmitting key, and at the same time eliminates the noise from the receiver so common on those systems which connect both monitor and receiver to a single pair of 'phones, is shown in Fig. 28. This scheme is a suggestion of C. W. Cashatt, W9JMX. Essentially, the method consists of a relay arrangement which disconnects the headset from the receiver when the key is pressed, the monitor being connected to the 'phones continuously. This arrangement is said to be noise-

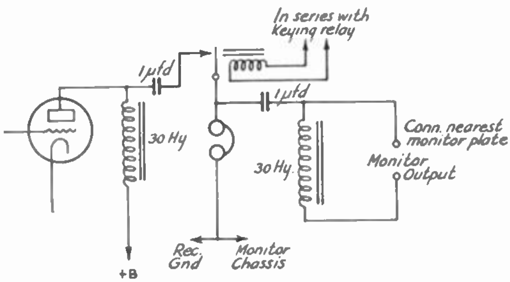

FIG. 28 — CONTINUOUS MONITORING WITH PROVISION FOR ELIMINATING RECEIVER NOISE WHEN TRANSMITTING

This circuit is readily applied when the transmitter is keyed through a relay.

less, since the relay breaks only a small current in the 'phone circuit.

Two audio chokes are necessary, one for the plate circuit of the receiver and the other for the monitor plate. The 'phones are condenser-coupled to both so that there is no d.c. in the 'phone circuit. The relay coil is connected in series with the keying relay, and the contacts should be arranged to open when the key is closed.

A Monitoring Kink

OWNERS of superhet receivers will be interested in this simple method of using their receivers as monitors. It is suggested by John N. Montgomery, 3rd, W8HWU, who writes:

"Here is a very simple monitor which costs nothing to build. Just place the send-receive switch in the lead from the first detector and r.f. tube cathode resistors to ground. When this circuit is broken the oscillator tube acts as a frequency meter-monitor when tuned to the local transmitter. This has worked on every super which we have tried it on, including several commercial receivers. It was tried originally to prevent r.f. in the antenna from burning out the r.f. gain control, but has worked so well as a monitor that I would not be without it. The only disadvantage is that the set has to be tuned to the transmitter in order that the signal may be heard on each transmission, which means that it must be retuned on each transmission during a QSO."

Single Control of Transmitter, Receiver and Monitor

THE diagram of Fig. 29 shows a simple device used here to overcome one of the minor irritations of operating. It should appeal to lazy hams. The purpose is to make one switch on the receiver panel do three things: first, suspend the operation of the r.f. portion of the receiver, second, to put the monitor into operation and third to apply plate voltage to the whole transmitter. It is still necessary to key the transmitter, however. Besides performing these functions it will reduce the power consumption due to

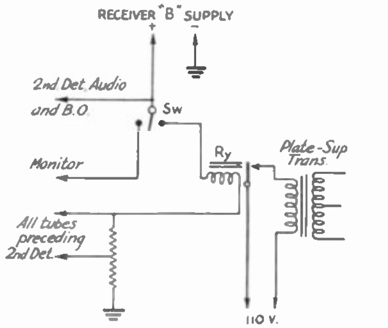

FIG. 29 — ONE-OPERATION CONTROL OF RECEIVER, MONITOR AND TRANSMITTER PLATE SUPPLIES

The relay, Ry, is described in the text. The switch, Sw, is a s.p.d.t. toggle switch, mounted on the receiver panel.

plate transformer and filter losses during listening periods, which with a large transmitter is no small item.

Referring to the diagram, the relay used is a Yaxley automatic power control, originally intended for use with a battery receiver to cut a B-eliminator on and off. The coil was rewound with No. 36 wire, which happened to be convenient, until the spool was full, and gave positive action on about 25 mils. The two sets of contacts are operated in parallel to increase the current-carrying capacity. The monitor, which is an integral part of the receiver, consists of an electron-coupled oscillator tuned to the signal frequency plus or minus the intermediate frequency, and loosely coupled to the second detector. This beats with the beat-frequency oscillator and puts an audible frequency through the audio system. The panel switch is a three-way toggle switch. Otherwise the diagram is self-explanatory.

— *D. C. Ketcham, W4BBX*

Audio Oscillator Keying Monitor Without Relays

W8GPF offers a keying monitor system adaptable to any keyed stage. His description follows: —

"The advantages of listening to an audio note which is keyed at the same time the transmitter is keyed have been pointed out by many operators. For the ham who is just getting used to his mechanical key or the old-timer who sends at high speed and likes to hear his sending ripple in his ear, the system has universal appeal. In all of the *QST* articles I have read on this subject most fellows have approached the subject by using two 'phone jacks, one for the audio oscillator output and one for receiver output. Variations of this are the d.p.d.t. switch which shifts the cans from the audio oscillator to the receiver, and so on. One good system employed spare contacts on the keying relay which shifted the 'phones from one output circuit to the other. In the composite transmitter of the Goodyear Tire and Rubber Company at Wingfoot Lake our chief engineer, Mr. Birdsall, approached what I would call the

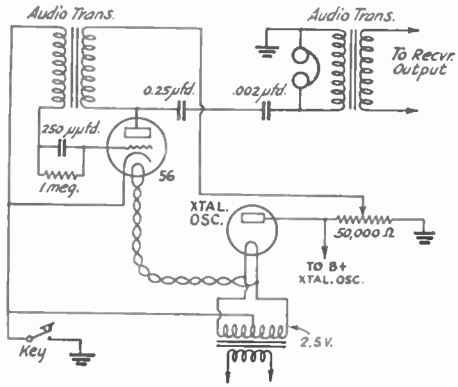

FIG. 30 — AN AUDIO OSCILLATOR FOR KEYING MONITORING WHICH CAN BE KEYED WITHOUT RELAYS SIMULTANEOUSLY WITH THE TRANSMITTER

Practically any type of interstage audio transformer can be used. The tone of the oscillator can be varied to some extent by changing the value of the grid condenser or leak.

utopian in this problem of what commercial radio calls 'howlers or side tones.' A keyed audio note is dumped into the 'phones when you are sending without having to touch a switch. It works in all cases. Those who cut the plate power on their receivers or those who use break-in operation can use this system.

"As shown in the diagram, Fig. 30, the audio oscillator employs a 56 which is keyed in the cathode circuit. The cathode lead is connected to the side of the key which is intermittently grounded as you key the center tap of your transmitter. The output of the 56 is fed through a 0.25-μfd. condenser to the audio transformer, which can be any old audio transformer which does not attenuate the output from your receiver too much. None of the circuit constants are critical and the plate voltage of the 56 as well as the filament voltage can be obtained by tapping into the crystal oscillator stage."

It can be observed readily from the diagram that the audio oscillator can be connected to any keyed stage so long as the power supply for that stage has a bleeder from which a suitably low voltage can be tapped.

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Sliding Bug Weight

It sometimes becomes necessary to change the speed adjustment of a bug during a QSO. Usually the set-screw on the weight is tight, and above all the operator gets a shock trying to change the dot adjustment. All this takes considerable time. Here's my way of solving the problem, and it may be helpful to others.

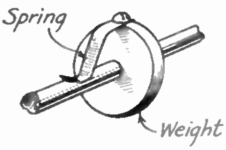

FIG. 31 — A SPRING CLIP ON THE BUG WEIGHT MAKES RAPID ADJUSTMENT EASY

A piece of spring brass with a hole in one end, such as a contact spring from the old type UX tube socket, is fastened to the weight with a short screw and the spring bent so as to place tension against the armature of the bug, as shown in Fig. 31.

The rest is simple. Whenever adjustment is desired it takes only one finger to reach over and slide the weight to any speed desired. If the spring tension is correct the weight will stay in any position indefinitely. — *D. B. Lane, W9BMA*

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Making a Bug Key

A home-made bug which eliminates the machine shop, mechanical engineers, cranes, etc., which are usually required in the making of even the simplest home-made bug, is being used here at W6AVQ; and although it has a rather strange and startling appearance, it works quite decently and can be made in any well-equipped kitchen or bathroom with very little struggle.

Briefly, the idea is to use a straight key set up on its right side with a couple of angles for the main part of the animal, and screw the vibrating spring onto the end of the arm. Thus in one swoop the tough question of bearings, main arm and one of the springs is disposed of.

Fig. 32 gives all the necessary details. The universal clips used for weights are easily adjustable for various speeds. They are the type our Hartleys used to bristle with before Hull got on the job. The angles are from the 5 & 10. The light spring carrying the dot contact is a prong contact from a Benjamin spring socket. Almost any light spring would do here. The vibrator spring is a one-inch piece of half-inch corset stay, with one-quarter inch bent at a right angle (it must be bent slowly as it is brittle) and drilled or punched at the unbent end for the back adjustment screw on the key. It is clamped under the locknut on this screw. The screw is lock-nutted to the bent end of the vibrator spring; a hole should be punched and the vibrating arm fastened securely. The rubber band balances the tension of spring near the dash contact so that the arm comes back to a middle position after a flock of dots. A light spring under the adjusting screw at the back of the key would look less queer, undoubtedly. The two sets of contacts should, of course, be connected in parallel.

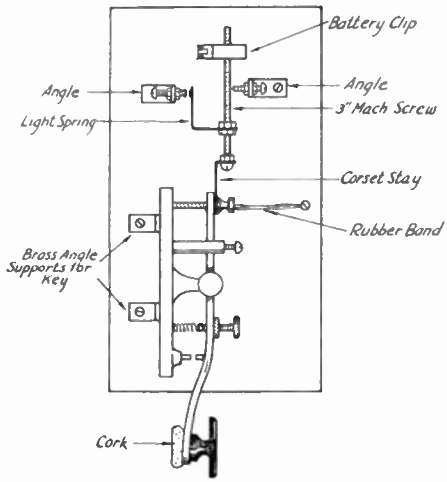

FIG. 32 — A BUG KEY MADE FROM AN ORDINARY HAND KEY

It was necessary to solder over each of the contacts on the dash end, making a solder to solder contact, as the high resistance of whatever Signal uses in his contacts made the dashes sound different from the dots (which have a low resistance path) in my monitor. A piece of cork glued to the under side of the regular knob makes the dot knob.

The adjustments of the thing call for much cut-and-try. The rubber band, the dash spring and the set screw at the back of the key are adjusted for about one-eighth-inch swing on the dot side and one-sixteenth on the dash side, with enough tension on each spring to bring the bar back firmly to the middle position. With the bar all the way over in the dot position, the contacts should touch with a slight tension on the spring carrying the dot contact. This makes a heavy dot. But the adjustments of home-made bugs have been explained many times; there is nothing different about this bug except the use of the straight key, which really makes the home-made bug a simple matter any ham can build. No more glass arms. . . . — *Frank Sullivan, W6AVQ*

6

Frequency Meters—Measurements

Freqmeter Calibration from B.C. Stations

Some of the fellows are unfamiliar with the fact that highly accurate frequency-meter calibrations can be obtained by utilizing signals that we have with us all day long and most of the night — every day of the year. Stations in the regular broadcast band are required to stay within 50 cycles of their assigned frequencies — better than .01% — and the fact that the assignments are all even multiples of 10 kc. makes it possible to get nice round figures for harmonic spots in the ham bands. We reprint here part of a note from E. Aymar, ex-W9HVA, outlining an excellent scheme for using the B.C. transmissions. The method requires only one easily-built oscillator in addition to the equipment ordinarily to be found in amateur stations, and can be used by anyone who knows what harmonics are and has a slight knowledge of arithmetic:

"The apparatus consist of two oscillators; one, the regular frequency meter, covering the 1715-kc. band; the second, using the same circuit, covering the broadcast band.

"The two oscillators, a receiver which can tune from 7000 to 8000 kc., and a B.C. receiver are all turned on, with the antenna posts strapped together. Let's tune in WLW on the B.C. receiver. Tune the broadcast oscillator to zero beat with WLW. Shut off the B.C. set. Now you could listen for the 5th harmonic on 3500, but there is an additional advantage in using the 10th at 7000 kc., as I will show later, though we found it most convenient to refer all readings to the 80-meter calibration chart. So we set the receiver near the edge of the 7000-kc. band, and then set the regular frequency meter to zero beat. This gives us one calibration point for the chart, which we will call 3500 kc.

"The same process will give us a 3550 point from WOR on 710, and a 3600 point from WGN on 720 kc. But that's not all.

"Since we are really listening in the 7000-kc. band, WLW will put an 11th harmonic on a point (7700 kc.) which when referred to the chart becomes 3850, and WOR gives us an additional point at 3905. Since we are working on the 3500-kc. curve we find it convenient to use the term '$5\frac{1}{2}$ harmonic,' although of course there actually is no such thing.

"The complete list of check points obtainable is much too long to write out here, but I'll tabulate a few so you can see how it goes. You can use practically every broadcast station for a check point by using one of the following harmonics: 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, 6."

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Spotting Frequencies

In case some experimenters may be having difficulties in getting "located" in making up tuned circuits for ten and five meters, we print herewith a letter from D. R. Stark, W8DUO, which outlines the "adjacent-harmonic" method of determining the frequency on which the transmitter or receiver may be set. The problem of identifying the order of harmonic picked up from a calibrated frequency meter working on a low-frequency band is considerably simplified by using this method. It has been outlined in *QST*, but may have been overlooked or be unfamiliar to some. W8DUO writes:

"A calibrated frequency meter is used, in the following manner:

"Set the meter to 1750 kc. and tune for a harmonic in the receiver under test. Then, leaving the receiver set at this point, tune the freqmeter slowly higher in frequency until another signal is heard. Suppose the meter reading is now 1842 kc. Next subtract these figures, (1842 − 1750) the difference being 92. Divide the larger figure by this difference ($1842 \div 92 = 20.02+$). This result, approximately 20, is the number of the harmonic of the *first* freqmeter reading: — in other words, the 20th harmonic of 1750 kc., or 35,000 kc.

"Another example: The meter first reads 1750 kc., with the next reading 1823 kc.

"Solving:

$$1823 - 1750 = 73$$
$$1823 \div 73 = 25 \text{ (approximately)}$$
$$25 \times 1750 = 43{,}750.$$

"Obviously the freqmeter must be read carefully, so that the result of the simple division comes out close to a whole number. If the dial reading were accurate to a few decimal places, the figures would come out in even numbers, but the rough reading will serve our purpose.

"The freqmeter may have coverage on any band, so long as two harmonics can be heard, and they may be any two figures. It is convenient to start with 1750 kc. or 3500 kc., since harmonics will then come at the low-frequency edges of the different bands."

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Extending the Freqmeter Calibration

PAUL E. GRIFFITH, W9DBW, 910-YA, State University of Iowa, at Iowa City, offers a practicable method of getting calibration points beyond the band limits.

"The amateur possessing a frequency-meter of the heterodyne type, calibrated in either the 1.75-Mc. or 3.5-Mc. band but operating in the 1.75-Mc. band, can easily extend its range on both sides of the band for which it is calibrated. All he needs is a receiver which will oscillate in the 14-Mc. band and an accurate calibration of his frequency meter.

"To find a point beyond the high-frequency end of the band, first multiply the frequency desired by seven and divide the product by eight. This will give the frequency in the calibrated portion of the band at which to set the meter. Set it there and tune your receiver until you find the eighth harmonic of this frequency, somewhere close to 14 Mc. Zero-beat it on the receiver and retune the frequency-meter to the other end of the band until a harmonic beats with the receiver. This will be the seventh harmonic of the freqmeter and will be the desired frequency that is outside the band on the h.f. end. If it is desired to find a frequency beyond the low-frequency end of the band, multiply the desired frequency by eight and divide the product by seven. This will give a setting of the meter in the high-frequency end of the calibrated portion of the band.

"An example may clear this up: Suppose it is desired to find the meter setting for 2020 kc. Multiply by seven: $7 \times 2020 = 14140$. Divide by eight: this gives 1767.5 kc., the point at which to set the frequency-meter. Zero-beat the harmonic of this and tune the meter past 2000 kc. until the next harmonic beats with the receiver. The point on the meter at which this occurs is the 2020-kc. calibration point.

—···—

Identifying the Freqmeter Signal on a Super

WHEN a heterodyne frequency meter is used in conjunction with a superhet receiver it is easily possible to be misled in checking frequency because of the nature of the receiving method. One way of avoiding confusion is pointed out by C. L. Roach, VE2BT:

"In using a frequency meter with a superheterodyne receiver, there are at least two places on the freqmeter dial (assuming that it covers a sufficiently wide band), where a signal on the receiver may be brought to zero beat, as follows:

"(a) Where the freqmeter frequency equals that of the incoming signal.

"(b) Where the freqmeter frequency equals that of the h.f. oscillator in the receiver.

"The first condition is the correct one, and here is a way to determine which frequency the meter is generating:

"Adjust the freqmeter to zero beat with the incoming signal, the audio beat oscillator of the receiver, of course, being turned off. Then detune the receiver slightly, which will change the frequency of the h.f. oscillator a small amount. If the freqmeter is on the incoming signal frequency, it will stay on zero beat, but if it is on the h.f. oscillator frequency, an audible note will be heard, rising from zero as the receiver is detuned. With this condition, it is obvious that a different setting will be required on the freqmeter to get back to zero beat, and it is possible to obtain a number of zero beat readings, depending on the receiver setting."

The same thing is true if the frequency meter happens to be set on the image frequency of the signal being received. In other words, the frequency meter is set on the received signal *only* when tuning the receiver slightly causes no change in the beat note between the two, the receiver beat oscillator being off.

—···—

Finding the 28-Mc. Band

THAT ten-meter band, where is it? Cut and try on the coils but nothing doing, no signals except harmonics from the e.c. frequency meter.

If we could only tell which harmonic we are hearing! We are hunting for 30,000 kc., which is the 15th harmonic of 2000 kc. So tune the meter to 2000 and zero-beat the receiver on the harmonic. Leaving the receiver set, tune the frequency meter — another harmonic! That looks interesting. The frequency of the fundamental of this harmonic is 1875 kc.

While tuning up the old think tank trying to zero-beat an idea, we start to play with the slide rule.

Now a slide rule is used to multiply and we do that little stunt. First we multiply 2000 by a number so as to give 30,000, the frequency needed; that number is 15. Then we try 1875 — but look at that, we don't have to move the slide at all, as 16 is opposite 1875 and 16 times 1875 is 30,000.

Thus, if we wish to measure a frequency near 30,000 kc. we have only to note what two fundamental frequencies will have consecutive harmonics at that frequency; that is, as in the illustration above, the fifteenth and sixteenth harmonic of the respective fundamentals will be equal, i.e., 30,000 kc.

Run the slide along until two numbers coincide with the two fundamentals; then the end of the scale will indicate the frequency of the receiver. This stunt helped me on 14 mc. when a queer frequency jump occurred in my detector. It jumped right over the 14-mc. band, and only this method told me what was happening.

— *C. E. Marsh, W6FFU*

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Freqmeter-Monitor with Dual-Purpose Tube

V. L. Daniels, W9IZL, Webster Electric Co., Racine, Wisconsin, has worked out an interesting application for the 6F7 tube as a combined electron-coupled oscillator and detector for the frequency-meter-monitor. The 6F7 is a new dual tube having a pentode and triode, entirely separate but using different sections of the same cathode, in one bulb. W9IZL uses the pentode portion of the tube as an electron-coupled oscillator and the triode as the detector. The circuit, complete with power supply, is given in Fig. 1.

W9IZL's frequency meter is contained in a metal box of small dimensions The power-supply apparatus can be kept down in size because the current drain is very low. Midget chokes and power transformers will do very well, the total current required by the tube being less than 10 milliamperes. The pilot lamp across the filament of the tube serves as a reminder to turn off the power when the frequency meter is not in use.

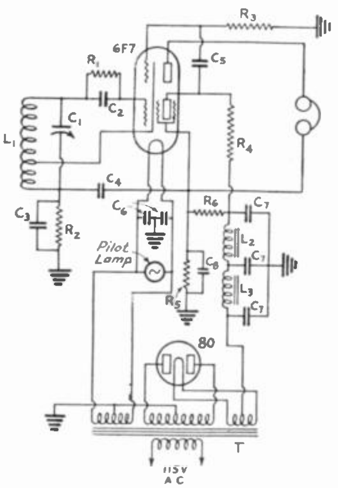

FIG. 1 — FREQUENCY-METER-MONITOR USING THE 6F7 TUBE

L_1, C_1 — Oscillator tank circuit. Preferably should be adjusted to cover the 1715–2000-kc. band with slight overlap at ends of tuning scale. Suggested constants are: for L_1, 90 turns No. 30 d.s.c. wire on 1-inch form, tapped 30th turn from lower end; for C_1, band-spread condenser having a minimum capacity of 50 μμfd. and maximum of 80 μμfd. The number of turns on L_1 should be adjusted to give suitable band-spread.
C_2 — 200 μμfd. mica condenser.
C_3, C_4 — .25 μfd.
C_5 — 0.002 μfd. mica condenser.
C_6 — 0.1 μfd.
C_7 — 8-μfd. electrolytic filter condensers.
C_8 — 1-μfd. electrolytic filter condensers.
R_1 — 100,000 ohms, 1 watt.
R_2 — 300 ohms, 1 watt.
R_3 — 1 megohm.
R_4 — 100,000 ohms, 1 watt.
R_5 — 20,000 ohms, 2 watt.
R_6 — 10,000 ohms, 2 watt.
L_2, L_3 — 20- to 30-henry, 25-ma. filter chokes.
T — Power transformer; high-voltage winding, 150 volts each side center tap; also 5-volt winding for 80 rectifier and 6.3-volt winding for 6F7 tube.

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Single-Tube E.C. Freqmeter-Monitor

Some time ago while reading an article explaining the operation of the 2A7 tube, I was struck with the idea of adapting this tube for use as an e.c. frequency meter-monitor. Inasmuch as this tube was designed for a very similar purpose, it seemed quite logical to suppose that this tube might have some advantages not possessed by other tubes commonly used in frequency meters. What experiments I have made seem to bear out this supposition.

The circuit used is shown in Fig. 2. Condenser C_5 is a homemade one, the capacity of which is unknown to me. However its capacity is without doubt close to that of the General Radio 556,

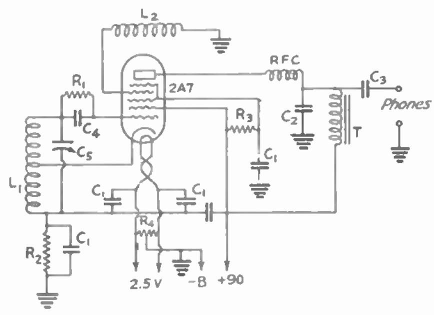


FIG. 2 — ELECTRON-COUPLED FREQUENCY-METER-MONITOR USING 2A7 TUBE

L_1 — 90 turns No. 28 d.c.c. on 1-inch form, tapped 30 turns from ground.
L_2 — See text.
R_1 — 10,000 ohms.
R_2 — 250 ohms.
R_3 — 50,000 ohms.
C_1 — .01-μfd. mica condenser.
C_2 — .0005-μfd. mica.
C_3 — .006-μfd. mica.
C_4 — .00025-μfd. mica.
C_5 — See text.
T — Audio transformer with primary and secondary in series.
RFC — See text.

since the inductance which it tunes is the same as that used in the frequency meter described in the *Handbook*. The radio frequency choke is a 3 to 1 a.f. transformer with the primary and secondary connected in series. Incidentally, it makes a difference in the effective impedance which way they are connected; I used an a.c. voltmeter to determine the right way. L_2 is the pick-up coil, and various sizes were tried here. As I use the frequency meter only for 80-meter band a coil of 65 turns (1-inch diameter) seemed to give the best results, but for other bands other sizes might prove to be better.

From my experiments the size of the pick-up coil doesn't seem to affect the frequency of the oscillator; indeed, it is possible to tune this coil with a variable condenser without affecting the frequency. The coil or even the grid cap of the tube may be touched with the hand without causing enough change in frequency to throw the oscillator off zero beat with either transmitter or receiver, and plugging headphones in or out has no apparent effect. The pick-up coil may be left outside the frequency meter-monitor shield box in order to obtain a good loud signal in the headphones. — *Lloyd L. Thornton, W8KDM*

Spreading Out the Calibration Curve

The accuracy with which frequency measurements are made depends to a large extent upon such purely mechanical things as precise reading of dials and calibration charts, as well as upon the goodness of the frequency meter itself. The use of a large sheet of cross-section paper and a large curve to make precise reading possible has therefore been recommended. But it is sometimes inconvenient to have to unfold a large curve sheet every time one wishes to take a reading, besides the difficulty of following accurately the lines from the margins to the curve without resorting to the use of a rule.

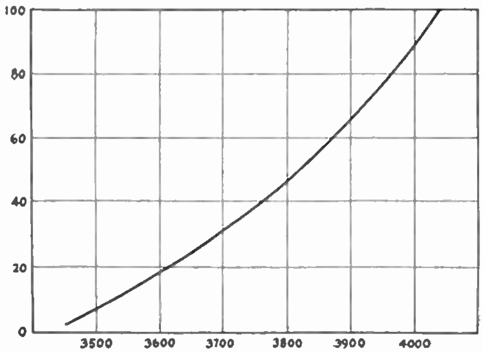


FIG. 3

A scheme called to our attention recently by one of our readers overcomes both of these objections nicely and makes it possible to fit a large curve into a small space as well as increase the ease of reading. It is best explained by reference to Figs. 3 and 4. In Fig. 3 we have a sample calibration curve occupying a 5 by 7 inch space on a sheet of ordinary cross-section paper, which has 20 lines to the inch. To avoid confusion only the lines spaced an inch apart are shown in the drawing. The calibration is assumed to cover the 3500-kc. band. This size of curve is easy to handle, but is difficult to read precisely because each dial division occupies only one-twentieth of an inch on the chart, and the nearest one can read is about a half division. The same is true of the frequency readings — the limit of precise reading is only about five kilocycles.

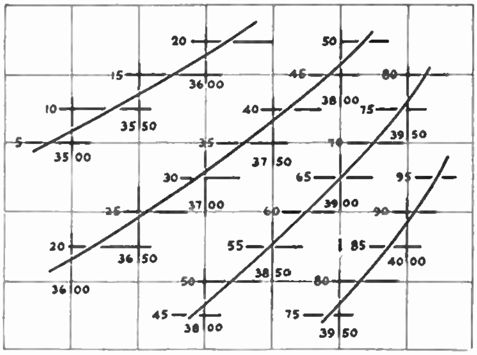


FIG. 4

In Fig. 4 the curve has been split into several sections, and the spacing has been doubled for both the dial and frequency readings, *without increasing the size of the sheet.* Each dial division now occupies a tenth of an inch, and the frequency can be read to 2½ kilocycles as easily as to five in Fig. 3. Besides this the chart is more easily followed because the values of ordinates and abscissas are plotted right on the curve.

The idea can of course be applied to any size of curve, and the sections may be chosen for the greatest convenience in use. For instance, the first section might include the phone band only, or might be drawn so that all of the 7- or 14-mc. harmonics would be on a single section.

In connection with plotting curves, it is a good idea to use a needle and make a small prick in the paper at the plotted points rather than to plot with a pencil. The advantages are obvious. The needle may be mounted in a wooden handle if many curves are to be drawn. Needless to say, the curve itself should be drawn with a hard pencil sharpened to a fine point or with a fine-pointed ruling pen, since a thick line is hard to read.

— *G. G.*

A Multi-Purpose Analyzer

The basic circuit of the analyzer, shown in Fig. 5, is that of an elemental vacuum tube voltmeter. Inasmuch as most amateurs are interested in comparative tests, it is not necessary to calibrate it. This immediately simplifies con-

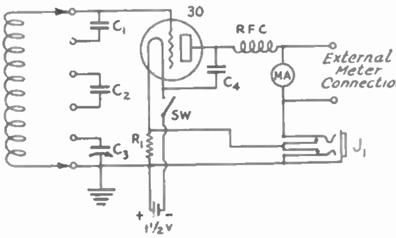
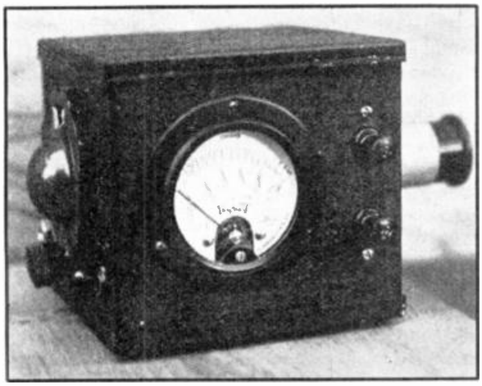


FIG. 5 — THE SIMPLE CIRCUIT OF THE ANALYZER

C_1 and C_2 — 50-μμfd. fixed mica condensers.
C_3 — 35-μμfd. midget variable.
C_4 — 500-μμfd. fixed mica by-pass.
RFC — 8-millihenry r.f. choke.
J_1 — Plate-battery jack, double circuit-closing type.
R_1 — 100,000-ohm ½- or 1-watt resistor.

struction and operation. When the 1½-volt cell is connected as shown, it supplies sufficient positive voltage to the plate of the tube to cause a plate current of approximately 80 microamperes to flow. If any audio or r.f. voltage is impressed on the grid, the plate current will increase as the applied voltage increases. As the one-milliampere meter used has a resistance of approximately 30 ohms, by the I^2R law we find it takes only 0.00003 watt (30 microwatts) to give a full scale deflection. It is evident that it takes very little input to give an appreciable reading. In fact, full scale on the meter requires less input than it takes to give a one-division indication on a current-squared galvanometer. If a tuned circuit is connected to the grid-filament, resonant at a desired radio frequency, it becomes apparent that we have a neutralizing meter *par excellence* at that frequency. In fact, it is so sensitive that it is all but impossible to get a minimum reading on the meter. Another point of interest is that the plate current is limited, since the plate potential is supplied by the filament cell. This makes it practically impossible to burn out the meter in a strong field. This is not true with instruments of the thermo-couple type, as many amateurs have found out to their sorrow.



THE HANDY ANALYZER IN ITS LITTLE CASE

The tuning dial is at the left end, the plug-in coil at the right. The binding posts are for external connections to the 0-1 milliammeter.

Another important use is the comparative measurement of antennas. Putting an ammeter in the center of a Hertz antenna and then giving it a haircut (the antenna, not the meter) is a laborious process. If the analyzer is set up near the free end of the antenna, in order to get as far as possible from the field of the transmitter and feeders, checking is much easier. If the amount of energy picked up is too small to give satisfactory readings, a short pick-up antenna may be connected to the grid side of the pick-up coil. The physical relation between the transmitting antenna and this wire should, of course, be kept constant during measurement. A crude indication of the field pattern may also be obtained by making checks of the meter readings at various points around the radiating system, thus putting the gadget to work as a field-strength meter.

With a resonant circuit required to develop the maximum voltage to secure the greatest sensitivity, it is evident that a calibrated absorption-type wavemeter is also provided as a feature at no additional cost. Some time ago this type of indicating device was the only one available for frequency measurement. Since the advent of the heterodyne type of frequency meter it has met with disfavor due to limited accuracy. While the heterodyne type of meter supplies a precisely-known fundamental frequency and a flock of harmonics, it is often a problem to identify the proper one.

The 35-μμfd. variable condenser and the two 50-μμfd. fixed condensers are connected to the six prongs of the sockets used for the plug-in coils. The filament terminals of the socket also connect to the grid and filament of the tube and the winding, of course, always connects to the filament terminals of the coil forms. By use of straps inside the different coil forms, between the pins, a wide variety of combinations of series and parallel condenser connections is available. The various combinations and the bands for which they are used, together with the approximate spread of each, are shown in Fig. 6. When a large band spread is available, care must be taken with the turns spacing. After the proper spacing is determined, the coils should be doped so that the relation between turns will not change.

With this device the frequency to which a receiver is tuned may be determined by the familiar "resonance click" method. Conversely, this is the method used in calibrating the various coil ranges. For transmitter measurements, with tube turned on the milliammeter can be read with the analyzer at a considerable distance from the transmitter.

Another important use is as an overmodulation indicator with which it is possible to determine easily whether the modulated amplifier or linear output amplifier is being operated properly. This is the reason for the cathode or filament bias resistor and the closed circuit jack which normally shorts out this resistor. If 135 volts of B battery are plugged into the jack, the bias resistor is automatically connected in the circuit and we have a linear detector. The plug should be in the jack before the battery is connected, as otherwise the batteries will short-circuit when the plug is inserted. Close coupling of the analyzer to the transmitter must now be avoided as the added plate potential supplies an ever-waiting current capable of wrapping the needle around the pin. "Kicks" with modulation show that there is over-shooting. It is obvious that by connecting 'phones in series with the batteries, an excellent listening monitor for 'phone is provided.

Still another use is as an output meter for receiver testing. By removing the coil and substituting a suitable resistance coupling unit, receivers of the superhet type may be readily aligned. Hum level may be checked and any improvement read directly on the meter.

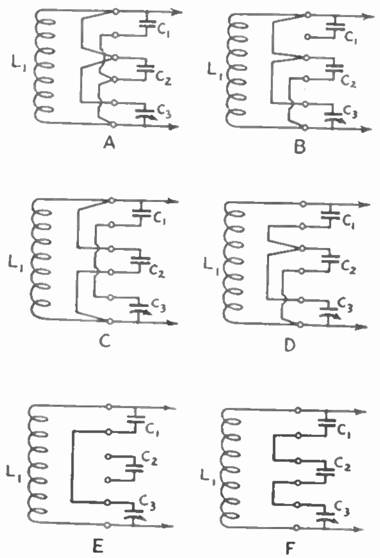


FIG. 6 — PIN CONNECTIONS AND COIL DATA FOR BAND-SPREAD TUNING OF THE ANALYZER

Diagram	*A*	*B*	*C*	*D*	*E*	*F*
Band, Kc.	*1750*	*3500*	*7000*	*14000*	*28000*	*56000*
Turns L_1	*50*	*27*	*12*	*7*	*4*	*1*
Divisions Spread	*95*	*80*	*70*	*80*	*60*	*70*

Constructional details require little comment due to the simplicity of the analyzer. The only precaution necessary in the wiring to the coil socket, tube, and tuning condensers is to make all leads as short and direct as possible. The various pin straps within the coils should also be short, particularly in the high-frequency coils. The meter should be mounted and wired in last to eliminate chance of damage to the meter during construction. The circuit should be carefully checked before inserting the tube and turning on the battery, as one mistake will convert the meter into a corpse for lamentation.

We have in the completed instrument a compact device, completely self-contained for most measurements. External connections to the milliammeter alone are provided by means of the two insulated binding posts. All of the uses mentioned concern radio or audio frequencies. But every amateur is also interested in the various d.c. currents and voltages around the shack, not forgetting resistances which have a habit of losing their labels. Hence the one-mil meter used is a stock Triplett type which has, in addition to the usual linear scale, a number of voltage scales, together with an ohmmeter scale. A companion unit, also utilizing this meter, provides voltage, current, and resistance measurements covering practically every amateur requirement.

— *D. A. Griffin, W2AOE*

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An Impedance Bridge

FIG. 7 is the circuit of an impedance bridge which I am sure many a ham would be able to use. I use it myself for balancing up *LC* circuits in the r.f. stages of receivers and for many similar purposes. The idea is to make up, say, the antenna coil and r.f. coupling coil of a short-wave super and connect one to each end of the bridge. If or when the inductances are equal there is no reading on the vacuum-tube voltmeter. Ganged condensers can be treated in the same way and checked right over their full scale. It is surprising what can be done in a tracking stunt like this. I have a super lined up with two r.f. stages and if you bend a grid lead out of shape it affects the a.v.c. meter.

A good method of checking is to use two resistances, one of 1000 ohms, fixed, and one variable to 1500 ohms. Connect the 1000-ohm standard to one pair of terminals (as 1 and 2) and the variable to the other pair; then find the point of balance on the 1500-ohm variable. Then if these are connected in series with the coils, condensers or resistors to be matched, you can tell at once whether it is a case of "too much or too little."

But before any measurements are made the bridge itself *must be balanced exactly*. This can be done by shorting terminals 1 and 2 together and

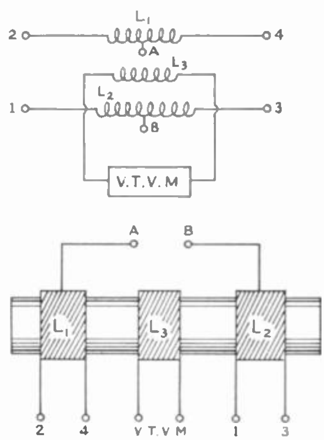

FIG. 7 — AN IMPEDANCE BRIDGE USEFUL FOR MATCHING COILS AND OTHER MEASUREMENT PURPOSES

L_1 and L_2 are each 30 microhenrys, centertapped; L_3 is the same without the center-tap. Various coil dimensions to give an inductance of 30 microhenrys can be secured by reference to the Lightning Calculator, Type A. For one-inch diameter tubing, a 30-μh. coil will have 32 turns of No. 30 d.s.c. or s.c.c. wire. It is advantageous to keep the coils small in the interests of maintaining circuit balance.

3 and 4 together. Make all coils alike and bring the circuit to balance by adjusting the coupling. The layout and leads should be as symmetrical as possible; a suggested arrangement is shown in the lower part of the drawing. The frequency I use, applied between terminals A and B, is approximately 500 kc. Don't forget body capacity when using the bridge. View it from a distance.

— *Maurice J. Kirk, Jamestown, S. Aust.*

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A Simple Photographic Recorder

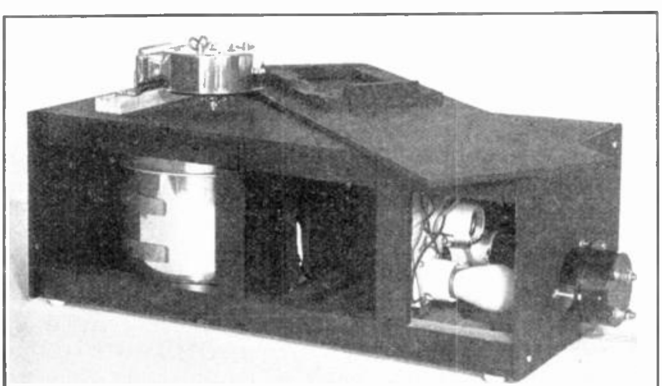
HERE is a gadget which may be hitched to a receiver, power line or other source of changing voltage and left to itself to make a picture of everything that happens.

This recorder was evolved with the thought that the most desirable possible basis for the instrument would be an ordinary standard meter operating under normal conditions. The job of transferring the movements of the meter needle to paper is done photographically with the simple scheme shown in Fig. 8. In this arrangement, the face of the meter is illuminated by two 10-watt lamps. An image of the meter face is then thrown, by means of an ordinary camera lens, onto the side of a drum carrying sensitive paper. A slit is then arranged immediately in front of the drum so that everything on the meter face is eliminated except an extremely small slice of the calibration marks and the needle. Then, as the drum rotates, the calibration marks record as straight lines while the needle produces a "trace" corresponding to its movement.

It is futile to attempt to describe in detail the construction of this particular recorder. Dimensions will all vary in accordance with the focal length of the lens used, the size of drum available and the desired size of the recorded image. Then, most workers will have their own opinions with respect to constructional methods. It might be well, though, to cover some of the more important basic requirements.

In this design, it was considered that a paper speed of two inches an hour would take care of the slow signal variations found on the ultra-high frequencies. Search was therefore made for a drum having a circumference of about 24 inches. An aluminum saucepan with vertical sides proved to be ideal for the job. The next item was the lens. An old *f* 4.5 anastigmat of 3-inch focal length was located and set up experimentally to determine the necessary spacings between the meter face, lens and drum. This was facilitated by using the torn edge of a piece of paper, well illuminated, in place of the meter. In this instance, the drum, lens and meter were so arranged that the image of the meter was exactly the same size as the meter itself. In this way, the preparation of the slit was facilitated. Any cheap lens from a drugstore box camera could be used instead of the anastigmat providing the illumination is increased suitably.

With the main dimensions available, construction of the box was begun, its length being such that the meter could be mounted an inch or so



THE "HOME-BREW" SIGNAL RECORDER WITH THE SIDE PANEL REMOVED TO ALLOW RELOADING OF THE DRUM

Recorders built according to this very simple scheme might well be widely used by experimentally inclined amateurs interested in observation work.

away from the box end. By doing this, provision was made for accurate focussing and also for visual examination of the meter dial with the aid of a "dentist's mirror." Ply-wood was used throughout for the box, corner pieces being fitted

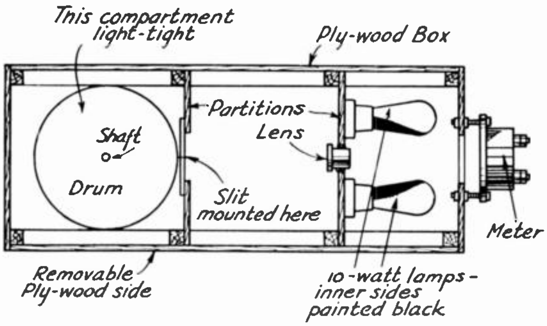


FIG. 8 — A SECTIONAL VIEW OF THE RECORDER SHOWING THE ARRANGEMENT OF THE DRUM WITH RESPECT TO THE LENS AND METER

to simplify construction and to avoid light leaks. The whole of one side was made removable so that the drum could be loaded conveniently and so that the lens or lamps could be adjusted or replaced.

After locating accurately the center of the saucepan lid and bottom, a 3/16-inch tapped brass rod was fitted for a shaft. Its lower end was made conical and supported in the end bearing of an old Cardwell condenser. The upper end of the shaft was connected with an ordinary flexible coupling to the hour-hand shaft of the clock. The paper clips on the drum were made from two pieces of thin brass rivetted at their centers to the drum wall.

Construction of the slit was simplified by using a piece of glass painted with Duco "Flat Black." The slit was then scratched with a pair of dividers set to the same radius as that of the meter calibration. The precise location of this slit is, of course, of prime importance. In our recorder it was set so that only the dial divisions representing tens of units crossed it.

A satisfactory sensitive paper for this work is known as "P.M.C. Bromide No. 1 Contrast." It may be developed with "Nepera Solution," or any of the scores of other paper developers available, and fixed in the usual acid fixer. The procedure is extremely simple and occupies but a few minutes.

Many possible changes in this design suggest themselves immediately. A more elaborate recorder we are now planning will have, for instance, a larger drum permitting a paper speed of four inches an hour. The drum will also be considerably higher and the focal length of the lens considerably longer. This will then permit the mounting of perhaps four or five meters one above the other so that simultaneous records may be made of several changing voltages. Some of the available meter holes may be filled with other instruments such as a hygrometer, barometer and thermometer. And that, by the way, is one very great advantage of this type of recorder, it will permit; the recording of many meters simultaneously, whether they be electrical meters or not, maintaining, all the while, the same order of accuracy inherent in the original instruments. Needless to say, the new recorder will have an electric clock movement in place of the present dollar's worth. —*R. A. H.*

Using a Voltmeter as an Ohmmeter

Articles on the use of a low-scale milliammeter in conjunction with shunts and multiplying resistors as a multi-scale instrument have appeared in past *QST*'s. Many experimenters do not know that such an instrument, or any sensitive voltmeter for that matter, may be used as an ohmmeter without altering it in any way. All that is required is a source of e.m.f., such as a 22½-volt battery, and a knowledge of the combined resistance of the meter and the multiplier being used. Choose a voltage scale that will give nearly full scale deflection when measuring the voltage of the source. Call this reading V_i. Then insert the unknown resistance, R_x, in series with the meter and source and note the reduced reading which we will call V.

$$\text{Then } R_x = \frac{(V_i - V)}{V} R_m$$

where R_m is the total resistance of the voltmeter at the particular scale being used.

The formula can be explained as follows:

The difference between the readings V_i and V represents the voltage drop across the unknown resistance. This drop is the product of the unknown resistance and the current flowing through it. $V_i - V = I \times R_x$. If we divide the voltage drop by the current, we have the resistance. Since the unknown resistance and the meter are in series, the same current flows through each. The current can be determined from the meter reading as follows:

$$I = \frac{V}{R_m}$$

$$\text{Substituting, we have } V_i - V = \frac{V}{R_m} R_x$$

and solving for R_x, we have

$$R_x = \frac{V_i - V}{V} R_m$$

Where greater accuracy is desired, the resistance can be approximated as above and then a scale chosen so that the resistance of the corresponding multiplier is as near as possible to that of the resistance being measured. If the resistance is high, the source of e.m.f. may then be increased to give large scale deflections and permit more accurate readings to be taken. — *KA1NA*

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Measuring Small Frequency Differences

In commercial power practice, the term "synchronism" is used to define that condition which exists when two or more alternating voltages are identical both in frequency and phase relationship. This condition of synchronism must be met when two or more alternators are used to feed a common load. For frequency *comparison*, or other purposes, the term "isochronism" is used defining the condition which exists when two or more alternating voltages are identical in frequency, but may or may not be in phase. The phase element is disregarded.

The usual method of adjusting two alternating voltages of high frequency to isochronism is by the "zero-beat" method with a headset in the output of a common detector. Because audio apparatus and the human ear will not respond to frequencies of a few cycles per second, a relatively wide region is present in which no beat note is heard — but at only *one* critical point are the two frequencies at absolute zero beat. For ordinary purposes, the aural method is sufficiently accurate, but to take full advantage of the various standard-frequency signals some electrical device must be substituted for the ear to obtain the same percentage of accuracy as the standard frequency. In other words, the high precision of the standard frequency transmissions is lost if the unknown frequency cannot be adjusted to absolute zero beat.

For the purpose of adjusting two frequencies to absolute zero beat, the outputs of two separate radio-frequency amplifiers are fed into a common detector, as shown in Fig. 9. The known frequency is coupled to one amplifier and the unknown source is coupled to the other amplifier. One or the other frequency, of course, must necessarily be variable. The potentiometers are provided so as not to overload the detector tube.

Fig. 9 shows the wiring diagram and constants of the various units. The input potentiometers are preferably of the carbonized-strip type. The coupling condensers are not critical in value and can be anything from 100 μμfd. to 0.005 μfd. The r.f. transformer constants depend upon the frequency band in which the apparatus is to be used. No tuning condensers are used; the windings should be of a value such that there is relatively-high inductive reactance at the operating frequency. Coupling should be very loose to the sources of radio-frequency voltage, such as through a small condenser, a few turns of a coil, or some such scheme. It is important that the coupling be as loose as possible, especially to a self-excited oscillator, so the frequency will not be affected. The detector is of the biased type. The meter can be permanently connected or, as in Fig. 9, a jack may be provided so that a meter need not be tied up in the apparatus. The meter need only be of such size as to determine the detector plate current conveniently, and can even be uncalibrated. The full-scale reading should be less than 5 milliamperes; a 0–1 milliammeter would be ideal. Construction should not offer any difficulties, and the isochrometer can be laid out to suit individual taste.

The instrument is used as follows: Each amplifier is loosely coupled to the different sources of radio-frequency voltage, and the potentiometers are adjusted for a convenient value of detector plate current. One or the other frequency is varied while listening in the 'phones for a beat note. The note is adjusted as closely as possible to zero beat while watching the needle on the meter. As the two frequencies approach isochronism, the needle will be seen to swing up and down at a rate equal to the difference frequency. The os-

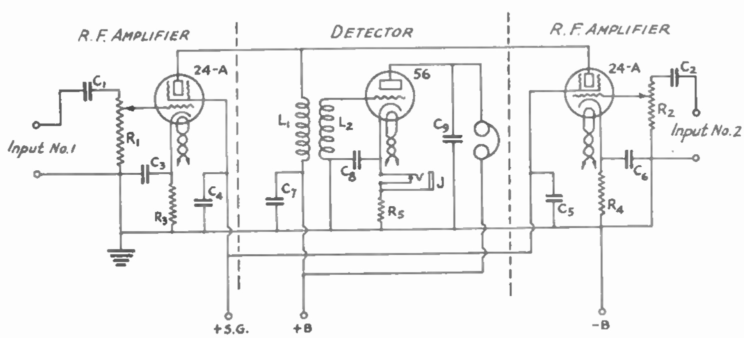

FIG. 9 — CIRCUIT DIAGRAM OF ISOCHROMETER OR ZERO-BEAT INDICATOR

C_1, C_2 — 0.002 μfd.
C_3, C_4, C_5, C_6 — 0.1 μfd.
C_7, C_8 — 1 μfd.
C_9 — 0.001 μfd.
R_1, R_2 — 250,000-ohm carbon-strip potentiometer.
R_3, R_4 — 500 ohms.
R_5 — 5000 ohms.
L_1, L_2 — Size depends upon frequency band in use. Use enough turns to be resonant around the operating frequency. Coils may be wound on same form and be plug-in if desired. Spare coils from receiver may also be used.

cillator or other source is then very carefully adjusted until the meter needle settles down to a constant value. At this point, the importance of shielding and coupling will become very apparent, and the various factors affecting frequency can be investigated readily while watching the meter.

Many uses suggest themselves, such for instance as determining the effect of keying or modulation of a transmitter on the frequency of the master oscillator. The master oscillator is coupled to one input of the isochrometer and a dynatron or electron-coupled frequency meter coupled to the other input. By first adjusting the two frequencies without keying or modulation, their respective effects upon the master oscillator frequency will be apparent by movement of the meter needle. Other applications would be in comparing the frequency drift of two frequency meters for the probable purpose of determining relative advantages and disadvantages of different types; the effect of load on an oscillator; in fact, in numerous applications where the objective is a *comparison* the isochrometer will be found very useful.

— *George J. Maki, ex-K7HV — W7HV*

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A Multi-Purpose Test Circuit

EVERY experimenter has wanted, at one time or another, a test circuit built around a tube for various measuring purposes. Besides, hams still like to listen on the long waves and use the honeycomb relics around the shack. Here is an instrument for both uses.

The heart of the instrument is a calibrated variable condenser. I used a General Radio but removed the dial and used the variable ratio dial made by National instead. The latter dial has a convenient place for writing in the capacity calibration from the General Radio dial.

Only three circuits are suggested in Fig. 11, but any experimenter will think of others. The first circuit shows a regenerative detector using plug-in honeycomb coils. Besides its usefulness as a long-wave receiver, it is handy for calibrating. It is especially useful for the intermediate frequency bands of a home-built signal generator. You will use the fundamental and thus avoid mistakes caused by using the wrong harmonic. It is also valuable for calibrating a grid-dip oscillator.

By simply doing a little plugging we have the crystal oscillator circuit shown. I use Yaxley insulated tip jacks because they will take either the banana type of plug or 'phone tips. The meter in the cathode circuit shows when the tuned circuit is in resonance with the crystal by a dip of the needle. This meter is inserted in the circuit simply by plugging your analyzer meter cords in pin jacks 7 and 8.

The other circuit shown is one of a simple inductance shunted by a calibrated variable condenser. It can be used as an amateur-band absorption wavemeter by plugging in a short-wave coil instead of a honeycomb. Then this inductance may be coupled to the detector coil of a short-wave regenerative receiver and resonance found by the click method, or it can be used with a neon bulb or small flash lamp plugged in series with the coil and condenser. Such a wavemeter is not as accurate as the heterodyne type but is useful in making certain that the transmitter is not tuned to a harmonic.

— *Jim Kirk, W6DEG*

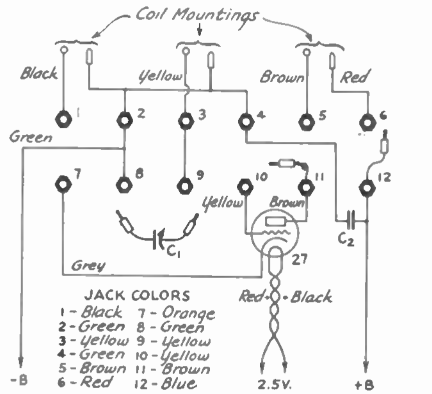

FIG. 10—CIRCUIT DIAGRAM OF THE MULTI-PURPOSE UNIT

Following is a list of the parts needed:

1 500-μμfd. variable condenser, C_1. Should be calibrated if capacity measurements are to be made.
1 vernier dial.
3 honeycomb-coil mountings (two hinged to vary coupling).
12 insulated pin jacks, colored (Yaxley).
4 'phone tips.
1 5-prong tube socket.
1 .25-μfd. fixed condenser, C_2.
1 Type 27 tube.
Four wire cable for power leads.
Set of honeycomb coils.
Metal cabinet.

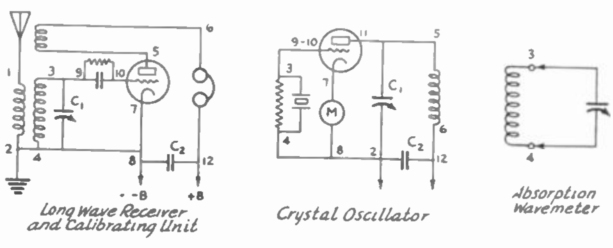

FIG. 11—TYPICAL CIRCUITS OBTAINABLE WITH THE UNIT

7

Improving the Power Supply

Power Supply Delay Switch

Many amateurs who do not have expensive equipment find two switches necessary for getting the rectifiers and the transmitter on the air. A slight alteration to a d.p.s.t. knife switch, as shown in Fig. 1, affords a simple and convenient

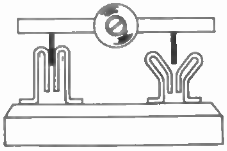

FIG. 1 — WITH ONE JAW OF THE POWER SWITCH BENT AS SHOWN, AND WITH THE CONNECTIONS DESCRIBED IN THE TEXT, THE FILAMENT POWER IS CERTAIN TO GO ON BEFORE THE PRIMARY CIRCUIT OF THE PLATE TRANSFORMER IS CLOSED

way of providing a few seconds time delay for the mercury tube filaments to heat, yet only one switch is required.

The filaments of the rectifier and transmitter tubes are controlled by the side making contact first, while the primary of the plate transformer is closed by the second contact. This combines all of the advantages of two separate switches, yet is simpler to operate. — *L. D. Miles, W2GGB*

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"Shockless" Meter Jacks

Some of the "brethren," who want to live as long as possible, may be interested in the following:

When using a single plate meter and single grid meter to service two or more stages in a transmitter, it is usual to connect the frames of one set of jacks to positive of plate supply and the frames of the other set to negative, which makes the front of the panel a very bad place for hands. The writer uses the four-spring, double-circuit type jack wired as shown in Fig. 2.

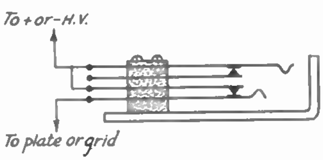

FIG. 2 — THE FRAMES OF UNUSED METER JACKS ARE "COLD" WHEN THIS CIRCUIT IS USED

The frame of this jack is "cold" except when the plug is inserted.

— *Neil E. Henry, W3BRY*

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Inexpensive Fuses

Every amateur knows the desirability of protecting his equipment from accidental shorts and overloads.

A very satisfactory low-priced fuse, which can be "tailored" to fit practically any amateur application, may be made by procuring some lug terminal strips. These are sold at a very reasonable price and can be had with from two to six

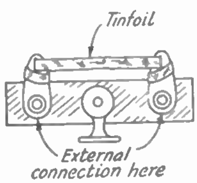

FIG. 3—HOMEMADE FUSE FOR TUBE CIRCUITS

The tinfoil should be pulled through the lugs and wrapped around them for connections. The width of the foil strip determines the current at which the foil will melt.

lugs. The fuse material is "Christmas Tree" tinsel or even the tinfoil from the popular brands of cigarettes. The strips of this material are fastened to, and wound around the lugs as shown in Fig. 3. This makes a dependable fuse, the current carrying capacity of which can be changed by varying the width of the tinfoil. The smaller the tinfoil, of course, the less current it will carry without blowing, and after a little experimenting the right size of strip to use can be determined quite accurately.

— *E. W. Hill, Fitchburg, Mass.*

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Home-Made High-Voltage Fuses

Fuses for use on 5000 volts or more, as well as those for low voltage, may readily be made and calibrated for currents as low as a hundred mils.

Get a sheet of tinfoil from a paper condenser or from the wrapping of a photographic film. The thinner the foil, the better for low current fuses. Some of the foil used in paper condensers is bonded to the paper; this is unsuitable. If the foil has any wax on it, this should be removed with a solvent such as benzol or gasoline. Lay the sheet of tinfoil on a plate of glass and carefully rub out the wrinkles. With a steel scale or straight edge and a razor blade or other sharp knife cut strips a few hundredths of an inch in width. The proper angle at which to hold the razor blade may be found by trial; with a little practice very narrow strips may be cut. One of these strips is then inserted in a quarter inch glass tube and the ends of the strip bent over, as in Fig. 4-A. For a 5000-volt fuse a tube about 4 inches long will suffice. The strip of foil should be about an inch longer than the glass tube.

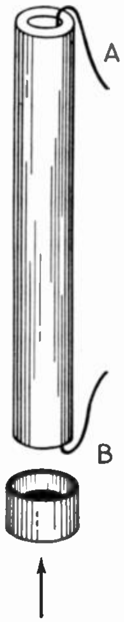

FIG. 4

To complete the fuse, take two end caps from a grid leak and attach them as follows: Heat the caps until the low temperature alloy is melted and push the glass tube and its strip into the molten metal as at B. In case no such caps are at hand, they may be made from brass tubing or cast from solder. The low-melting alloy is the same as that used for mounting detector crystals. It is obvious that such fuses may be re-filled an indefinite number of times.

The calibration of the fuse is carried out by connecting it in series with an ammeter or milli-ammeter of suitable scale, a sensitive rheostat, and a battery. As the current is increased, the fuse is watched carefully for any sign of heating. There will always be some narrowest point, and this will heat up first. When a faint red glow is seen, the instrument is read, and this reading is taken as the rating of the fuse. If the rheostat is further reduced in resistance, the current stays at almost this value until the fuse blows. The reason is that the resistance of the fuse increases with temperature so that the voltage drop across the fuse increases slightly thus preventing the current from rising.

All fuses of this type, consisting of a simple wire without de-ionizing devices, are properly used only on alternating current or on unfiltered rectified d.c., such as in the plate circuits of 866's and other high voltage rectifiers. There is a possibility of a continuous arc forming when the fuse is used in a pure d.c. circuit of over 250 volts, as for example, on the output side of a filter, because of lack of quenching of the ions formed when the fuse blows.

A de-ionizing agent such as silisic acid may be put in the tube around the fuse wire if the fuse is to be used on d.c. The writer has never tried out this scheme because there has been no occasion to use fuses on d.c., but the fuses made as described in the preceding paragraphs have given excellent results at W7EZL and represent a considerable saving when much experimental work is being done. — *E. A. Yunker, W7EZL*

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Metering Several Stages

When economy is desirable in a multi-stage transmitter, it is common practice to use a single current-meter terminated with a plug which can be inserted in jacks connected in the circuits where one wants to read the plate or grid currents. If a common supply is used for the plate or grid voltages an alternate method suggested by the diagram, Fig. 5, may be employed. A dummy plug (metal rod or short circuited plug) is inserted into the jack of the circuit which it is desired to read.

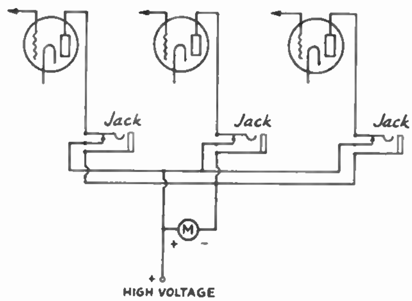

FIG. 5 — A PLUG-AND-JACK METERING SYSTEM IN WHICH NO FLEXIBLE CORD IS REQUIRED
Single closed-circuit jacks are used.

The necessary resistances to give the correct voltages to the different tubes may be placed in the circuit on the tube side of the jack. One meter should be used for the plate currents and, if desired, another for the grid currents. Western Electric uses this method in some of their equipment. — *W. B. Gould, 3rd, W1NP*

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Insulating Filter Chokes

The following idea may be of some value to amateurs who have high-voltage power supplies to build, Instead of purchasing an expensive, high-voltage filter choke insulated to withstand umpty-ump thousand volts between winding and core, one can get along very nicely with any type of choke which has the desired current, resistance, and inductance rating, regardless of its voltage insulation. It is only necessary to mount the "under-insulated" choke on two or more sturdy stand-off insulators, so that its core and frame are isolated from any grounded circuit. The frame and core can be painted red if the operator fears that he may forget the status of this filter arrangement. A still safer procedure is to enclose the choke in a grounded metal box, the frame and core being insulated from the protective covering by the stand-off insulators. It might be decidedly unhealthy and not in the least conducive to longevity for the operator to touch the frame of said choke with himself grounded and the power supply in operation. This dodge, however, is certainly worth remembering as a shekel-saver. — *L. C. Waller, W2BRO*

Boosting Voltage

Many power transformers, particularly those used with low-power transmitters, have unused filament windings. By connecting such a filament winding in series with the primary winding so that the voltage drop across the filament winding bucks that of the primary winding, the turns ratio is increased and a higher output voltage results.

To determine the proper connections, place an a.c. voltmeter across the secondary high-voltage winding and note voltage, then place one of the filament windings in series with the primary winding and note the change in voltage. If it increases the connection is correct, if not reverse the filament connections. More than one may be connected in series and then placed in series with the primary. If excessive heating is noted, it is advisable to cut out one or more bucking windings to prevent damage to the transformer.

I have used this kink for some time. The transformer in question normally supplied 1300 volts a.c. at 200 ma., and since placing one $2\frac{1}{2}$ and one $7\frac{1}{2}$-volt winding in series with the primary, the voltage increased to 1500 volts with the same load current without heating. The same scheme may be used to boost the voltage of a filament transformer. — *Dean C. Logan, W2GKZ*

Filament Voltage Regulator

Many amateurs are troubled with poor line voltage regulation; also, when the key is pressed, the filament voltage drops, which is hard on the filaments.

To overcome these troubles the writer devised a system whereby the filament voltage could be regulated when the line voltage changed, and also be kept constant while keying. This system will compensate for changes of 18 volts each way from 110 volts, as well as changes in filament voltages of 10% caused by keying.

As shown in Fig. 6, the equipment needed includes an auto-transformer, T_1-T_2, a pair of variable resistors, R_1 and R_2, and a relay, *Ry*, which is connected in parallel with the keying relay. The auto-transformer is homemade, wound on a core measuring $1\frac{1}{2}$ by $1\frac{1}{2}$ by $5\frac{1}{2}$ inches. The

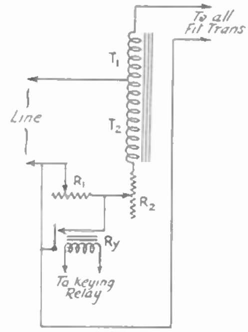

FIG. 6 — SYSTEM FOR COMPENSATING FOR FILAMENT-VOLTAGE DROP WHEN KEYING

Provision also is made for adjustment of the filament voltage to take care of line voltage variations.

110-volt winding consists of 510 turns of No. 20 s.c.c. wire, while the step-up winding; T_1, has 107 turns of No. 12 d.c.c. R_1 is a small 75-ohm wire-wound variable resistor; the voltage drop across it is low so its power rating need not be very large. For R_2 the writer uses a 500-ohm 250-watt Super-Power Clarostat. The relay is simply an automobile generator cut-out.

To put the system into operation, turn R_1 so that all its resistance is cut out and adjust R_2 to give the proper filament voltage. This should be done with the plate power off. Then apply plate voltage, close the key, and note the drop in filament voltage. Remove the plate power and readjust R_2 until the filament voltage is as much above normal as it was below when plate power was applied, then adjust R_1 to give normal voltage once more. The filament voltage will then stay constant with keying. Line voltage variations can be compensated for by varying R_2; R_1 probably will not need to be touched again so long as the line voltage changes are not excessive. — *Victor Emmert, W6DVV*

Rectifier Switching for Voltage Changing

Having several plate voltages available is desirable not only from the standpoint of being able to change power to suit QRM conditions, but also for economical reasons, since the difference between one or two hundred watts and a kilowatt quickly shows up on the power bill. The switching arrangement shown in Fig. 7, used by J. O. Ellison, W8COW, is quite flexible in this respect. Two porcelain-base knife switches are required, one a d.p.d.t., and the other a t.p.d.t. By manipulation of the switches either center-tap or bridge rectification can be used, and the voltage taps on the transformer changed as well.

When both switches are in the upper position,

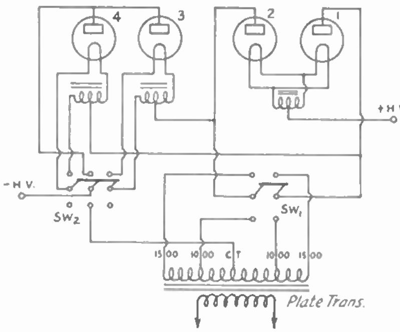

FIG. 7 — RECTIFIER SWITCHING CIRCUIT FOR VOLTAGE CHANGING

the filament circuits of rectifiers 3 and 4 are closed and the four tubes are connected in bridge; the 1500-volt taps on the transformer are connected in the circuit so that the output is 3000 volts r.a.c. With Sw_1 down, the output is 2000 volts r.a.c., using the same bridge rectifier. With both Sw_2 and Sw_1 down, the filament circuits of tubes 3 and 4 are opened and tubes 1 and 2 are connected in the center-tap circuit. The output is 1000 volts r.a.c. If Sw_1 is now put in the upper position, the output voltage is 1500. The plate transformer must, of course, be capable of handling the power taken from the highest-voltage connection.

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Simple Filament-Voltage Booster

PROBABLY some of the gang have been hesitant about trying some of the metal tubes in receivers because of the necessity for getting a separate 6.3-volt filament supply when the existing receiver is geared up for 2.5-volt tubes. W1CD has an inexpensive and simple solution to this one. The gadget is an auto-transformer, made by winding 100 turns of No. 20 wire on an old audio transformer core (every ham has one!). A tap is brought out at the 39th turn and the works connected as shown in Fig. 8. Both 2.5 and 6.3 volts are available.

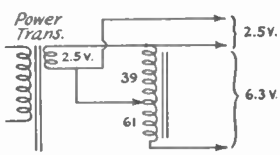

FIG. 8 — INEXPENSIVE AND EASILY-MADE BOOSTER TRANSFORMER FOR OPERATING 6.3-VOLT TUBES FROM A 2.5-VOLT SUPPLY

W1CD's transformer handles four 6.3-volt tubes, the other three in his receiver operating at 2.5 volts. He writes that from the way the transformer operates it would seem to be capable of handling the remaining three just as readily. It took about five minutes to build.

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Power Supply for Multi-Stage Transmitters

THE question of economy in power supplies for multi-stage transmitters has always been quite a problem, since the differences in voltages required by succeeding stages usually make more than one power supply necessary. Voltage dividers may be used to obtain lower voltages, within certain limits, but where the voltages differ by any great amount a voltage divider consumes considerable power, besides having poor voltage regulation.

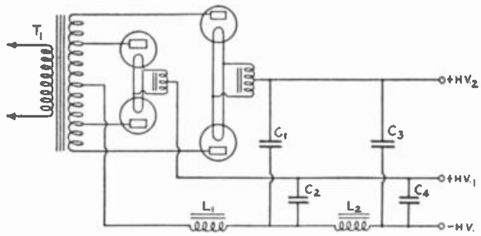


FIG. 9 — A POWER SUPPLY CIRCUIT IN WHICH A SINGLE TRANSFORMER AND SET OF FILTER CHOKES IS MADE TO SERVE FOR DIFFERENT VOLTAGES

Each voltage has its own rectifier and filter condensers. Although only two voltages are indicated, others may be obtained provided the transformer has the necessary taps.

The circuit shown in Fig. 9 was designed for use with multi-stage transmitters where the successive stages require much greater voltages in comparison to the voltages of the preceding stages. The cost of the equipment is considerably less since but one transformer and filter is required to produce several different voltages. Compactness is another advantageous feature of the circuit.

The transformer is center-tapped at the various voltages required. These voltages are rectified independently of each other and then filtered through a common filter whose chokes are in series with the center-tap or negative lead from the transformer. Transformers having taps at all the voltages likely to be required may be hard to obtain commercially, especially if more than two voltages are needed. One can be made especially for the job, however, or an old one can be rewound.

The rectifier performance will be improved if the input choke, L_1, is of the swinging variety instead of the ordinary type. Filter constants are not given since they will depend upon the voltages and currents to be handled. Design data can be found in the *Handbook*. The chokes must of course be built to handle the total direct current to be taken from all taps on the power supply.

The wave form was not studied by means of an oscillograph; however, two oscillators of different powers were rigged using the rectifier for power source. Either oscillator could be keyed without noticeable change in filtering. As true of any circuit the parts must be of the proper ratings with a suitable safety factor.

The circuit has been used at W7CNS and K7CKK for over two years with proved success. Several modifications were also tried out, but the circuit of Fig. 9 seemed to be most satisfactory.

This power supply will furnish voltages for any number of stages, from oscillator to final amplifier, although for a modulated transmitter it is suggested that two supplies be used, especially when dealing with large power.

— *E. E. Comstock, Ensign, U.S.S. Coast Guard*

Combined Plate and Bias Pack

The idea of making one plate transformer supply simultaneously plate and bias voltages through the use of two separate rectifiers, although described in *QST* many years ago, has had less application than it deserves. Here is some practical dope from M. C. Bartlett, W9JHY, who writes:

"I am enclosing a sketch (Fig. 10) of a power supply that solved a problem: That of getting a bias supply cheaply.

"I already had a crystal oscillator power supply and by buying one filament transformer, one choke, one more 83, an electrolytic condenser and a resistor, I had a perfectly good bias supply that avoided the objectionable features of grounding the middle of the bleeder resistor, involving poor regulation, high voltage drop, etc.

"This rig is suitable for use with transmitters having bias requirements up to 250 volts, and is the veritable 'nerts' for 852 tubes, or others requiring high bias values.

"At W9JHY this rig is used for the oscillator plate, and furnishes bias voltage for the whole transmitter, Class-B modulators and all."

The only point to be watched is to make certain that the high-voltage transformer can supply the additional power to be dissipated in the bias bleeder, which should have low resistance for the sake of good bias-voltage regulation. The total current in W9JHY's arrangement is in the neighborhood of 300 ma., assuming 250 ma. for the bias section and 50 ma. for the oscillator and its bleeder, R_3.

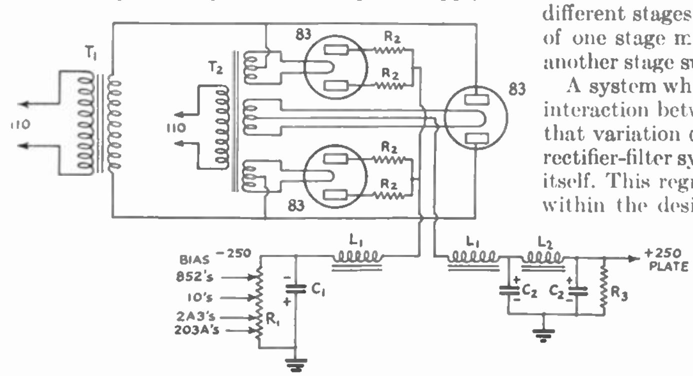


FIG. 10 — COMBINED OSCILLATOR PLATE AND AMPLIFIER BIAS POWER PACK

T_1 — Power transformer, 325 volts each side center tap.
T_2 — Filament transformer, three 5-volt windings.
L_1 — 5-15-henry swinging choke, 250 ma.
L_2 — 25-henry smoothing choke, 150 ma.
C_1 — 8-μfd. electrolytic (can not grounded).
C_2 — Doubler 4-μfd. electrolytic.
R_1 — 1000 ohms, 200 watts.
R_2 — 100 ohms, 10-watt wire-wound.
R_3 — 50,000 ohms, 10 watts.

Self-Regulating Bias Supply

Late radio literature has described several methods and devices for attempting to prevent the "soaring grid bias" on power amplifiers using rectifier-filter types of grid bias sources.[1] Why should we prevent this change in grid bias? In some cases it is desirable to maintain perfectly fixed grid bias; but with most ordinary Class-C systems it is only necessary to have complete control over the grid bias at zero and maximum excitation of the amplifier tube. The thing which it is very desirable to prevent is interaction with the changing grid biases of several different stages of an amplifier. The operation of one stage may change the bias applied to another stage sufficiently to cause trouble.

A system which I have developed limits the interaction between the various stages only to that variation caused by the regulation of the rectifier-filter system of the bias voltage supply itself. This regulation can very easily be held within the desirable limits. The system is illustrated by Fig. 11. Each amplifier stage receives its grid bias from a separate anode of a diode rectifier tube connected, as shown, across the bias supply output. By the use of a resistor with two adjustable taps, the minimum and the maximum grid bias can be set to any desired value. When under load, the rectifier-filter system must supply at least the minimum voltage required for the biasing of the

[1] Yates, "Automatic Vacuum-Tube Regulation Control," *QST*, Sept., 1934; also, "874 Regulator," Experimenters' Section, same issue; Robinson, "Gaseous Voltage Regulators," *QST*, Jan., 1935; Priest and Olney, "Vacuum-Tube Voltage Regulators," *QST*, July, 1935. — Editor.

grid of the tube which requires the highest grid bias with no excitation applied.

With no excitation applied to a Class-C amplifier, the bias may be adjusted so as to cut off the plate current. Simultaneously with the above condition, the resistance in each -C lead should have a value which will develop the desired maximum grid bias when the maximum grid current is flowing (maximum input condition). This value may be calculated by Ohm's Law:

$$R = \frac{E_g}{I_g},$$

where E_g = the maximum grid bias voltage desired and I_g = the (d.c.) grid current (in amperes) at full excitation. For instance, if a grid bias of 300 volts (maximum) is desired for a tube which will draw a grid current of 50 milliamperes (0.05 ampere), the resistance to which the bias tap should be set is

$$R = \frac{300}{0.05} = 6000 \text{ ohms}$$

The -C tap should first be set to approximately 6000 ohms; and then the supply tap (from the diode plate) should be set so that the bias applied to the grid without excitation will cause cut-off of the plate current. After the excitation has been applied and all current and voltage readings have been checked, any slight changes of adjustment which are found to be necessary may easily be made. After several stages have been connected to the bias supply some *slight* final adjustments may be found to be necessary in the biasing of the stages connected first.

Two very great advantages of this system are that in case of failure of the bias supply voltage, automatic bias will be effected as long as the amplifier is excited, and (the main advantage) that a low-voltage bias supply will suffice for an amplifier requiring a bias nearly double the voltage of the supply. The diode tubes prevent the bias voltage built up in the grid circuit from "backing up" into the lower voltage supply circuits and possibly breaking down the filter condensers, as well as from acting upon the grids of other tubes.

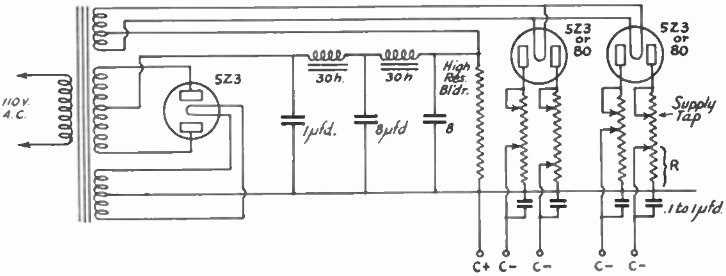


FIG. 11 — CIRCUIT ARRANGEMENT OF DIODE "VALVE ACTION" BIAS DIVIDERS FOR MULTI-STAGE TRANSMITTERS

Determination of resistance values is discussed in the text.

If Class-B stages must also be biased, the same voltage supply may also be used for this purpose. The difference in the design for the Class-B stage lies in the fact that the bias must remain very nearly constant and at such a value as to cut off (or nearly cut off) the Class-B stage plate current when no excitation is applied. This necessitates that the bias supply shall deliver a slightly higher voltage than that required to cause cut-off in the Class-B stage. For the Class-B stage, however, the required bias is only about half of that required for a Class-C stage, so that the same bias potential supply will usually suffice for both types.

To gain the required constancy of bias for amateur transmitter Class-B stages, the resistance R required may be calculated as before and then divided by about five. The voltage should then be set by the position of the supply tap, as before, except that the bias should not be raised above the plate current cut-off point.

If greater constancy for the bias of the Class-B stage is desired, its "valve action" diode may be changed to a triode of a low plate-resistance type, as shown in Fig. 12. The triode must be able to carry the current drawn by the resistor. If one triode (such as a '45 or '50 or 2A3) will not handle the current, several of them in parallel will do the work.

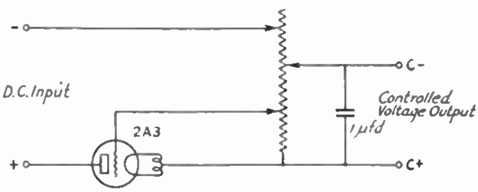


FIG. 12 — TRIODE SERIES REGULATOR FOR CLOSE CONTROL OF CLASS-B AMPLIFIER BIAS

As the grid of the regulator tube becomes more negative with respect to its filament, its series plate-filament resistance rises and holds down the output voltage.

The current is

$$I = \frac{E}{R}$$

where E = the supply voltage and R = the value of resistance between the supply tap and C+.

It will be noted that the triode must be connected in the positive lead; therefore, if more than one stage is to be biased by the same supply, either all must be operated from the same triode regulator and voltage divider; or, if separate triode regulators are used, the amplifier filament circuits must be entirely separate and ungrounded.

From this it may be easily seen that the diode method gives the more simple and fool-proof system of the two. It will supply controlled and protective bias for Class-C stages and nearly fixed bias for Class-B stages, without interaction between the bias acting on the various amplifiers; and only one rectifier-filter circuit is needed.

— *A. W. Friend, W8DSJ-W8KIU*

Combination Time Delay and Bias Supply

THE circuit of Fig. 13 works very nicely as a time delay relay for mercury vapor rectifier tubes, and in addition serves as a transformerless "C" bias supply and automatic cut-off of high voltage in case of any failure in this supply.

To obtain the time delay feature, advantage is taken of the heater type of filament of the 25Z5 which was designed to operate as a voltage doubler directly off the 110-volt line. Two tubes are used in parallel to stand the drain through the low-resistance bleeder used to stabilize the "C" voltage, and to operate the heavy-duty relay that was at hand. Care should be taken to hook the plate and cathode connections at the tube sockets in the exact order shown in the diagram.

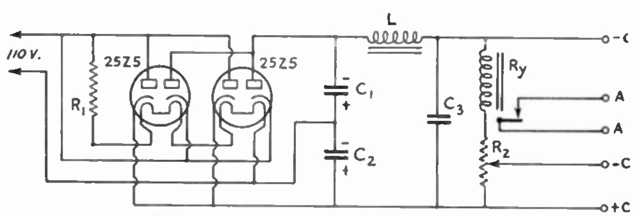


FIG. 13 — TIME-DELAY RELAY AND C-BIAS SUPPLY

C_1, C_2, C_3 — 8-μfd. electrolytics, 225-volts.
R_1 — 200 ohms, 25 watts.
L — 30-henry, 200-ma. choke.
Ry — S.p.s.t. relay.

A time delay of 17 seconds was obtained with the particular 25Z5s used. This will probably vary somewhat with the make of tubes.

Practically any d.c. relay that has contacts heavy enough to handle the current drawn by the plate transformers can be used. Telegraph relays or sounders might be fitted with heavy contacts or automobile generator cutouts revamped. To obtain good regulation as a C bias supply, 75 to 150 ma. bleeder load should be used. The particular relay at hand and value of bleeder resistor will have to be adjusted to secure this. If the relay has a resistance of several thousand ohms it can be used directly across the output of the filter; if of low resistance and operating on 75 to 150 ma. can be used as shown in the diagram. If it takes less than 75 ma. it can be shunted by a variable resistor, the latter being varied to give proper relay current, and the combination tied in series with the bleeder resistor.

In the unit constructed the relay required 140 ma. and the winding had a d.c. resistance of 150 ohms. With a bleeder resistor of 850 ohms in series the load current was 140 ma., with the voltage 140. A voltage of 165 could be secured at this load if C_1 and C_2 were increased to 16 μfd. each.

Many hours of life should be added to the tubes protected with this arrangement. A cut in the line voltage immediately opens the high voltage; a several-second cut will allow the filaments of the 25Z5s to cool slightly and there will be a delay before the high voltage is automatically reapplied.

There is one precaution to be observed: If the high voltage negatives are tied to direct ground it will be impossible to use this unit as a "C" supply, since it is necessary to connect the C positive to B negative. One side of the a.c. line is grounded and that shorts out C_1 and C_2. In this case the device would still be useful as a time delay relay, and one 25Z5 might prove sufficient to operate the relay.

— *Paul S. LeVan, W3MG*

Troubled with arcing between the leads below the press in small rectifier tubes such as the 83 and 81, VE3QH cured several of them by removing the base, cleaning the wires and then pouring in about an eighth inch of rubber cement. After the cement dried the rest of the glass stem was filled up with plaster of Paris and the base replaced. To remove the base, first unsolder the lead wires in the pins and then immerse the base in warm water, which will soften the cement which holds it to the glass.

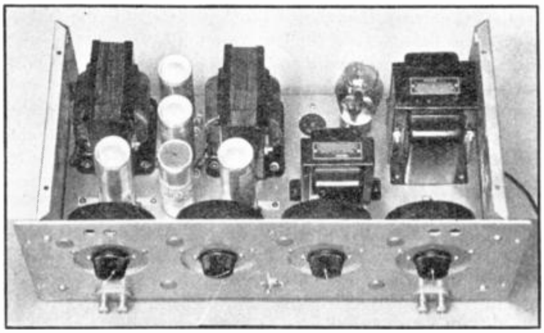
When testing to see if a transformer winding is continuous, many hams are accustomed to using a small electric-light bulb connected in series with the 110-volt line. If the winding delivers high voltage the resistance may be too great to permit enough current to flow to light the lamp. In cases like this one of the small neon bulbs, substituted for the lamp, will make a good indicator, since the current taken by the neon bulb is minute.

— *W2BRY*

Universal Power Supply for Experimental Work

WHEN doing experimental work, it seems inevitable that one never has at hand the facilities one needs. Particularly is this true in the case of power supply equipment, especially when working with receivers, audio amplifiers, and the like. In an attempt to cleave through this difficulty with one stroke I built a universal power supply which provides me with any voltage up to 400 on eight different terminals, with a maximum current drain of 235 ma. The maximum current drain was arrived at by subtracting the bleeder current (15 ma.) from the total capabilities of the unit, 250 ma.

Four husky potentiometers provide as many variable voltages; their interconnections provide the same number of semi-fixed voltages. Variable voltages are thus available for every circuit element. To illustrate: by connecting terminal 1 (Fig. 14) to grid, 2 or 4 to cathode, variable grid bias of the "fixed" variety is obtainable. Plate, screen, and cathode grids can then be connected to any suitable one of the higher-voltage taps, also readily variable. Units requiring different plate or cathode voltages are easily accommodated. In fact, there is no requirement short of a 400-volt total potential difference that can't be met. Every terminal is heavily by-passed, both for filtering and to eliminate inter-coupling.



A POWER SUPPLY FOR EXPERIMENTAL WORK

Currents up to 200 ma. at any voltage up to 400, can be obtained. Voltages are readily adjustable through heavy duty potentiometers.

A 6-prong socket is provided for filament and variable plate voltages to facilitate use of a separate beat frequency oscillator and signal generator unit in connection with experimental work. A separate 16-μfd. condenser provides added filtering for this unit. The current reserve is ample to accommodate an ordinary receiver on test as well.

Construction is simplified by use of the General Radio punched panel, and chassis and end plate assembly. No dust cover is used because it would impair heat radiation — at times there is as much as 100 watts to be radiated.

Using the constants given, the hum is negligible, being less than one-half volt at the high-voltage terminal, with an even lower percentage on the lower terminals.

— *Clinton B. De Soto, W1CBD*

An Economical Filter Arrangement

When a single power supply is used for a high-voltage amplifier and low-voltage buffers, the circuit of Fig. 15 will provide adequate filtering for the high-voltage circuit with only a single filter condenser of maximum voltage rating. Usually a single high-voltage condenser is insufficient to give pure d.c. on the amplifier stage, and in many cases the expense of extra condensers is too great for a slim pocketbook.

In Fig. 15, the output of the rectifier feeds into the high-voltage condenser, C_1, thence to the choke and the bleeder resistor, R. A tap is taken off R for the low voltage, and additional filter, using condensers of lower rating, is provided by C_2, C_3 and the second choke. The low-voltage filter is thereby made to improve the smoothing in the high-voltage section. Condenser C_2 normally will have a rating of 500 to 800 volts and should have a capacity of about 4μfd.

I have had this filter in operation for quite some time and can get the same S9 reports on either low or high voltage. With only one high-voltage condenser and choke, however, the note is harsh. The system is now in use at a number of St. Louis stations, and is a blessing to the

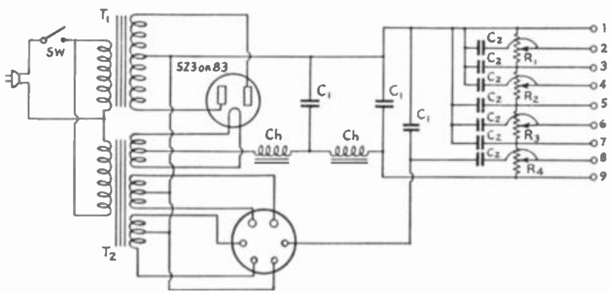


FIG. 14 — CIRCUIT DIAGRAM OF THE UNIVERSAL POWER SUPPLY

T_1 — 400-v. 250-ma. plate transformer (Thordarson T-5303 or equivalent).
T_2 — Combination filament transformer to meet circuit needs; in this case, 5 v. 3 a., 2.5 v. 10 a., and 2.5 v. 3.5 a
Ch — 15-henry 250-ma. chokes.
C_1 — 16-μfd. 500-v. electrolytic condensers.
C_2 — 3-section 4-μfd. 500-v. electrolytic condensers.
R_1 — 4500-ohm 150-watt potentiometer (Ohmite 0547 or equivalent).
R_2, R_3 — 10,000-ohm 150-watt potentiometer (Ohmite 0549 or equivalent).
R_4 — 2250-ohm 150-watt potentiometer (Ohmite 0545 or equivalent).

ham who can't afford high-voltage filter equipment. — *Arbie Willis, W9NEV*

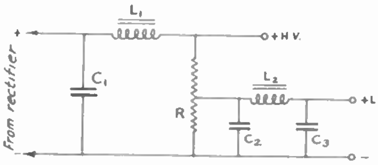


FIG. 15 — A COMBINED HIGH- AND LOW-VOLTAGE POWER SUPPLY IN WHICH A LOW-VOLTAGE FILTER CONTRIBUTES TO THE SMOOTHING IN THE HIGH-VOLTAGE SECTION

C_1 is a single high-voltage condenser of rating suitable for the output voltage of the rectifier. Resistor R should be between 35,000 and 50,000 ohms, with the tap taken off at the proper point to deliver 500 volts to the driver tubes. Condensers C_2 and C_3 should be rated at 800 volts, C_2 being 1μfd. and C_3 2μfd. Choke values are as in ordinary filter circuits. An input choke may be used if desired. The choke and C_3 in the low-voltage circuit can be omitted, but provide additional filtering for the small tubes.

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Safe Starting and Excitation-Failure Protection

Many arrangements have been devised to prevent the careless operator from switching the plate and filament transformers on simultaneously. All that have come to our attention have some shortcoming footnoted. The arrangement used at W6EZY not only protects cold filaments but cuts the plate voltage if anything goes wrong back of the final amplifier. The foundation is the famous Philco AB relay switch rewound, hooked up as shown in Fig. 16. The holding coil, L_2, has 600 turns of No. 28 wire and is designed to release at 100 mils. L_1 is the starting coil, an audio transformer primary, which operates the relay snappily on 45 volts.

To operate, push the start button. If the main-line switch is closed the filaments will be hot, and grid current through L_2 will hold the relay. Anything that interrupts the flow of grid current through L_1 will release the armature. Shorting L_2 with the stop button does likewise. L_1 and L_2 are of course wound to assist.

Since the contacts on the Philco switch are not intended for heavy loads, they should be replaced by heavier silver contacts, depending upon the plate-transformer load. The resistors in series with the amplifier and buffer grid leads are the usual grid leads to provide additional bias under operating conditions.

— *L. M. Turner, W6EZY*

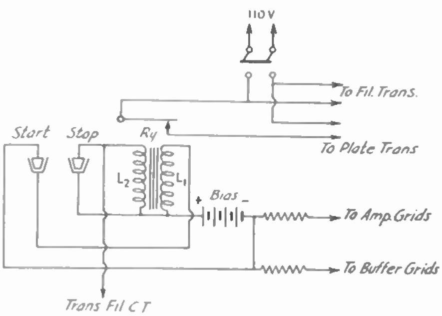

FIG. 16 — PROTECTIVE CIRCUIT FOR PREVENTING TUBE DAMAGE IN CASE OF EXCITATION FAILURE

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Overload Protection

Fig. 17 is the diagram of a kink used at W4BZX for a simple, cheap, and quite effective method of overload protection.

The heart of the circuit is relay Ry_2, which is one of the type originally used with d.c. receivers to turn off the A battery trickle charger and turn on the B battery eliminator automatically when the filament circuit in the set was closed, the relay coil being of rather low resistance and connected in series with the filament circuit. The relay is revamped by connecting as shown in the diagram and using only the contacts normally closed. Since the relay will operate on 300 milliamperes, a rheostat of 15 ohms is shunted across the coil

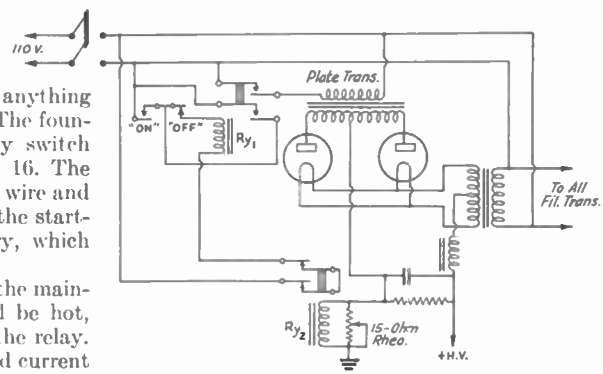

FIG. 17 — OVERLOAD PROTECTION WITH PUSH-BUTTON CONTROL

The overload relay, Ry_2, is a unit taken from an old "AB" eliminator.

to adjust for the desired operating current.

Operation is something like this: The transmitter filaments are lighted by closing the master switch, while relay Ry_1 serves to turn on the high voltage. It is controlled by the "On" and "Off" push buttons, which are located on the operating table and connected to the transmitter by a three-wire cable. The double-pole relay Ry_1, with a 110-volt a.c. coil, has one of its contacts in the primary circuit of the high voltage transformer, while the other contact serves to lock the relay closed once the momentary-contact "On" push button has been depressed. The high voltage is normally turned off by pressing the "off" button, which is of the closed circuit type, and which, when pressed, breaks the holding circuit of relay Ry_1.

When an overload occurs, relay Ry_2 operates, instantaneously breaking the holding circuit of relay Ry_1, and allowing the contacts of Ry_1 to open. To apply the high voltage again, it is only necessary to press the start button, since Ry_2 is normally closed and immediately resets itself when the overload is removed: thus the necessity of having to get up from the operating position to reset the relay on the transmitter (if separated from operating position) is avoided.

The overload protection has really been worth the small trouble it took to install it, particularly so when troubled by "arc-overs." The system may be of value to others needing an inexpensive and effective method of overload protection.

— *R. D. Lambert, Jr., W4BZX*

A.C. from D.C. Generators

Amateurs who are isolated from a.c. or might like to have an auxiliary a.c. power supply for portable or emergency use may be interested in the system used at W4AVR for obtaining a.c. from a d.c. generator.

The only source of power here is a 750-watt 32-volt Delco farm-lighting plant. By a slight alteration of the generator, however, enough a.c. power is obtained to run all filaments and supply plate power for all but the final stage of a crystal controlled 'phone-c.w. transmitter ending up with a 75-watt tube. Dynamotors supply the plate voltage for the final stage, since I was already in possession of them and saved the trouble of building an a.c. power supply for this stage.

It is possible to obtain 350 watts of 60-cycle a.c. from a four-brush 750-watt d.c. generator (25-cycle if it is a two-brush job), and at the same time get d.c. at the rated voltage of the generator.

To accomplish this a pair of slip rings and a brush rigging must be added to the commutator end of the armature. An extension shaft, 5 inches long and ½-inch in diameter, threaded at the free end, was attached to carry the rings. The shaft here was made from an old Chevrolet fan shaft.

A number of discs, 2¼ inches in diameter, with ½-inch holes in the center, were cut from old bakelite panels and slipped over the extension shaft. They are held securely in place by the nut on the end of the shaft. The slip rings were made from brass tubing of 2-inch inside diameter with ⅛-inch walls. The rings are 1½ inches wide.

The group of bakelite discs, or drum, was turned down while the generator was running so that the slip rings would fit tightly on the insulated shaft. The rings are separated about ¼-inch so that there is no danger of a short circuit. A ⅛-inch hole is drilled through the insulation parallel to the shaft to carry the wire from the commutator to the outside slip-ring. A 1/16-inch hole is drilled ¼-inch deep in one of the commutator bars near the hole in the insulation. No. 14 copper wire is used to make the connection between the commutator segment and the outside slip-ring; it is threaded through the insulation and the connections well soldered. The connection to the other ring is made to a commutator bar exactly one-fourth the way around the commutator from the other segment.

The brush rigging here is made from old automobile generator brush holders, two regular auto-generator brushes being used to each slip-ring. The brush rigging must be insulated from the frame of the generator.

The d.c. voltage taken from the armature is of the order of 38 volts at a speed of 1800 r.p.m. The r.m.s. value of the a.c. voltage (which must be used in making calculations for winding transformers) is, therefore, approximately 27 volts. As there is some loss in the windings the transformer primaries are designed for 25 volts. Wire of sufficient size to carry the current must be used, No. 14 being about right for the primary of a 300-watt transformer.

If the d.c. generator is a two-brush job, the slip-ring connections should be made to commutator segments exactly opposite each other on the commutator. The a.c. taken from such a generator will be of the order of 25 cycles at a speed of 1500 r.p.m. The transformers will, of course, have to be designed for 25 cycles. Additional dope on transformer winding may be found in *The Radio Amateur's Handbook*.

About 75 watts of 60-cycle a.c. may be taken from a Ford power-house type auto generator, which is of the four-brush variety. This is about the only four-brush automobile generator available. The a.c. r.m.s. voltage from such a generator is about 5.6 volts, so the transformer primary should be designed for 5 volts. The current will be about 12 amperes, so the wire used in winding the primary should be No. 12 enameled. A transformer with a core cross-section of one square inch is large enough to handle the output of a 6-volt auto-generator, and if standard core material is used 7 turns per volt will be about right for the windings. The primary should consist of 35 turns and the number of turns on the secondary would be the desired voltage multiplied by 7. The size wire used in winding the secondary is, of course, determined by the amount of current taken from the secondary winding; No. 30 is OK for 300 volts each side of the center tap.

If the generator is left running all the time while on the air it will be found necessary to use some means of suppressing the interference caused by the brushes. At W4AVR a 1-μfd. condenser is used across the d.c. brushes; the frame of the generator also is well grounded. Two ½-μfd. condensers are connected in series across the a.c. brushes and the center tap is run to a separate ground. If severe interference is encountered it may be necessary to use heavy r.f. chokes, consisting of 150 turns of No. 10 wire on a 2-inch form, in series with each of the leads carrying the output of the generator.

— *Wilbur Jackson, W4AVR*

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A Junk-Box Voltage Regulator for the M.G.

Those who use a motor generator for plate supply and require close regulation will be interested in this voltage regulator, which cost 15 cents at the five-and-ten. The 15 cents was expended for two tungsten contact points (Ford) and a bird-cage spring. The rest of it comes from the junk pile. It is conventional in every way; see Signal Corps Pamphlet No. 40, 1921, page 190. The heart of it is an ancient audio transformer, a Thordarson 6-to-1 in this instance.

The diagram, Fig. 18, is slightly clarified from the Signal Corps description. In operation the field rheostat of the generator is short-circuited by the contacts as the line voltage rises and falls about a given point, determined by the tension of the spring. The core of the transformer is reformed into a W-section across which the vibrating armature is hung by taking out one leg. The primary and secondary of the audio transformer provide the control and bucking coil of the instrument, with suitable resistances in series with each to hold the current to safe operating values.

In the instrument I describe, the secondary of the transformer is the control magnet (b). It is connected directly across the line, with 3000 ohms in series. As the voltage of the line rises, the control magnet opens the contacts, making the rheostat operative in the shunt field of the generator. This causes the voltage of the generator to fall, which weakens the control magnet and allows the spring to close the contacts again. The cycle repeats itself rapidly, causing the line voltage to float about a given point, at any point on the line to which the regulator is attached.

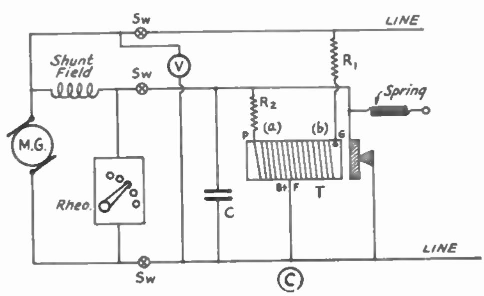

FIG. 18 — VOLTAGE REGULATOR FOR THE MOTOR-GENERATOR SET MADE FROM AN AUDIO TRANSFORMER AND FORD CONTACTS

T — 6-1 audio transformer (Thordarson). Secondary winding at (b); primary winding at (a).
R_1 — 3000 ohms.
R_2 — 5000 ohms.
C — 2 μfd., 400-volt rating.

The bucking coil *a* (the primary of the transformer) refines and quickens the action. When the contacts are closed, both the field rheostat and the bucking coil (connected in reverse across the rheostat) are short-circuited and inoperative. When the contacts open, both become operative. The bucking coil demagnetizes the core, but its inductive lag delays this action long enough to permit the non-inductive resistance of the field rheostat to operate. Properly adjusted, this device will hold the voltage within a fraction of a volt about the desired point, within the capacity of the generator and prime mover. Each winding requires only a few milliamperes. The best operating density for the reverse winding can be determined by varying the resistance in series with this winding. The one described uses 5000 ohms. A reversing switch across the contacts permits them to wear evenly, although at 5 cents each the cost of renewal is not excessive.

The device described has been in 24-hours-a-day service for three months on a 3.5-kw. 125-volt water-wheel driven generator used for lights and small power; and its regulating properties are such that it controls the voltage perfectly from full load to runaway speed. The original contacts are still in use. They should be set very close — 0.02 inch or less — as the travel is very small.

In the audio-frequency transformer used here *G* is connected to the line and *P* to a point between the field rheostat and the shunt field. *B* and *F* are joined together by a jumper and connected to the other side of the line at point *C*. To determine the size of condenser across the contacts, operate the device near a.b.c. receiver, adding capacity until a quiet point is reached. I use a 2-μfd. 400-volt condenser.

To put the regulator in operation, turn the field rheostat back until it gives desired voltage across the line at runaway speed. Then switch in the regulator, and adjust the spring until the voltmeter shows the desired voltage.

— *F. I. Anderson, New Boston, Mass.*

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A Portable Power Supply

Several ways of getting plate power from low-voltage d.c. for a small transmitter have been described in past issues of *QST*. A simplified arrangement operating on the vibrator-transformer principle has been worked out by A. P. and I. L. Brown, W8VJ-W8IDE, so that no special apparatus is needed — further, the power supply can be used on a regular a.c. line when such a line is available. In brief, the idea is to use an ordinary small power transformer, hook up the rectifier and filter in the regular way, and connect a 6-volt storage battery in series with a Ford spark coil to one of the unused filament windings on the transformer, preferably a 5-volt winding. When a.c. is available the regular primary is connected to the line. Fig. 19 gives the details.

W8VJ recommends that the transformer be one giving about 300 volts each side of the center-tap. The power supply as shown would be suitable

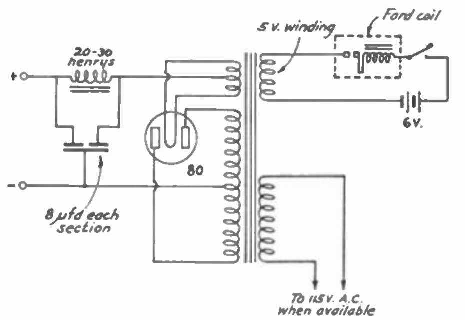

FIG. 19 — POWER SUPPLY, FOR A SMALL TRANSMITTER OR RECEIVER, WHICH WILL OPERATE FROM EITHER A SIX-VOLT STORAGE BATTERY OR AN A.C. LINE

for a low-power transmitter, but by the addition of a second filter choke and a third 8-μfd. condenser section it can be used to supply a receiver. In the latter case it has been found advisable to put the Ford coil in a grounded metal can to help cut out the "hash" from the vibrator. Filaments of the tubes used in the receiver or transmitter can be supplied with power.

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High Voltage from 32 Volts D.C.

HAMS without access to commercial power but having 32 volts d.c. available will be interested in the power supply used at W9KUI. The set-up described is the result of a couple years spent experimenting on various types of power supplies for 32-volt systems. Among others, a home-grown motor-generator was tried, but its efficiency was terrible.

The supply used now is relatively efficient, easy to build and is entirely satisfactory. It supplies 35 watts to a pair of 45's with 375 volts at 95 mils. This supply consistently brings better QRI reports to the same transmitter than my previous supply which had 24 mikes and 3 chokes. In 31 contacts on 80-meter c.w., not counting two contacts made with the choke shorted out, tone has been reported as T8 once, at all other times T9, sixteen of which were T9X.

The lay-out consists mainly of an altered Stancor ten-tube transformer P949, having a 110-volt primary, 700-volt 120-ma. center-tapped secondary, 6.3-volt secondary and a 5-volt secondary. The idea is to change the 110-volt primary to adapt it to 32 volts. The fiber mount carrying the soldering lugs is removed, also the half shell. Without removing the laminations, cut the wire in the two low-voltage secondaries and remove them, being careful not to damage the 110-volt primary which is underneath. Remove three layers of the primary and about 10 turns of the fourth. Remove a little of the insulation under these ten turns exposing the fifth layer. This gives you three taps on your primary, one at the end of the coil, another at edge of the fourth layer where wire goes to fifth layer, and the third tap is where the fifth layer was uncovered by removing those ten turns. Experiment to find which tap works best. Using too few turns in the primary causes excessive sparking at the vibrator points. I use the middle tap. This primary is put in series with a Ford coil. The high-voltage terminal of the coil is not used. The success of this supply depends largely on the buzzer adjustments. Put a toothpick under the brass reed of the stationary contact. Connect your transmitter to the set-up for a load. A high-range voltmeter or other means of noting results is necessary. With the buzzer running, voltage will probably be about 150. Now, take another toothpick, place it between the core and the vibrating reed and gently push the reed toward the stationary contact. The voltage will rise sharply. This second toothpick is only temporary, to show what results may be expected. To make the permanent spacer, cut strips of thin QSLs about 1 inch by 1½-inches and place them between core ending and vibrator. The idea is to dampen the vibrations so as to increase the period of time that current flows during each cycle. I use two strips and get a fine adjustment by sliding a smaller third strip up and down between the two. There should be very little sparking at the points.

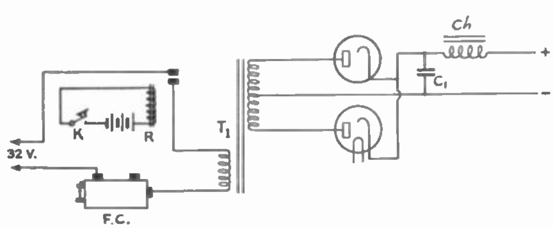

FIG. 20—COMPONENTS ARE DESCRIBED IN THE TEXT

The vibrator should give out a vigorous buzz. It will pay to spend plenty of time experimenting with different thicknesses of paper and adjustments of the thumb screw. A fraction of a turn from where it works best, the points start arcing. You must have good points. They cost only a nickel a pair so have some spares.

A little arcing usually spoils them in short order.

I have taken 40 watts from this outfit, but it is more stable at 35. I use 36 volts input, usually, sometimes only 30, which gives 30 watts output from the supply.

The keying relay is a Ford cut-out, stripped of wire and rewound full of No. 32 d.c.c. wire. A 1-μfd. condenser across the keying points may be advisable. The rectifiers are a pair of Type 1s. Full-wave rectification is used. Half-wave rectification didn't work at all. The filter consists of a 1-μfd. electrolytic and an overloaded 30-henry choke. At first thought, this would seem inadequate, but the high-frequency supply filters very easily.

A single 6Z4 was used for a while, but it gave considerably less output. The regulation was poor and it was necessary to have sufficient load on it to hold the voltage down.

The vibrator adjustment makes a lot of difference about the chirp, too. This rig draws not more than 2½ amperes when key is pressed and, of course, none when key is up so its average efficiency is quite high. It will handle 25 w.p.m. okay. Break-in can be worked with it also. I have my Type 45 filaments in series and heat them with five volts d.c. The 6-volt battery for the keying relay heats the rectifier tubes which are in parallel. Very likely, an excellent portable power supply could be built up like this, using No. 6 dry cells. — *Wilbur J. Tabor, W9KUI*

Transmitter Power from 32 Volts—Another Design

THE power supply being used at W8EZQ probably will be of interest to those amateurs who are handicapped by having nothing but low-voltage d.c. for power supply. It operates directly from the 32-volt Delco lighting circuit here but the same idea may be used on any d.c. supply from a single 6-volt storage battery to the 220-d.c. used in some village lighting circuits.

The rig here consists of a special home-made spark coil having two filament windings, one for the Type 80 rectifier and one for the 10 oscillator, in addition to the high-voltage winding and primary. The circuit, with the exception of the primary, is identical with the well-known a.c. rig using a half-wave rectifier and brute-force filtered system. Fullwave rectification is of course more desirable, but unfortunately the wire on hand for the h.v. secondary was not sufficient to give enough voltage each side of the center-tap. The result was the half-wave system using the two sections of secondary in series. The complete circuit of the power supply is shown in Fig. 21.

The core of the spark coil used now is made up of laminated iron and measures 1½ by 1¼ inches in cross section. The first coil tried used a soft iron wire bundle one inch in diameter. The length in both cases was 7 inches. There seems to be no advantage to the larger core; it was tried in an effort to reduce the number of turns per volt, but it was found that 10 turns per volt was the best that could be done. This gave 320 turns of No. 20 enameled wire on the primary for 32-volt operation. A smaller number of turns caused prohibitive sparking at the buzzer points. The 5-volt winding for the 80 rectifier contains 60 turns of No. 20 enameled wire; a few extra turns were added here for good measure but the voltage was not excessive. The winding for the filament of the 10 oscillator contained 90 turns of the same wire; the extra turns here made the use of a filament rheostat necessary.

The high-voltage secondary contains 2.8 lbs. of No. 28 s.c.e. wire, wound in two sections of 3450 turns each. These sections are wound in even layers with a piece of typewriter paper between each layer. Thinner paper was not used because of the trouble with the end turns of each layer.

The interrupter is the regular Ford buzzer assembly, with a toothpick under the brass reed on the stationary contact and an extra spring-steel vibrator under the regular Ford vibrator to add stiffness and increase the frequency.

The whole power supply is assembled in a wood box 10 by 10 by 6 inches. A four-wire cable about 9 feet long, carrying the 10 filament supply and the high-voltage leads, runs from the power supply to the oscillator. This power unit is then placed in the next room as far away from the operating position as possible. In this way the noise of the buzzer is scarcely audible, which is greatly appreciated by the rest of the family.

The oscillator unit is a vertical breadboard layout using the single-control transmitter circuit. The rig has been on the air every day since early February, and the log shows 40 contacts during 15 days, all on the 80-meter c.w. band. The QRI reports are two near d.c., 6 crystal p.d.c. and all the rest p.d.c. Signal strength varied from S6 to S8 with the average about S7. These contacts were all with 8th and 9th

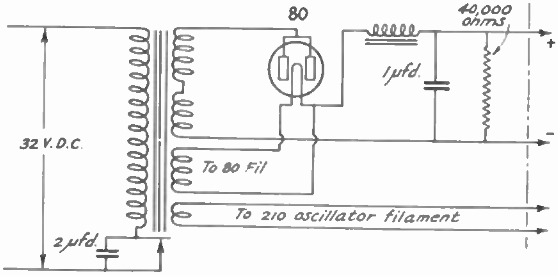

FIG. 21

district stations within a radius of about 300 miles. The plate current with antenna on is 55 mils, and with antenna off about 38 mils. The actual voltage is not known but it put the pointer off the scale on a 300-v. meter early in the experiment.

In a problem of this kind there are always detail difficulties, and I would be glad to hear about them from anyone building a similar rig. The most unsatisfactory part of the thing is the buzzer. Possibly a circuit breaker such as is used on automobiles, operated by a small motor, would do the trick. A closed-core transformer could then be used with a possible improvement in the voltage regulation and the number of turns required per volt.

This power supply seems to require less filter then the usual a.c. rig. The choke is an old make-and-break coil from a gasoline engine. Only one filter condenser is used. An 8-μfd. condenser was first tried in place of the 1 μfd. but did not improve the signal to any extent.

A word of warning may be in order against the use of a 60-cycle a.c. volt meter in checking the filament voltage. The meter I have seems to read one-half the actual voltage although it checks o.k. on a.c. broadcast sets.

— *Lyle L. Farver, W8EZQ*

Transformerless Plate Supplies

The idea of taking the power for receiving tube plates direct from the power line without the intermediary services of a transformer is by no means new, but it is only recently that the practice has been at all widespread. "Transformerless" or "universal" receivers are popular in the extremely low-price class in the broadcast field, and it is for these sets that the new 25Z5 rectifier has been developed. The 25Z5 has two separate cathodes and plates — and is equipped with a relatively high-voltage heater. Consequently it is possible to do things with this tube that could not be done with previous types without an unjustifiable amount of auxiliary apparatus.

To the ordinary amateur the saving represented by the elimination of the transformer from a receiver plate supply is not great because the smoothing filter, which represents a large part of the cost, is just as necessary and must be just as elaborate, if not more so. Besides, the receiving tube filaments have to get power from somewhere, and this usually means that a transformer is needed anyhow, since serious operation of filaments from the 110-volt line is not so satisfactory with regenerative receivers. Nevertheless it is possible to make a very compact plate supply without a transformer — probably useful for a portable set, for instance. Again, a plate supply of this type can be used to replace the B batteries often used with receivers employing a.c. tubes.

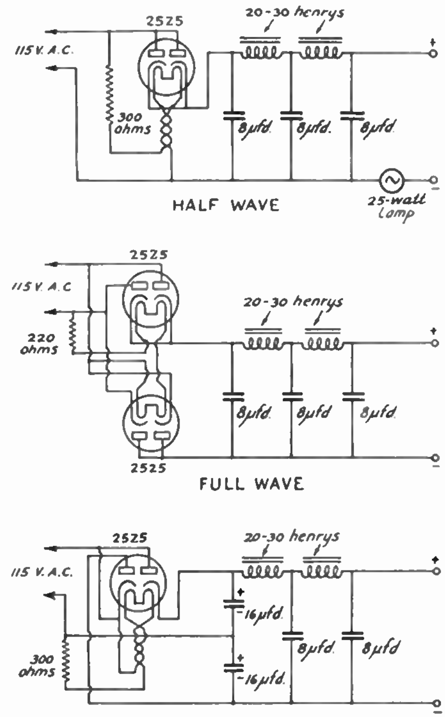

FIG. 22

Three circuits using the 25Z5 rectifier are shown in Fig. 22. The first — and in many respects the most satisfactory of the lot — is the ordinary half-wave circuit, the plates and cathodes of the two diodes within the tube being connected together. The filter is a two-section affair, using three 8-μfd. electrolytic condensers and a pair of miniature chokes (about 50-mil. capacity). A 300-ohm resistor is connected in series with the heater of the 25Z5 to drop the voltage to 25 volts. This resistor should be capable of dissipating about 30 watts continuously. A plate supply of this type has shown itself to be capable of operating a standard three-tube regenerative receiver very satisfactorily. With the receiving-tube heaters grounded in the usual way through a center-tapped resistor, there was no noticeable hum attributable to insufficient filtering. There may be some trouble with tunable hums — a different breed of noise altogether — but these usually can be eliminated by shunting a fixed condenser of about .002-μfd. capacity across the plate and cathode of the rectifier tube, and sometimes by connecting a non-inductive .1-μfd. condenser across the 300-ohm resistor. The output voltage is about 140 with the receiver and voltage divider connected. The 25-watt lamp is in the circuit to prevent blowing of fuses should the negative side of the power supply be connected to the ungrounded side of the 110-volt line. One of the chief advantages of this half-wave circuit is that a direct ground may be used on the receiver. If the power supply is plugged in "wrong way to," the lamp will light but no damage will be done.

The full-wave circuit is shown chiefly as a matter of interest, in that it is possible to make a bridge rectifier with but two tubes. Using exactly the same filter as with the half-wave circuit, the bridge rectifier had much more hum, possibly because the predominating ripple is 120 cycles instead of 60 and a little bit of it is much more apparent to the ear. The output voltage was exactly the same as with the half-wave circuit. A direct ground cannot be used on a receiver supplied plate power from this type of circuit. The best that can be done is to ground through a mica condenser of about .002 μfd.

The voltage-doubling circuit offers about the same hum difficulties as the full-wave circuit and has the same limitation on grounding the receiver. Its principal claim to consideration is the fact that fairly high output voltage is obtainable. Actual measurement, using the same three-tube receiver as a load, showed that the output voltage was about 240 volts. The regulation will depend principally on the size of the two input condensers. Anything from 8 μfd. up seems to work well at the small load taken by the usual ham receiver.

Let us repeat once more — *do not use a direct ground on the receiver with either the second or third circuits.* One of two things is sure to result — either one rectifier will be inoperative; or, if the ungrounded side of the power line is connected to ground through the rectifier tube, the tube will be ruined. In the voltage doubling circuit there is also the possibility of blowing out one of the input condensers, to say nothing of line fuses.

— *G. G.*

Multi-Metering the Transmitter

MANY of us are constantly looking for ways to get the most out of the game at the least expense. Here is one method of economizing that will detract in no way from the performance or appearance of the particular "heart's desire" we are working on at the moment. Most systems of using one or two meters to do duty in several stages have disadvantages, such as being unsightly, cumbersome, or dangerous; the method described here, however, is inexpensive and allows fast meter QSY from one stage to another.

Fig. 23 is practically self-explanatory. A 0–1 ma. meter is connected between the rotor arms of two multi-point switches, the switches being ganged together but insulated from each other. Appropriate meter shunts, indicated by S_1, S_2, etc., are left permanently across the indicated points of the two-deck multi-switch. Except when the meter is to be used for 10- or 20-mil ranges, the shunts will be of some value in the vicinity of

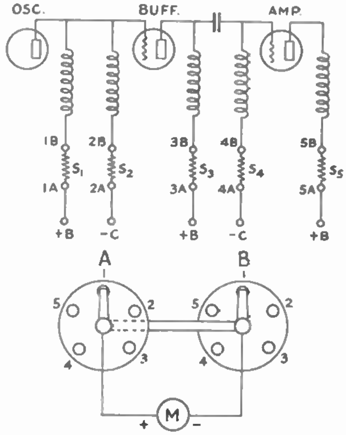

FIG. 23 — METER-SWITCHING CIRCUIT

The meter shunts are part of each circuit to which the meter is connected. The numbers on the terminals of the shunts correspond to the numbers on the two multi-point switches A and B. A suggested arrangement for a three stage transmitter is shown; the system can be used for metering more or less circuits, of course.

1 ohm or less; therefore it will be apparent that the shunts will not affect the performance of the set. In the event that a meter having a full-scale deflection of, say, 50 ma. is used in place of the indicated 0–1 milliammeter, the shunts would be of even lower ohmic resistance. In other words, use any meter at hand as long as the internal resistance is known — this in order that the external shunt may be calculated correctly. Some may say that the switch points will introduce errors, and this is true to a certain extent; however, the error is so small as to be unnoticeable for all practical purposes. Using a good meter, the error from this source will be less than is the case where many of the bargain-type meters are used without shunts. I have been using the system for some time and have tried substituting a correctly-scaled meter for the shunted one, with no difference in results.

EDITOR'S NOTE. — Two-gang multi-point switches of the type used for receiver coil switching would appear to have good enough insulation for low-power transmitters using 500 volts or less. For higher powers it would be desirable to make up special switches with plenty of insulation between contact points.

The formula for calculating the shunt resistance required is

$$R_s = \frac{R_m}{n - 1}$$

where R_s is the required shunt resistance, R_m the meter resistance, and n the scale-multiplying factor desired.

It is suggested that two meters be used, each with its separate switch, in order to obtain simultaneous grid and plate readings on one stage, or plate current in one stage and grid current in another. This will facilitate neutralizing. Remember that all grid meter connections should go to one switch, and all plate connections to the other.

— *Henry T. Brummett, W6EKS*

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Measuring Power with Watt-meter

THE following trick was given me by an unknown public service meter tester and I am passing it on for what value it may have.

To determine the number of watts used by any electrical device operating on the regular line, simply disconnect the other apparatus in the house on the same meter and apply the following formula to the data obtained from the watt-hour meter reading in the cellar.

$$\frac{\text{No. of turns} \times \text{“K”} \times 3600}{\text{time in seconds}} = \text{watts}$$

Simply count the number of turns of the aluminum damping disc in the meter for the length of time that it was observed. As for "K," this is the so-called "disc constant" and for Westinghouse meters it is ⅓ for 5 amp. meters, ⅔ for 10 amp. meters and 1 for the 15 amp. meters. In the other meters such as the General Electric, Duncan and Sangamo the constant is stamped on the disc. In the newer Sangamos the constant is not marked and follows the same rules as the Westinghouse. — *Maynard B. Chenoweth, W2GCC*

—···—

Eliminating Hum Modulation

MANY hams who change from battery to resistor bias find that with only the transmitter filaments on an a.c. hum is imposed on signals tuned in on the receiver. The popular "10's in push-pull" do this plenty. In one instance, a high resistance voltmeter across the plate supply read 600 volts positive when "on" and 20 volts negative when "off" the air. Being cut-and-try here, we looked for the cure first, and found that a 7½-watt lamp in series with the plate transformer primary balanced out the hum. A small "C" battery in series with the grid resistor sometimes works, too.

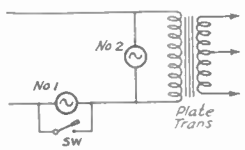

FIG. 24

Going a bit farther, the diagram of Fig. 24 shows a simple "on-off" signal device. Lamp No. 1, in series with the primary of the plate-supply transformer, shows white when the set is off the air. Lamp No. 2 comes on red with the transmitter and No. 1 goes out. Both lamps are 7½ watt. The lamps help smooth things for primary c.w. keying also.

— *Harry Hurley, W6QF*

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Battery Grid Bias

THERE are certain grid bias requirements, such as in Class-B audio and Class-B linear amplifiers, demanding a constant voltage which can be most satisfactorily and easily met by the use of battery bias. Batteries are also much used for biasing Class-A and Class-C amplifiers.

One difficulty often experienced with the use of bias batteries is the effect of the grid current. This current, flowing through the battery in a reverse direction, has a charging action which often results in very erratic battery voltage and short battery life. The circuit shown in Fig. 25 will correct this condition. The resistor in shunt with the bias battery eliminates the charging component by compensation. In operation, all tuning and neutralizing adjustments are made with the switch *S* open. Then, after closing the switch, the resistor *R* is adjusted so that the milliammeter reads zero.

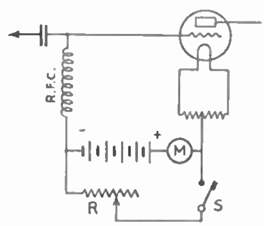

FIG. 25 — BY CHOICE OF SUITABLE RESISTANCE VALUE AT R, THIS CIRCUIT WILL ELIMINATE BIAS FLUCTUATIONS AND PREVENT DAMAGE TO BIAS BATTERIES CAUSED BY GRID-CURRENT FLOW

Under these conditions the grid bias is definitely fixed at the open-circuit voltage of the bias battery and is not subject to fluctuations because of charging. Since no current is drawn from the battery its voltage will remain constant except for the slow decline due to aging. Of course, the switch should only be closed during periods of operation.

To determine the value of resistance needed, divide the battery voltage by grid current (in amperes) and for the wattage multiply the same two factors.

— *L. S. Fox, W2AHB*

Reducing Power

Two simple methods of reducing power for tuning, local work, etc., are given in Figs. 26 and 27. The arrangement of Fig. 26 is used by Harry E. Hurley, W6QF, who has found it particularly useful for those tuning operations (such as adjustment of an antenna filter) during

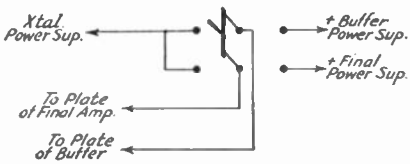

FIG. 26 — THIS SIMPLE SWITCHING ARRANGEMENT CONNECTS THE OSCILLATOR PLATE SUPPLY TO BUFFER AND FINAL AMPLIFIER FOR TUNING OR QRP

which the amplifier tank circuit is likely to get out of resonance. Since the crystal power supply, usually quite low voltage, is connected to all stages when the switch is thrown to the left, the off-resonance amplifier plate current is limited to a fairly low value, thus prolonging the life of the tubes.

The second circuit, in use at W4CBV, uses a

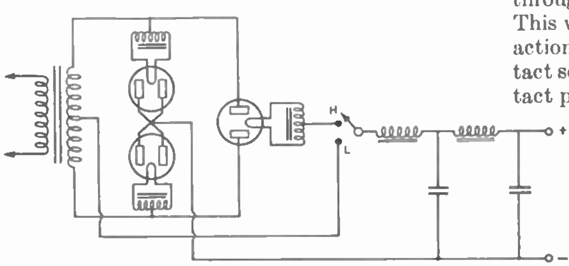

FIG. 27 — BRIDGE TO CENTER-TAP FOR VOLTAGE CHANGING

s.p.d.t. switch to change a bridge rectifier to the center-tap arrangement so that either full or half voltage can be obtained. In the particular circuit shown, 83's are used in bridge with a transformer giving 550 volts each side of center tap. With the choke-input filter, the d.c. output voltage is 960 with the switch on the upper contact, and 480 with the switch on the lower contact.

—···—

An Anti-Blinker

Here is a scheme which may help out hams who find themselves the object of their neighbors' complaints that the lights are blinking.

The transmitter at W4GQ draws quite a bit of power from the 110-volt line, as it uses a 204-A in the final stage, with a 203-A for exciting buffer, both of which stages are keyed simultaneously in the center tap. Consequently, when the key was pressed lights all along the line took a sudden dip, and the filament voltage on the transmitting tubes dropped about ten percent. It was quite impossible for anyone to read while the trans-

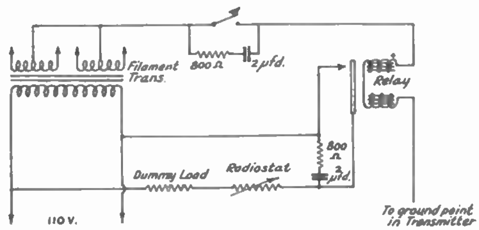

FIG. 28 — ANTI-LIGHT-BLINKING CIRCUIT FOR HIGH-POWER TRANSMITTERS

The dummy load consists of electric heater coils taking approximately the same power as the plates of the keyed tubes. The Radiostat (or heavy-duty rheostat) gives a fine adjustment of load. The 800-ohm resistors and 2-μfd. condensers prevent clicks by eliminating sparking at the key and relay contacts.

mitter was being keyed because of the blinking lights, so the following scheme was adopted:

A dummy load consisting of two 660-watt electric heater coils in parallel was put in series with a Bradley Radiostat (heavy duty) and run through the contacts of a reverse-action relay. This was a 150-ohm telegraph relay with double-action armature. In telegraph use the rear contact screw has a piece of fiber in place of the contact point, and is used only for a back-stop. The contact screws were reversed, so that with the coils energized the contact was broken. Also a heavier pair of silver contacts was soldered on instead of the lighter contacts.

By reference to the diagram Fig. 28, it can be seen that when the key is pressed the d.c. in the center-tap lead actuates the relay coils, releasing the dummy load from the line. When the key is released the transmitter load goes off and the dummy load immediately takes its place. The Radiostat should be adjusted so that the filament voltmeters have the same reading when the key is down as when it is up. When so adjusted, and when the relay contact spacing and tension spring are adjusted to give quick action, there will not be time for the electric light filaments to cool perceptibly during the action of the relay. Result: No blinks, and steady transmitter filaments. When once set the unit may be forgotten. The same switch which cuts the power to the filament transformer during listening periods also disconnects the dummy load, so there is no avoidable waste of current in the dummy.

One word of warning! Don't use a relay with too high d.c. resistance, as it will introduce bias to the transmitter. The 150-ohm relay works very nicely here.

This arrangement has been in use at W4GQ for some time, and works perfectly with any power used. A broadcast receiver in the next room, approximately 15 feet from the transmitter, operates with no interference at all. The only indication that the transmitter is being operated is a dip in the lights when beginning a period of transmission and a brightening back to normal when the transmission is concluded.

— *A. H. Davis, W4GQ*

Home-Made Overload Relay

BEING of an experimental mind I am constantly making some change in my transmitter with the result that I am forever blowing fuses, so I decided to make an overload relay. Sounds simple but isn't. I found that because of the varying load caused by keying, the relay armature would not stay steady until the proper time to throw, and also that to break the high voltage was impracticable because of the long arc between the contacts. Using a 1500-volt plate supply, the contacts had to open more than an inch to make a complete break. Several systems of latches designed to hold the armature closed until an overload came on and to hold it open after the break proved unsuccessful.

The contacts were changed to make instead of break, and in making contact energize a second relay which in turn breaks the line supply. The transmitter "C" bias batteries are used to operate the second relay. The first relay, carrying the transmitter plate current, is wound with No. 25 d.c.c. wire; the second with No. 36 enameled wire. As shown in Fig. 29, the first relay is arranged to be adjustable, varying the space between the armature and pole, to take care of different load requirements.

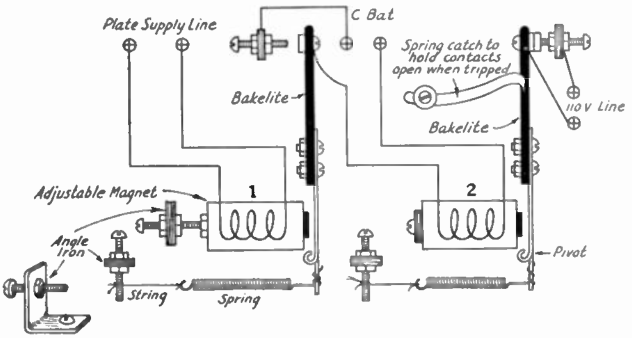

FIG. 29 — HOME-MADE OVERLOAD RELAY

Relay No. 1 in series with the d.c. plate supply line, closes when the plate current passes a predetermined value. This in turn closes the circuit of relay No. 2, which breaks the 110-volt supply to the power transformer. A spring catch prevents the armature of relay No. 2 from dropping back to its original position until released by hand.

On test this could be adjusted to trip at any load from 150 milliamperes up. Winding with smaller wire would permit it to trip on less load.

— *N. M. Patterson, W4EG*

A simple arrangement for keeping the filaments from blinking when the transmitter is keyed is to wind a few extra turns on the core of the power transformer, if space will permit, and connect them in series with the primary of the filament transformer. Three or four turns usually is enough. The key should be in the primary circuit of the power transformer. — *W7ASQ*

8

The Antenna System

Antenna Supports

THE winter season often sees many an antenna lying on the ground because the wire contracted and snapped, or because it was forced down by heavy snow or a strong wind.

I have saved myself a lot of annoyance and trouble by stringing up my antenna as shown in Fig. 1. Of course, weights on pulleys or other superior ways of holding up an antenna are to be preferred, but most of us depend on fixed supports to hold up our antennas, and in such cases this idea may help.

We must have our antennas tight enough so as not to sway too much, and as a result it doesn't take much to snap the supporting wires. If another supporting wire (as shown) is provided to hold the antenna temporarily in place, the antenna is still operative, and when a warm day comes the broken wire can be replaced.

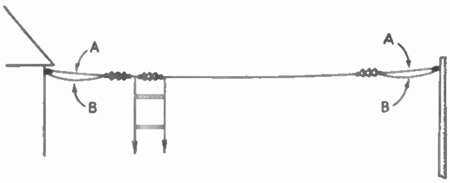

FIG. 1 — COLD-WEATHER PROTECTION FOR THE ANTENNA

The regular supporting wires are of lighter gauge than the antenna wire to ensure their breaking before the antenna itself in case of unusual strain. The extra loops will hold up the antenna until the broken wires can be replaced and normal tension restored.

— *Antonio Gelineau, W1BHR*

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Guying Antenna Masts

IN GUYING antenna masts the only possible advantage of having more than three guys to a set is that in case one of them breaks the remainder can be re-arranged to support the pole, but since any shock strong enough to cause breakage of a properly installed guy will likely bring the pole down anyway, even this advantage is doubtful. All guys of a three-guy set will always be at the same tension, just as a three-legged table never rocks.

Any intermediate guys should be arranged like the top set on the "2 by 2" mast in the *Handbook;* that is, one guy directly opposite the antenna and two front guys, all three evenly spaced 120 degrees apart. This leaves a clear space under the antenna, which is an advantage, particularly when antenna is lowered for repairs or changes.

In the case of the top guys this arrangement is not so good, because when the antenna is tightened it takes the strain off the two front guys and there is a tendency for the rig to rock sideways in a wind. It is better here to reverse the arrangement and have two back-guys, possibly somewhat less than 120 degrees apart, adjusted to pull the pole slightly back from vertical so that when antenna is pulled tight it straightens it up, the antenna and two back-guys forming a three-guy set. A top front guy directly under the antenna merely serves to keep the pole in place when antenna is down, and if intermediate guys are used and the mast is reasonably rigid this third guy will be unnecessary.

When raising a mast which is big enough to tax the facilities available, it is some advantage to know nearly exactly the length of the guys. Those on the side on which the pole is lying can then be fastened temporarily to the anchors beforehand, which assures that when the pole is finally raised the chaps on the opposite guys will pull it into a nearly vertical position with no danger of its getting out of control. The guy lengths can be figured by the right-angled triangle rule that "the sum of the squares of the two sides is equal to the square of the hypotenuse." In other words, measure the distance from the base of the pole to the anchor, square this and add it to the square of the length of the pole up to where the guy is fastened. The square root of this sum will be the length of the guy.

It is advisable to carry the pulley rope back up to the top in "endless" fashion same as a flag rope; then if antenna breaks close to the pole due to sleet storms, boys using the insulators as targets, etc., there will be no trouble in pulling down the remnants and making repairs. The writer has always used stranded clothesline wire for pulley lines rather than rope; there may be electrical disadvantages in this but it eliminates trouble due to stretching or breaking of ropes.

Care must be taken in selecting the pulleys, however, to make sure there is not enough slack between the sheave and the frame for any chance of the wire's climbing the side and jamming.

— *W. F. Reeves, VE5CT*

Twisting Heavy Guy Wires

THE business of twisting guy wires on to egg and antenna insulators becomes a tedious and difficult process when the wire size is large, as in the case with some of the high masts

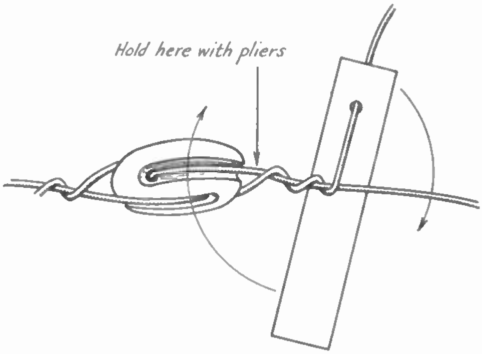


FIG. 2 — USING A SIMPLE LEVER FOR TWISTING HEAVY GUY WIRES

now in vogue. A labor- and time-saving device that is as simple as it is useful can be made from a piece of heavy iron or steel with a single hole, about twice the diameter of the wire, drilled about a half-inch in from one end. The wire is passed through the insulator, given a single turn by hand, and then held with a pair of pliers at the point shown in Fig. 2. By passing the wire through the hole in the iron, and rotating the iron as shown, the wire is quickly and neatly twisted, resulting in a junction that will satisfy the most meticulous.

— *W1JPE*

Universal Joint for Zepp Antennas

THE construction of a Zeppelin feeder system is, on paper, a perfectly simple matter. With a tightly stretched horizontal antenna and feeders suspended straight downwards, the antenna, the feeders and the spacers make a perfect aggregation of right angles, as may be seen from *A* of Fig. 3. The feeders do not need to run straight down; they can be displaced to either side of the antenna without disturbing the symmetry of the system. But even this ideal condition does not permit raking the feeders fore or aft along the antenna to the attitudes shown by the dotted line, in the endeavor to lead them into the shack.

In practice it is always a different matter. The antenna is never perfectly tight, the insulators

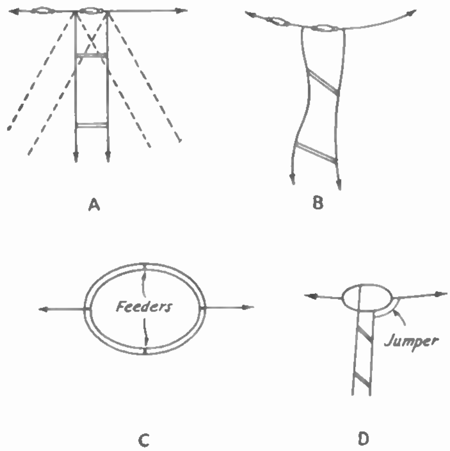
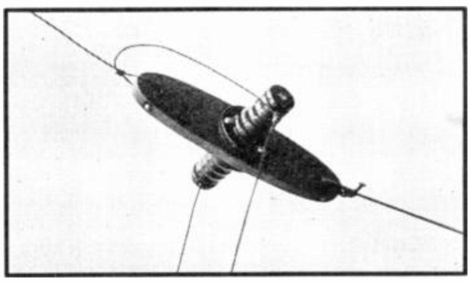


FIG. 3

always sag and the general theory goes all to pot as shown in *B* of Fig. 3. There is one attitude in which the feeders can be put and kept evenly tight — if one can find it — but as every amateur knows from bitter experience the feeders are then invariably running in the wrong direction, frequently directly away from the waiting lead-in insulators. It takes a civil engineer and all his working tools to design such a rig so that the feeders may be under even tension and yet terminate at the desired point. And even then the result will change with the tension on the antenna.

Fed up with this sort of thing, I bethought me of the arrangement shown in Fig. 3-*C*. It is in effect a species of universal joint for Zepp feeders. Antenna and halyard would connect to the "ends," the feeders to the "sides," with a jumper from one side to the antenna. With such an arrangement the antenna may terminate wherever it need be and the feeders may be brought to wherever they have to go, yet remaining evenly taut. By reference to *D* of Fig. 3 it is plain that if the feeders are placed thus side by side they may



HOME-MADE UNIVERSAL JOINT FOR THE ZEPP be displaced fore or aft to any desired degree. They may similarly be displaced to either side, the entire assembly assuming a slight rotation, simply by twisting the antenna wire a few degrees. Any desired combination of the two movements is possible. You don't worry about it — you just stretch the feeders from here to there and the gadget does it.

The photograph shows an experimental insulator incorporating these ideas. A piece of half-inch hard maple thoroughly boiled in paraffin acts as the antenna insulator and carries two G.R. stand-off insulators which support the feeders. The feeders are twisted around the neck of the insulators. The planes of movement are the same as for the ellipse shown in Fig. 3.

— *K. B. Warner, W1EH*

Improving the Performance of the Voltage-Fed Hertz

Recently I had some difficulty in making the usual form of voltage-fed antenna, shown in Fig. 4 A, work satisfactorily. I should like to make known a personal discovery concerning it.

The theory of operation of this circuit is based on the fact that a free oscillating tank "assumes" a ground point at the center due to the capacities

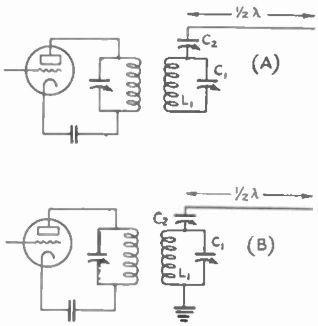


FIG. 4 — THE CONVENTIONAL METHOD OF COUPLING A SIMPLE HERTZ ANTENNA TO A COUPLING TANK (A), AND AN IMPROVED ARRANGEMENT (B) WHICH PERMITS BETTER POWER TRANSFER

of the tank to ground, provided that these capacities are equally distributed. Thus, with the center of L_1 at ground potential there is a voltage between either end of L_1 and ground. Therefore, an antenna could be voltage fed from either end of L_1. However, coupling the antenna to the tank in this manner would offset the capacities to ground, because of the ground capacity of the antenna, and thus move the "assumed" ground point nearer the end of the tank, so that the voltage feed into the antenna would be small and this method would be inefficient for coupling, as in reality is the case.

The ideal condition for most efficient operation using this method would be to have the ground point and the antenna coupling point at opposite ends of the circuit, as this would give the maximum voltage feed to the antenna. The impedances would be well matched, as the impedances of both a resonant tank and an antenna at this point are extremely high. The only way possible to obtain this condition is actually to attach a ground to one end, as in Fig. 4B. The antenna now takes on the appearance of a Marconi instead of a Hertz, but it must be remembered that a resonant tank has very high impedance and high voltage instead of low impedance and low voltage, as is necessary for feeding a Marconi.

As there is practically no current flowing, no special ground is necessary, a steam radiator or a water pipe being sufficient. In tuning this arrangement, best results are obtained when L_1, very loosely coupled to the transmitter and with ground connected, is first tuned to resonance by C_1. Next, the coupling is increased until the proper load is obtained. The antenna is then connected and tuned by a series condenser or loading coil to get minimum current circulation in L_1C_1 or to get maximum current indication near the center of the antenna. It is impossible to tune by current at the end of the radiator because there is so little current that ordinary instruments cannot detect it (about 30 mils for 35 watts). It is also impossible to tune the antenna itself by the plate current of the vacuum tube, as the antenna changes affect the oscillator itself very slightly.

It is quite obvious that any current fed system, instead of being useless on even harmonics, can be made to work very efficiently as a voltage-fed antenna simply by tuning the pickup coil to resonance with the r.f. output by a parallel condenser. It is not necessary to connect a ground in this case as the capacities balance.

I experimented with this system at W1BIH's portable location in Worcester, Massachusetts, and results were all that one could wish for. Before the ground was connected, W1BIH and I called about twenty-five stations and worked only one. With the ground connected we worked an average of three out of four called, with excellent reports. Incidentally we were using a half-dead 10 at the time, and the antenna had a 90° bend near the middle.

— *C. C. Cutler, W1TX*

Remote Switch

The drawing of Fig. 5 shows a home-made switch built by Frank Robison, W6HDX, for the purpose of changing the length of his antenna — in this particular case to change the length so the fundamental wavelength would be shifted from 40 to 80 meters and *vice versa.* A copper switch blade is pivoted as shown on a bakelite "T," the ends of the antennas being fastened at the ends of the arms of the "T." One wire is connected to the blade by a short piece of

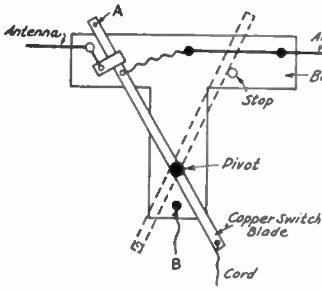


FIG. 5 — A SWITCH FOR CHANGING ANTENNA LENGTH

Similar switches can also be used in other applications where the most satisfactory electrical location is mechanically inconvenient.

flexible wire; the other antenna connects to the switch jaw, also a piece of copper. A coil spring is fastened between the points marked *A* and *B.* A cord is fastened to the end of the switch blade so the switch can be operated from the ground. A jerk on the cord carries the blade slightly past the vertical position and the spring pulls the blade over to the opposite side, much in the manner of the small snap switches used on lighting circuits.

The uses of a switch of this type are not necessarily confined to changing the length of an antenna; for instance, for antenna changeover when the feeders are located close to a transmitter which is remotely controlled; or for operating lightning switches without opening the window, etc.

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Inexpensive Feeder Separators

A FEW ideas for easily-made and inexpensive feeder separators are suggested in Fig. 6. The upper drawing shows the type of spreader used by Earle J. Lander, W7AHN, for which he claims the advantages of light weight, strength, and the ability to "stay put" when once installed on the feeder. It is made from five-eighths inch round celluloid rod, obtainable from small "fixit" shops at a great deal less cost than the bakelite rod often used. Holes are drilled near the ends perpendicular to the axis of the rod to pass the feeder wires, and a second pair of holes drilled in from the ends to meet the first pair. The axial holes are threaded to take whatever size machine screw is used to hold the wires tight.

A second type, suggested by E. M. Gillespie, W2EAF, uses half-inch strips of appropriate length cut from junked bakelite panels, fitted out with Fahnestock clips at each end as shown in the lower drawing. This type will stay in place without special fastening, and can be readily slipped along the feeder wires if it should be necessary. J. B. Abernathy, W6FII, uses the Fahnestock clip idea with spreaders made from half-inch dowels boiled in paraffin.

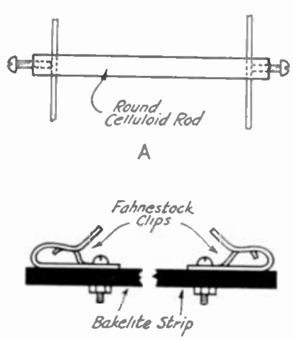

FIG. 6 — FEEDER SPACER SUGGESTIONS

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Voltage-Fed Antenna with Twisted-Pair Feeders

THE antenna feed system of Fig. 7 is suggested by Thomas J. Campbell, W8IEH, for combining a voltage-fed antenna with the twisted-pair type of feeder so that the antenna can be worked on even harmonics, which cannot be done efficiently when the antenna is center-fed in the conventional manner. The method requires attaching a tank circuit, tuned to the transmitter frequency, to one end of the antenna. Although

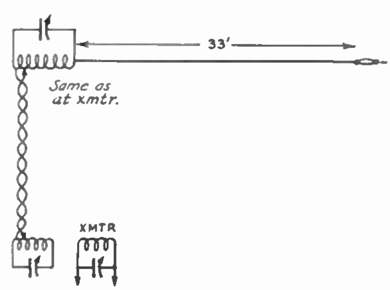

FIG. 7 — TWISTED-PAIR TRANSMISSION LINE COUPLED TO A VOLTAGE-FED ANTENNA

The arrangement is useful when one end of the antenna is accessible but is not brought into the operating room itself. The twisted line may be any convenient length; when the system is properly adjusted the line losses will be small in lengths up to 100 feet or so.

this may be inconvenient in a great many cases, since the antenna tank circuit has to be retuned each time the transmitter is shifted to a different band, nevertheless the idea can be applied with benefit when the operator is confronted by an antenna problem similar to that at W8IEH. In

Campbell's case the construction of an outdoor antenna was not feasible, and the only location which offered reasonable clearance between the antenna and nearby power wires was the attic. Furthermore, it was undesirable to install the transmitter itself in the attic because of the temperature extremes characteristic of attics. Tuned feeders were considered impractical because part of the path they would have to follow in going from the transmitting room to the attic involved rather close association with water and heating pipes. The twisted-pair feeders are unobtrusive and require very little space.

Operating the system requires tuning the coupling tank circuit to the same frequency as the transmitter, adjusting the number of turns across which the feed line is connected, and making similar adjustments at the antenna tank circuit. W8IEH did all his tuning with only a neon lamp, the object of adjustment being to get maximum glow when the lamp was touched to the end of the antenna. The adjusting procedure can be simplified somewhat by omitting the coupling tank at the transmitter and connecting the feeders directly to the transmitter tank circuit through insulating condensers of about 0.002 μfd.

The antenna should be cut for the lowest-frequency band on which operation is desired. The 33-foot antenna at W8IEH was all the attic length would permit, and the system is therefore best at 14 Mc. and higher frequencies. It has been successfully operated on 7 Mc., however, the antenna tank circuit acting as end loading to lower the frequency of the system.

The Twisted-Pair-Feeder Transmitting Antenna for Receiving

The following might be of interest to those amateurs who use a low-impedance twisted-pair line for the transmitting antenna,

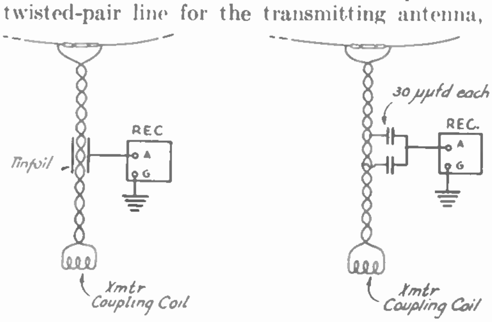

FIG. 8 — USING THE TWISTED-PAIR-FEEDER TRANSMITTING ANTENNA FOR SIMULTANEOUS TRANSMISSION AND RECEPTION

and who would like to use this antenna for reception without the customary changeover switch or relay.

A piece of tinfoil or leadfoil about six inches long is wrapped around the lead-in, as shown in Fig. 8, and the antenna post of the receiver connected to it. The ground post of the receiver is connected to ground. The antenna now works as a "T" type for receiving because of the relatively high capacity between the lead-in wires but is unaffected for transmitting. The receiver antenna coupling coil or condenser, together with this coupling device, comprises a balanced high-impedance circuit bridging the low-impedance feeder, and does not absorb a measurable amount of power.

Two equal small capacities of about 30 μμfd. could be used, but most hams probably will want to use tinfoil or leadfoil because it costs nothing.

— *M. W. Rife, W9IWV*

Half-Wave Hertz for Receiving

The selectivity and signal-to-noise ratio of the National SW3 has been greatly improved by coupling a half-wave Hertz antenna inductively as shown in Fig. 9.

The additional control, C_1, is not critical. The receiver remains "single control" over ranges of 40 to 60 kc. An optimum and critical value of coupling exists between L_1 and L_2. When the coupling is properly adjusted, variation of C_1 effectively discriminates between signals which would ordinarily interfere, and such tuning affects the signal strength alone and not the frequency of the beat note.

This attachment has proven very satisfactory during the past two months. There is no reason why it should not operate equally well at other

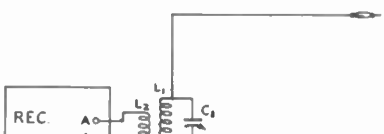

FIG. 9 — TUNED ANTENNA TO IMPROVE REGENERATIVE RECEIVER PERFORMANCE

The specifications given below apply to the 7-Mc. band. The antenna should be approximately 66 feet long.

C_1 — 90-μμfd. variable condenser.
L_1 — 21 turns No. 22 enamelled wire on 1½-inch diameter form. Turns should be spaced to make length of winding one inch.
L_2 — 10 turns No. 22 enamelled wire, close wound.

frequencies when the aerial is cut to a length calculated to develop a voltage loop at the end connected to L_1. — *Robert A. Gallery, W3CTQ*

Editor's Note: The chief requirement of the circuit L_1C_1 is that it should be capable of tuning over the band to which the receiver is set. It is therefore an easy matter to apply the method to bands other than 7 Mc. The antenna will work well on harmonics; it may, in fact, be made approximately 130 feet long and will be suitable for 3.5 Mc. and all higher-frequency bands.

Kink for Using Single-Wire End-Fed Antennas

HERE'S a tip from Bill Reeder, W2HLX, which may help some of those hams having trouble with end-fed antennas when coupling to the final tank is through an additional tuned circuit. He says:

"In using the end-fed single-wire antenna system I find that the set-up does not always function properly. A parallel tuned coil and condenser

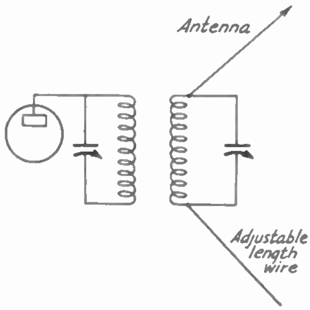

FIG. 10 — COMPENSATING FOR WRONG ANTENNA LENGTH IN THE END-FED ANTENNA SYSTEM

circuit will load up an r.f. amplifier regardless of whether an antenna is coupled to it or not. I have found that sometimes although my antenna tuning circuit loaded the r.f. amplifier very nicely, very little r.f. energy was getting into the antenna. This trouble was due to incorrect length of the antenna proper and was cured as follows: Another wire, the length of which must be determined by the cut and try method, is connected to the opposite side of the antenna tuning circuit, as shown in Fig. 10. The length of this wire is adjusted until an equal amount of r.f. voltage, as judged by a neon bulb, is present at both ends of the antenna coil. Often if the antenna is not the right length exactly all the r.f. voltage tends to be at the end of the antenna coil opposite from the antenna.

"One very useful application of this arrangement is when a station has several different frequencies. In this case a number of single-pole switches can be inserted in the wire for adjusting the length to suit the frequency."

Some Zepp Pointers

IT IS surprising how few amateurs are using the once popular Zepp antenna since the advent of crystal control. Many amateurs contend that this type of antenna will not couple tightly enough to draw sufficient power from their amplifiers and so they use single-wire matched impedance antennas which are difficult to get working properly. I believe the following dope will help these men to build a Zepp which will outperform most "yard-stick tuned" single-wire affairs.

To begin with, the multiple 1.56 times the wavelength in meters is a little short — so short, in fact, that an antenna so designed will fall too far above the crystal frequency to resonate properly.[1] The multiple used here is 1.59 and thus a 65-foot flat-top will tune to 7228 kc. and a 66.5-foot one to 7185. This is proven by tuning a self-excited oscillator to the antenna and measuring the frequency.

A Zepp is a one-frequency affair. No amount of juggling a feeder series condenser will affect the length of the flat-top. Therefore we can cut the feeders to half the length of the flat-top minus the number of feet of wire in the antenna coil. Thus an antenna 66 feet long with 3 feet of wire in the antenna coil will use feeders 31.5 feet long. This eliminates the series condensers.

Most manufactured feeder spreaders are too short. Sterling's Manual is my authority for using 1/200th wave spacing or 7 inches for the 40-meter band.[2] The simplest low-loss spacers may be made by using a hard rubber dowel 8 inches long with hack-saw cuts in the ends and machine screws passed through to tighten them to the wires. The rods come in two-foot lengths and a pair of these will make six spacers, which is enough for quarter-wave feeders at 40 meters.

No. 14 wire is the easiest to work and will carry all the antenna power an amateur may legally use. Paraffin-impregnated wood is not recommended for spreaders because in my experience they leak in damp weather and throw the system out of tune.

To make the system even more low loss the antenna insulator is slipped along the flat-top to the proper spot and the wire twisted around the insulator and brought down as a feeder. This does away with a soldered connection and the antenna is one piece from skywire to antenna coil!

It is well to remember that a half-wave antenna radiates best broadside. This effect may be marked, and on a low-power rig here it meant the

[1] In many cases the opposite has been found to be true the factor 1.56 giving an antenna length slightly too great for the frequency. The length for a given frequency will vary somewhat with local conditions; if the antenna is to be adjusted exactly to frequency a little cut and try is called for. — EDITOR.

[2] The closer the wires the better the cancellation of the fields about them, hence the requirement that the spacing should be small compared to the wavelength. Since the capacity between wires increases as the spacing is reduced, closely-spaced feeders will show larger currents for a given amount of power, which tends to increase the ohmic losses slightly. Neither factor is of great importance in the ordinary amateur tuned feed line, however, customary practice being a fair compromise. — EDITOR.

difference between working Africa, Hong Kong and Japan with a north and south antenna and merely Australia with the same antenna pointed east and west.

Many of these Zepps are in use around Los Angeles with consistently good results. Accuracy in measuring the wire and care to keep the antenna far enough from tin roofs to prevent absorption are the main considerations. Also it is poor practice to use a No. 10 flat-top and No. 16 feeders. No. 14 is cheap now and four bits or so is a good investment in the most important part of your station.

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An Unorthodox Antenna

Many antenna systems, though theoretically good radiators, have the weakness of radiating at angles often not effective for communication. In addition, theory cannot provide sufficiently for the presence of objects such as metal roofs, gutter pipes, BCL antennas and the like, which usually exist on the premises of most amateurs. Hence an antenna which is designed from experiment rather than theory would seem to be justified.

Such an antenna has been designed by the writer's friend, Mr. H. J. Siegel, W3EDP. On first coming on the air two years ago, though he consumed over a thousand feet of wire in experimenting with antennas of the usual types, W3EDP failed to get satisfactory results. His goal was an antenna which could be operated efficiently on all bands, so he set about to design a new antenna, trying to find the best compromise between radiating angle and theoretical efficiency. The radiating angle of an antenna depends not only on the height above ground and the orientation with respect to the horizontal but also on the length. Being unable to alter the first two factors, W3EDP varied the third.

A one-hundred-foot roll of wire was hung up to his mast and tried out for several weeks on 7 Mc. The results were carefully tabulated, with due allowance being made for adverse conditions. Four feet of wire was then cut off and this process repeated. Almost every reasonable antenna length was tried, and then the entire process was repeated several times. When all the tabulations were complete, a length of 84 feet seemed to stand out as being the best of all the combinations tried. It may be apropos here to state that the antenna in all cases was inductively coupled to the final power amplifier by a parallel-tuned tank circuit on all bands. This parallel-tuned circuit was arranged for variable coupling to the final power amplifier tank coil so that it could be adjusted for maximum efficiency and so that the load on the final amplifier could be controlled. It is important to mention here that low *C* in the antenna circuit gave by far the best efficiency. High *C* caused a high circulating current and looked very nice on the thermocouple ammeter but was nil for results.

Not liking entirely the idea of an end-fed single wire antenna, W3EDP set about to find a counterpoise for the best results with his 84-foot antenna. Going through a pruning process similar to that with the antenna itself produced a counterpoise length of 17 feet as the one working best in combination with the antenna. This combination seemed to work excellently on 160, 80, 40 and 10 meters, but on 20 meters a counterpoise length of 6½ feet seemed to outshine all others. The parallel tuning arrangement remains untouched for operation on all bands. W3EDP was a bit skeptical about the operation of this system on 10 meters, so he put his transmitter down there to find out. Results were about equal operating with the 17-foot counterpoise and in operating without any counterpoise at all. The antenna is about 20 feet from the ground and the counterpoises are strung in the room near the ceiling of the first floor of his house. No lead-in arrangement was found necessary, the antenna and counterpoise both being brought directly to the antenna coil. The antenna and counterpoise are at right angles to each other.

Like most antennas, this one has its directional properties, though it is a bit difficult to say just what they are, for at most times it gives excellent results in all directions. Recently we have been getting VK, ZL and ZS stations twice daily on 14 Mc., apparently by different paths; VK and ZL have been worked in the early and late mornings, early afternoon and evening and again at midnight; ZS stations at early afternoon and again just before midnight. Roughly speaking, the antenna seems to give best results in a direction at right angles to its length. It also has the unusual property of emitting a very weak ground wave. On 7 Mc. W3EDP's signals have been barely audible across town, when at the same time he was QSO the west coast and getting an S8-9 report.

Though this antenna may seem unorthodox to many, the results obtained with it should justify it fully. Using a pair of 46's with 50 watts input to the final P.A., W3EDP has consistently received S7-8 reports on 7 and 14 Mc. from five continents. In addition he has worked 75 countries in all continents within two years with this little rig from an average DX location, a record not duplicated by many using higher power. W3EDP has used his antenna system at two different locations with equal results. In addition the writer has used this antenna in a badly screened location, between two houses and under several trees, yet without altering the dimensions from those given him by W3EDP he has obtained excellent results on 3.5 Mc., having worked Europe several times with a pair of '10's.

This antenna is not offered to the reader as a cure-all for his antenna troubles. To discover its true value it will have to be tested at more locations of different characteristics. The dimensions may have to be altered slightly in some locations for maximum efficiency. It is the writer's belief that the design of this antenna perhaps may be the basis of further antenna experiments.

— *Yardley Beers, W3AWH*

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A Sleet Melting Antenna

Nearly every winter we have sleet storms in this section and many transmitting antennas are broken down by the weight of the ice or rendered useless by excessive losses and the detuning effect of the ice.

Several years ago it occurred to me that the most dependable type of antenna would be the feederless end-fed type since the total weight and exposed insulation is much less than with other types. However, the detuning effect of sleet is still serious, and in an effort to correct this condition, a scheme of sleet melting by means of a 60-cycle circulating current was devised and installed this Fall.

The antenna consists of two parallel wires, closed at the far end and separated about one inch by spacers inserted every four feet. These spacers are one-inch square blocks of soft wood fastened in place by binding with fish line. The transmitter end is attached to a d.p.d.t. switch so that the antenna may be switched quickly to the heating transformer. A quick changeover is desirable as it may be necessary to apply heat during listening periods to prevent the sleet from sticking.

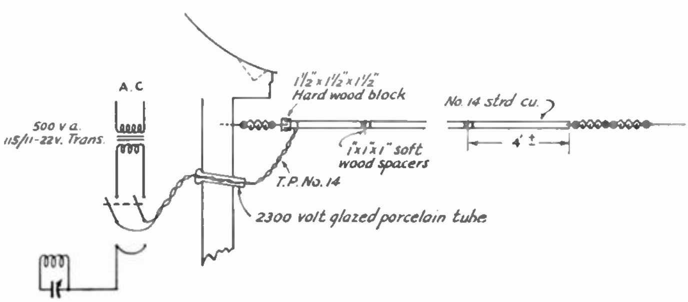

FIG. 11 — SLEET-MELTING SYSTEM FOR AN END-FED ANTENNA

From experience with melting sleet on power lines, I calculate that 230 to 400 watts will produce adequate melting at 0° F. for a 130-foot No. 14 wire antenna. The current is supplied by a 500-va., 115/11-22-volt sign lighting transformer. These transformers are comparatively easy to obtain around repair shops as many incandescent signs that once used them have now been replaced with neon signs.

With the end-fed antenna, better efficiency is realized by using a high-L in the antenna tank. The coil here for 80 meters is 19 turns of No. 14 d.c.c., 3½ inches in diameter. The tuning condenser is a 7500-volt, 30-$\mu\mu$fd. size.

Even if you prefer some other type antenna for regular use, this type would be worth while as a stand-by for emergency use. It is well to remember that during sleet storms, amateurs are often called on to supply emergency communication.

— *Chas. W. Carter, W3EZL*

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Antenna Pruning for Efficiency

In connection with end-fed antennas, James A. O'Neil, W6GIS, has some good suggestions on the business of getting the proper antenna length. His letter is quoted below:

"The method we use is to cut the antenna over-long and then clip to the final tank circuit, which of course is tuned to resonance, selecting a point where plate current is near the desired amount. It then becomes necessary to retune the final to lesser capacity for minimum plate current.

"Disconnecting the antenna, six inches or a foot is cut off, the final retuned to resonance, and the antenna put back on. The change in capacity for the low point in plate current will be less. This process is repeated several times until a length of wire is obtained which requires no retuning of the plate circuit; resonance has then been obtained. It is quite an accurate indication of exact length because as the antenna resonant frequency is approached the pruning must be done in inches. Should too much be removed, the plate tank again requires retuning, the capacity now being increased. With ordinary No. 12 copper this presents no problem. A strong tug restores the needed inches

"The foregoing, of course, only applies to transmitters which are not self-excited. Adjustment of such may be achieved without much more trouble. The receiver, monitor, frequency meter, or what have you, should be set to the portion of the band where operation is desired and the transmitter tuned to zero beat with the antenna disconnected. Tapping on the over-long antenna will drive the transmitter off the selected frequency and necessitate retuning of the transmitter and checking device for zero beat. Cut and again cut till the transmitter frequency remains constant unloaded or loaded.

"In either case the antenna resonant frequency perfectly corresponds to that of the transmitter and the radiating system acts as a resistor load. A good match can be expected over the whole band, usually better than the average hit and miss installation.

"Clipping onto the plate coil for coupling is the ultimate in simplicity, particularly if a split-stator is used for harmonic suppression, but unfortunately is not lawful. The next best thing is the antenna filter described by Collins, which also discriminates against harmonics, and furthermore gives a perfect match on any part of any band if frequency shift is desirable.

"Surely someone will say: why cut to the inch, when copper will stretch a foot or more under strain and any difference can be compensated for in the coupler? The first answer is copper-weld cut to the frequency most in use, or else a periodic trimming of the wire. Secondly the antenna filter is fine and dandy for moving hither and yon, but, for the main frequency, it is my personal opinion that the antenna should be a straight stretch of wire without a loading device. Particularly so when low power is used and every watt is wanted where it belongs.

"The preceding remarks apply mainly to the end-fed antenna since it enters directly into the shack. It is advisable to place the set as close as possible to the entrance for obvious reasons, which brings up the question of loss of height and absorption. Theoretically, they both tend to lower radiation efficiency. But actual results — and after all that is what the majority strive for, whether by orthodox means or not — proved the end-fed superior to a Zepp and single-wire feed system in the same direction at a greater height. Better transfer of energy from the transmitter to the antenna proper helps account for it, and in addition, the usual end-fed has one end considerably lower than the other with resultant directivity off the low end which is absent in the horizontal type.

"To sum up —

"1. The end-fed is the essence of simplicity, requiring no feeder arrangement.

"2. The correct length is easily obtained using only the plate meter.

"3. There is no need to worry whether the power entering the feeder or feeders is being transferred efficiently.

"As a specific instance, an ordinary Zepp caused a 203-A to color slightly at 200 watts input while an end-fed allowed the same tube to be run cold at 350 watts.

"In conclusion, no matter what type of antenna or feed is used the results obtained from careful adjustment are well worth the trouble, since, as K. B. Warner pointed out, the antenna is the weak link in the set-up."

Adjustable-Length Antenna

With the increasing popularity of the vertical antenna for the higher frequencies, many amateurs will be interested in a method for adjusting the length to match the transmitter frequency. A scheme used by Keith Russell, VE9AL, makes it possible to adjust the antenna length quite accurately without cutting. He writes: "I have . . . noticed that a large number of amateurs are coming around to the use of 20-meter half-wave vertical doublets, usually fed by a twisted wire pair. The antenna I am using is of this type, fed with a twisted pair. My frequency is 14,112 kc. so it worked out that each half of the doublet was approximately 16 feet 6 inches in length theoretically. It is well known, however, that contiguous objects such as poles, other wires, etc. have an effect on the natural period of the antenna, and my job was to figure out how to compensate for any such discrepancies with a minimum of exertion to myself. I think I have succeeded in doing this by a device which others might care to copy, as it is so relatively simple.

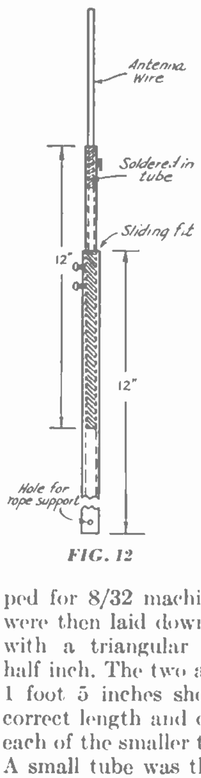

FIG. 12

"I went to the local hardware store and bought two feet each of two brass tubes, the smaller of which made a nice sliding fit into the larger tube. The larger tube has a fairly thick wall, so that it will readily hold a tapped hole and screw. I sawed the two rods both in half, making them exactly one foot in length. I then drilled and countersunk a fairly good-sized hole in one end of each of the large tubes, for attaching the rope or other insulating device. Near the other end two holes were drilled and tapped for 8/32 machine screws. The small tubes were then laid down alongside a steel rule, and with a triangular file nicks were cut every half inch. The two antenna wires were then cut 1 foot 5 inches shorter than the theoretically correct length and one soldered into one end of each of the smaller tubes to a depth of one inch. A small tube was then inserted into each large tube, and using the nicks as a guide, were pushed in and locked tight with the set screws to form one solid piece. The aerial was then pulled up and feeders coupled very loosely to the transmitter and a plate current reading taken. Then the antenna was lowered away and the inside tubes at each end of the antenna slid either in or out some four inches, the antenna pulled up and the reading taken again. Considerable change will be noticed in the plate current of the transmitter, indicating whether the frequency of the transmitter is getting more closely into resonance with the antenna, or farther away. Corresponding adjustments back and forward will enable a very close match to be made between the antenna length and the frequency of the transmitter. The cut marks in the small tubes enable the adjustments to be made identically at both sides of the antenna to one-half inch.

"This scheme avoids the necessity for clipping off portions of the antenna with a pair of pliers and then finding that you have taken off too much."

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Changing the Antenna Directional Characteristics

It is not generally realized that some change in the directional properties of a center-fed full-wave antenna can be brought about by changing the feed method. Quoting from a letter from Edward W. Sanders, W3AKU, "In *QST* several articles have appeared in which mention has been made of the use of an antenna system having two half-waves in phase on the flat-top. Such a situation results in an antenna directional at right angles to the axis of the flat-top, and is accomplished by the use of a full-wave flat-top with an odd quarter-wave feeder connected in to the center. If we increase the length of the feeder by one-quarter wave by means of loading coils or by switching in the appropriate length of wire, we will have two half-waves on the flat-top, but they will be out of phase, corresponding to an end-fed full-wave antenna. This system will produce a four-lobed characteristic, as shown in Fig. 13."

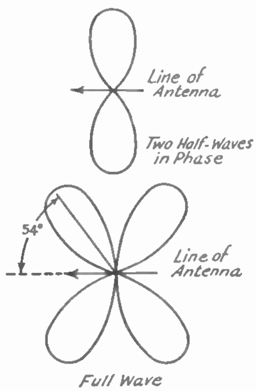

FIG. 13 — HORIZONTAL-PLANE DIRECTIONAL CHARACTERISTICS OF TWO-HALF-WAVES IN PHASE (UPPER) AND FULL-WAVE (LOWER) ANTENNAS

The reversal of phase in one half-wave section of the antenna can be brought about in a number of ways. A section of wire measuring a half wave can be inserted in *one* feeder, or a loading coil having the same equivalent length can be substituted for the half-wave section. A third method is shown in the lower left drawing of Fig. 14. In this case the two quarter-wave feeders are simply connected together and the whole system worked against ground. A short ground lead is necessary in this case. In all three of these methods the feeders are no longer non-radiating, but become a part of the antenna.

To have the feeders non-radiating with either method of antenna phasing, it is necessary to use a third feeder wire which can be appropriately connected to the other two. The two right-hand drawings in Fig. 14 illustrate the method of connection. The upper drawing corresponds to the usual method, giving the directional characteristic of the upper drawing of Fig. 13. The lower drawing puts the two half-wave sections out of phase, giving the directional characteristic of the lower drawing of Fig. 13. This corresponds to feeding two half-wave antennas from a Zepp feeder. The change can be made quite simply and quickly by installing a switch to shift one of the active feeders from one side of the coupling apparatus to the other.

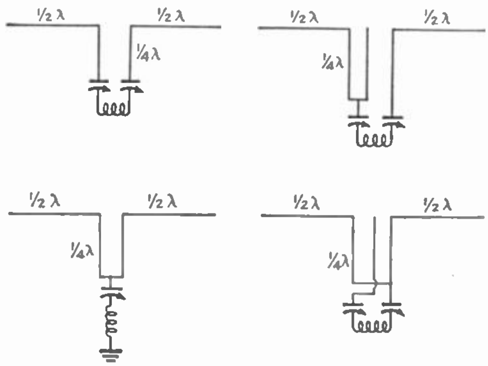

FIG. 14 — FEEDER-CHANGING METHODS TO ALTER THE DIRECTIONAL PATTERN TO CORRESPOND TO THE DIAGRAMS OF FIG. 13

The two upper drawings will give a pattern like the upper drawing of Fig. 13. The lower drawings give the lower pattern of Fig. 13.

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Antenna Directivity

The following letter from W. W. Smith, W1HIO, describes his experiments along the line of obtaining antenna directivity. Undoubtedly it will be of interest to fellows who want to do some work of this type and have the necessary space:

"I have erected and tuned a matched-impedance Zeppelin antenna similar to the one described by L. L. Hardin in February, 1935, *QST*. It is unnecessary, however, to cut the flat top and insert a meter or lamp for tuning. I used a low-resistance lamp bulb in the center of the shorting bar, a scheme which gives good results since the shorting bar is at a current antinode when properly adjusted. On high power a small shunt could be placed around the meter or lamp bulb. After the adjustments are completed the shorting bar with the lamp in it can be replaced with a solid wire soldered to the feeders.

"After using the half-wave Zeppelin for a while I began to wonder how I could improve it. I then decided to add another half-wave section on the dead ended feeder and operate both flat tops in phase. This made the antenna slightly directional and improved reports from stations at right angles to the flat top. After using it this way for a while I wanted more directional effect, so made up another quarter-wave feeder with shorting bar and another half-wave flat top and added that to one end of the antenna. This narrowed the beam of radiation to about a 45-degree arc at right angles to the flat top, and we started getting S9 plus reports with only 50 watts input to a pair of 46's. The second quarter wave feeder is tuned with a shorting bar with lamp bulb in series with it, the bar being slid up and down until the point of maximum brilliancy is found just the same as on the first feeder.

"To date I have operated four half waves in phase for a flat top, and it gives better results than any beam idea I have tried. Some day I am going to make a reflector just like the antenna and place it a quarter wave behind the flat top for still more gain. This will make it a one-direction radiator of a shape more suitable for my location than a 'V' type antenna."

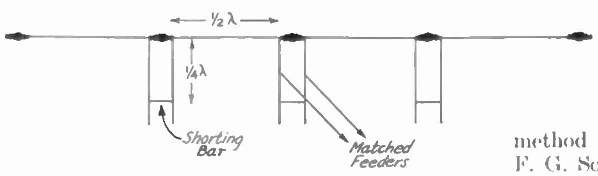

FIG. 15 — A DIRECTIVE ANTENNA CONSISTING OF FOUR HALF-WAVE ANTENNAS FED IN PHASE

Quarter-wave phase-transposing sections are used between the individual antennas, the correct length being found by adjustment of the shorting bar. An antenna of this type radiates best in the direction at right angles to the line of the antennas.

Changing Antenna Directivity

Several times in the past I have noted in *QST* various methods of switching a full-wave center-fed antenna so as to change the directional properties by feeding the two sections of the antenna so that they are either in or out of phase. W3AKU gave some very good connections for accomplishing this (see opposite page); however, they have their objections in that with one system the feeders radiate and with the other three feed wires are required.

For several months I have been using at W5EBP on the 20-meter band a system of feeding the two ends of the antenna out of phase, without radiation from the feeders, with series tuning at the transmitter, and with two feed wires. The arrangement is shown in Fig. 16. Although I do not switch from in- to out-of-phase, this could be done very simply with a pull-cord switch at the junction of the feeders and the antenna.

— *M. H. Lovelady, W5EBP*

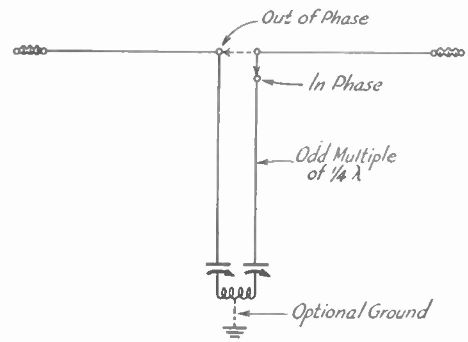

FIG. 16 — SUGGESTED SWITCHING ARRANGEMENT FOR CHANGING ANTENNA RADIATION PATTERN

Antenna-Rotating Device

The essentials of an electrical method for rotating a beam antenna used by F. G. Southworth, W5EOW, are shown in Fig. 17. Rotation is in sixteen steps, which is more than sufficiently fine in graduation to utilize fully the directional properties of a simple beam antenna. W5EOW writes:

"The antenna is copied after Mims' at Texarkana *à la* December 1935 *QST*. However, it was impossible for me to rotate the antenna from the operating table by mechanical means, therefore the birth of the attached brainstorm.

"Briefly, the antenna is turned by an electric fan motor in one direction only through a 250 to 1 pinion and gear combination. Mounted on the antenna drive shaft is a rotary switch with 16 contacts. One of these contacts points directly north. The selector bar strikes one contact at a time.

"Now on the operating table there is also a 16-contact switch, each contact being labeled a direction; i.e., *N*, *NNE*, *NE*, *ENE*, *E*, etc. On this switch there are 15 selector bars, closing all but one contact at each setting. Mounted alongside this switch is a red pilot light. The hookup is simple; the contact on the switch at the antenna end which points directly north is connected to the contact on the operating table switch tap marked *N* and so on through all sixteen contacts. One side of the motor is wired to 110 volts and the other side to the center contact on the antenna switch. The other side of the 110-volt line goes to the selector on the operating table switch. The pilot light is wired in parallel with the motor.

"The operation is simple. Set the operating table switch for any desired direction, which is the direction of the open contact. The pilot light immediately goes on and the motor slowly turns the antenna and the selector switch. When the selector bar reaches the tap corresponding in direction to the open tap on the operating switch, the power is broken and due to the pinion drive the antenna immediately ceases turning. The pilot light also is doused, informing the operator that the antenna is correctly pointed."

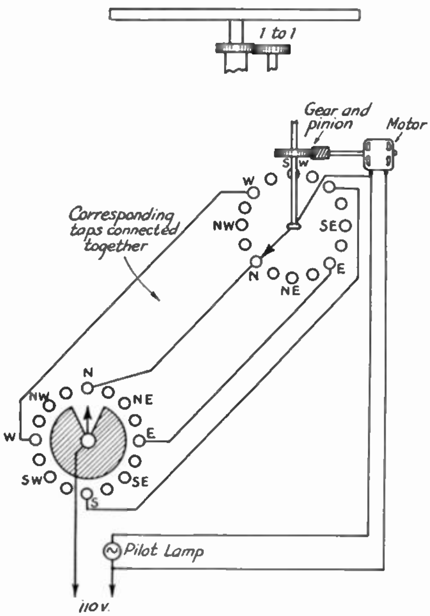

FIG. 17 — AN ELECTRICAL METHOD FOR ROTATING A BEAM ANTENNA

It utilizes a small motor with a pair of sixteen-contact switches, the antenna automatically moving to the direction at which the operating-table switch is set.

Tuning the Receiving Antenna

Most of the modern receivers have so much sensitivity that we don't worry about an antenna, but just hang any old wire on the antenna post and forget it. Some of us, of course, use a doublet with a low-impedance line for receiving, and, finding that it also works well on bands other than that for which it was cut, forget about the probable poor transfer efficiency.

Many of the latest type superheterodyne receivers are equipped for low-impedance input, and are working quite efficiently when a doublet is used on its fundamental frequency. A worthwhile improvement can result, however, by matching things up a little better on the harmonics. Then, too, there is the case of the fellow who wants to use his transmitting Zepp or single-wire-fed Hertz for receiving also. He runs a wire over to the receiver and opens it with a switch when the transmitter is running. But he probably does not get maximum signal transfer, merely an improvement because the transmitting antenna was given first choice of location.

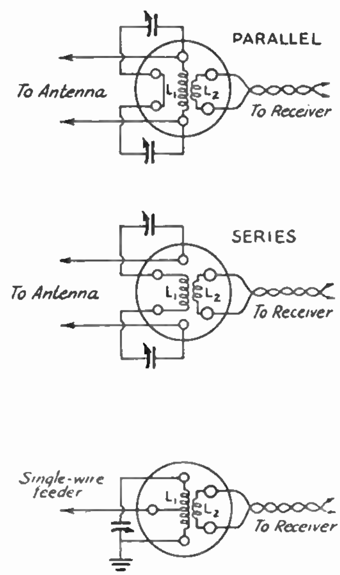

FIG. 18 — TUNED COUPLING CIRCUITS FOR THE RECEIVER

Connects to standard 5- and 6-prong coil forms are indicated. In general, inductances must be adjusted by experiment for optimum results. In the parallel-tuned circuits, L_1 should be of sufficient inductance to resonate on the desired band in conjunction with C_1 (100 μμfd.). With series tuning, the number of turns required on L_1 probably will be small. L_2, the link coupling coil, should have from two to five turns, depending upon the band and the input circuit of the particular receiver used.

A suggestion that works is shown in the sketch, Fig. 18. It merely consists of a tuning system readily adaptable to the type antenna being used, coupled to the receiver through a low-impedance line. Provision is made so that by plugging in the proper coil either series or parallel tuning may be used. In the case of a single-wire-fed Hertz, no provision for series tuning is necessary.

To prevent the tubes in the receiver from burning up when the transmitter is running (high grid currents can be drawn even though the plate voltage is off) provision can be made for shorting the input of the receiver. The transmitting antenna, if used for receiving, should be switched from the coupler to the transmitter. The switching can of course be done by relays, greatly simplifying changeover.

— *Byron Goodman, W1JPE*

A Three-Feeder Double-Antenna System

We know that a single-wire half-wave antenna radiates best at right angles to its axis if it is in free space. It never is, but we'll get to that later. Now, supposing we put up two half-wave radiators at 90° from each other, not connected but fed separately. Then let's put the two together with one common feeder and another for each antenna, making three feeders in all, rigging a switch to select either radiator alone or both together, as shown in Fig. 19. This means we can select either a north-south, east-west or northwest-southeast directioned antenna.

I constructed an antenna like this and am more than pleased with the results. The switch was made with five stand-off insulators and two pieces of copper tubing, as sketched in Fig. 20. Three insulators are spaced five inches apart, with the two that support the two blades of the switch between them. The mechanical construction is only important in so far as the feeders should be kept apart to prevent the inactive wire from increasing the capacity between the other two. The three feeders should be exactly the same length, and should be spaced to form an equilateral triangle so that all three are equidistant. This is important, because it will be necessary to retune when switching from one antenna to another if the system is not perfectly balanced.

If an impedance-matching filter system is used for tuning, the feeders can be less critically cut in length (so long as they are equal), and the difference made up in the filter. One thing might be said, however, about the filter system. If the feeders are of such a length as to bring a current loop at the first condenser, adjusting this condenser often accomplishes little or nothing and is probably the reason why a number of amateurs have condemned the otherwise popular "pi" system. If you run into this condition, adjust the loading coils until the second condenser, when set at resonance, causes the proper plate current to flow in the final stage.

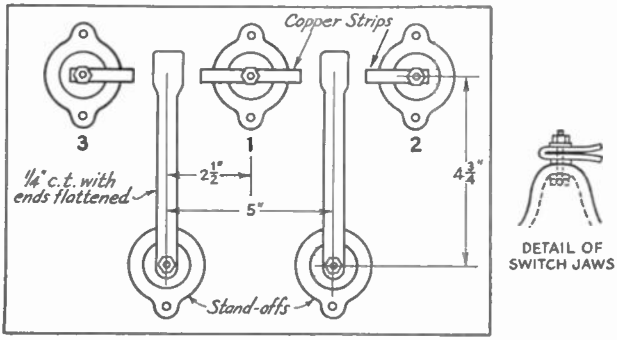

FIG. 20 — FEEDER SWITCH CONSTRUCTION

As mentioned before, the action and influence of surrounding objects affect the antenna appreciably. For this reason the feeders should be tuned without the antennas connected, but pulled up in their final positions. Reduced voltage should be used during this testing. Note the dial reading of the antenna tuning condenser at resonance and attach one antenna. If a readjustment of the condenser is necessary with the antenna connected, the antenna is too long or too short. If the capacity has to be increased, the antenna is too short, and vice-versa. The best way is to make the wire a little too long in the first place; then prune until the length is right. Now attach the other antenna and with the switch in this position, proceed as before. After both aerials have been adjusted you are ready to load your final and CQ.

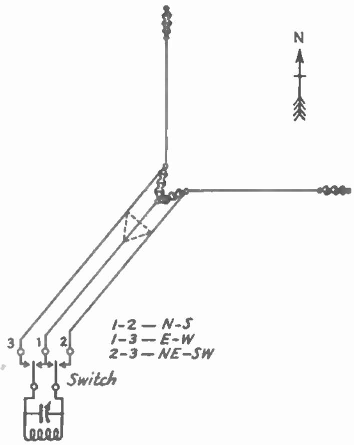

FIG. 19 — THE DOUBLE ANTENNA WITH ITS THREE FEEDERS

The switch permits selecting either antenna or using both at once for different directional effects.

Something should be said about what to expect. With either antenna connected singly, the other is almost ineffective. However, there do seem to be some reflecting properties because my signal strength, judging by reports from those contacted, seems to have increased in all directions. With the switch in the 3-2 position there may be an increase in plate current, the reason possibly being that the inactive feeder is acting as a shield, or perhaps because of a reduction in impedance as a result of feeding two antennas instead of one. As to results, in every contact an increase of at least one "S" point was noted.

As a further suggestion, current fed systems could be tried, crossing at the center. However, I am inclined to believe that the feeder and one antenna right in the center of radiation might cause complications. For ultra-high-frequencies, reflectors might be added fore and aft of the system. Combined horizontal and vertical polarization can be used for a switch from high- to low-angle radiation or both.

The three-feeder double antenna system has more than proved effective in the seven-megacycle band, and I should like to hear of results from others who try it in this or any other band.

—*J. A. Pool, W3ZZ*

Hard-Drawn vs. Soft Copper Wire

When we recently considered putting up a 160-meter fundamental antenna, we ordered some antenna wire and were shipped, by mistake, some No. 12 enameled magnet wire. The question arose as to the stretch and final strength of this No. 14 magnet wire. A very simple tensile testing apparatus was rigged up and several samples tested, with data being recorded as to the increase in length up to the breaking point. The results of tests on a number of samples showed the wire to have an ultimate strength of approximately 150 lbs., and the amazing property of stretching, before breaking, to the extent of 1⅛ inches in an original measured length of 6½ inches, the distance between markers on the sample being 7⅝ inches at the time the wire broke. In the case of an 80-meter fundamental antenna, this would give a total stretch of 280 inches. Why then measure to the fraction of an inch or test for the proper length? The first heavy wind or load of ice will give the antenna additional length.

With these thoughts in mind an investigation was made of the genuine "hard drawn" No. 12 copper wire. In the same test setup, the hard drawn wire showed a breaking strength of approximately 300 lbs. This wire showed a stretch of approximately 1/64 of an inch in the 6.5 inches between markers, when stretched to the breaking point of 300 lbs. If the hard-drawn wire is stretched up to a 150-lb. load, sufficient to break the magnet wire, the total stretch would be only approximately one inch, compared with 280 inches for the softer wire.

— *John H. McAulay, W7BUX*

Link Coupling to the Antenna Tuner

The gang here in Nevada are using a stunt which may be of considerable interest to others. W6UO at Yerrington, Nev., first tried the scheme on his t.p.t.g. 852 rig and it worked beautifully, so others of us have tried it with good results.

It seems to me that the proper place to terminate a pair of tuned feeders is at the point where they enter the building. This usually permits greater antenna height and precludes the possibility of r.f. feeding into power wiring, water pipes, etc. It is not always possible to place the transmitter exactly at the place where the feeders enter the building, however; in my case the transmitter is ten feet from the feeder terminus.

At W6AJP a single turn of wire around the cold turn of the output inductance and a single turn around the middle of the antenna tuning inductance are connected by a link of twisted lamp cord, as shown in Fig. 21. The twisted line has no external field and transfers more energy with less effect on tuning than the usual coupling coil. A small box mounted right at the point where the feeders enter the building contains the antenna tuning unit, with two series condensers, a parallel condenser, and the antenna coil of fourteen turns.

There seem to be so many advantages to this low-impedance coupling arrangement that many of the gang should try it. The twisted link can be

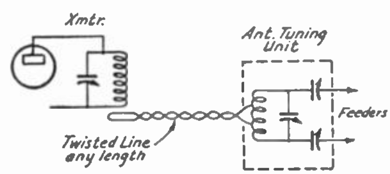

FIG. 21 — LINK COUPLING BETWEEN THE TRANSMITTER AND ANTENNA TUNING APPARATUS

This system eliminates variable inductive coupling and permits placing the antenna tuning apparatus at any convenient point.

run around picture molding, base boards, etc., since the length of the line doesn't affect its operation. For the experimenter, any number of transmitters can be built up using a common antenna tuning unit. With 100 watts output the r.f. voltage in the line is very low and the energy transfer is complete. With self-controlled rigs, critical coupling is eliminated, with greater stability and output. It is necessary, of course, that the antenna be of the proper length, otherwise r.f. will show in one or both of the twisted wires.

— *Tom J. Boland, W6AJP*

Forced to do some soldering on the roof when his antenna lead broke off, W2BNJ saved the day (there was no way to heat a soldering iron on the roof) by using a can of Sterno bought at the local five and dime store. The joint to be soldered was held in the flame until hot enough to melt solder, which was then allowed to run in the joint. This worked on a cold winter day, and may help some hams who run into the same kind of emergency.

Raising a Sectionalized Tower

As everyone who has tried it knows, raising a mast of the order of sixty or eighty feet long in one piece is an awkward proposition, even though the radio club turns out *en masse* to help. One way of simplifying the job was devised by Dr. H. K. McWilliams, of Waller, Texas. His mast is 60 feet high, but the ease with which it went up leads him to believe that an 80 or 100-foot tower could be handled equally well.

The mast—actually a tower of square section, tapering from a width of 30 inches at the bottom to 4 inches at the top—was built complete on the ground, using "2×2's" as the corner members with lattice cross bracing. It was divided into three sections each approximately 20 feet long, the sections being bolted together with appropriate overlap. When finished, the three sections were unbolted and the two upper ones telescoped into the largest, or bottom, section. Since the total height of the "collapsed" tower was only about 20 feet, this was raised easily. The bottom section was then guyed at the top. By means of a ladder, pulleys were then fastened to the upper end of the middle section, ropes being run through the pulleys from outside the tower down through the middle section to ground, where the ropes were tied to the bottom of the inner section. Pulling on the ropes then raised the inner section up through the middle; when pulled up to the right height the ropes were fastened securely and the upper and middle sections bolted together. The two left-hand drawings in Fig. 22 illustrate this procedure. The pulleys were then moved to the top of the bottom section, the ropes fastened to the bottom of the second section, and the upper part of the tower pulled up into place and bolted.

Guys are provided at each joint. Higher towers could be raised by providing additional 20-foot sections and following the same procedure. Dr. McWilliams' tower, although constructed of light material, has successfully withstood several Texas gales.

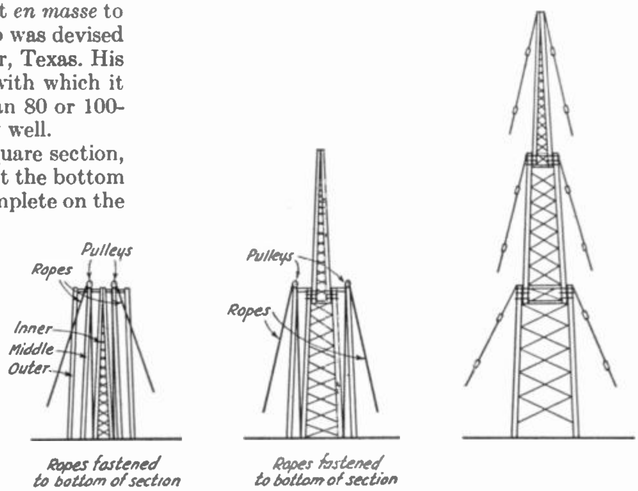

FIG. 22—RAISING A SECTIONALIZED TOWER BY MEANS OF ROPES AND PULLEYS

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Here's a suggestion for a cheap lightning arrester from Lamar Allison, Emory, Va. Get a blown-out plug fuse (generally there are at least one or two around a ham station), screw into an ordinary porcelain lamp socket and mount on the window sill. Connect antenna and ground as with any other arrester. The gap in the fuse preferably should not be too great—a 64th of an inch will be about right—so pick out one that has been blown gently (!!).

9

The Ultra-High Frequencies

R.F. Indicators for Ultra-High Frequencies

WHILE conducting some tests on 56 mc., we found a real need for a very sensitive r.f. meter. The ordinary absorption meter caused a shift in oscillator frequency because of power drain and coupling; a neon tube also was unusable since small variations in power level aren't noticeable, especially during daylight. The problem was solved by building a vacuum-tube indicator of the type shown in Fig. 1.

It is essential that the grid-plate return be connected to the negative side of the filament since a slight negative bias is needed. If the instrument is to be calibrated for laboratory measurements, the filament voltage should be kept constant. Also, it would be necessary to put a potentiometer across the filament battery with the arm connected to the grid-plate return. The potentiometer is then adjusted for a small positive meter reading.

On our tests, we set the meter near the feeder input to the antenna and adjusted the oscillator and the antenna length for real efficiency. The same result was obtained by placing the meter near the antenna ends. Two sets installed in cars were similarly adjusted, while operating over a distance of about four miles, with the result that maximum signal strength was secured.

The pointer of the milliammeter will jump off scale if the unit is brought within four or five feet of a small unshielded oscillator. Its sensitivity and simplicity make it of real value.

— *E. E. Comstock, W3FKQ*

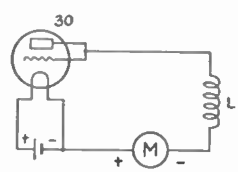

FIG. 1 — AN R.F. INDICATOR FOR ULTRA-HIGH FREQUENCY WORK

An instrument of this type is considerably more sensitive than ordinary meters or neon lamps, and introduces negligible loading in the circuit under measurement. The filament of the 30 is lighted by a single dry-cell or flash-light cell. The meter M is a d.c. microammeter or 0–1 milliammeter. L, the pickup coil, consists of a few turns of small diameter.

Another type of indicator which is particularly useful for locating standing waves on Lecher wires is suggested by Richard C. Elliot, of Tacoma, Wash. He writes as follows:

"For those ultra-high frequency enthusiasts who sometimes experience Lecher wire difficulties this little device, which I call a 'standing wave locator,' may be an aid. It came about in following Hull's [1] instructions on Lecher wire measurements. Because of the physical character of the oscillator and the work room, it was impossible to arrange the meters in a position where they could be read easily from the location of the Lecher wire. Consequently an adaptation of Professor Yagi's [2] method of measuring wavelength was made. The diagram is shown in Fig. 2.

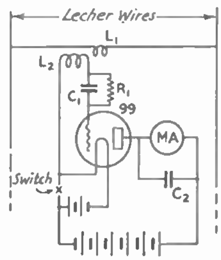

FIG. 2 — STANDING-WAVE LOCATOR

L_1 — 2 turns No. 18 wire spaced about 3/16 inch on a half-inch hard rubber tube the ends of which slide over the Lecher wires.
L_2 — 3 turns on same tube, spaced same as L_1.
C_1, C_2 — .003-μfd. fixed mica condensers.
R_1 — 7–10 megohms. May not be needed.
MA — 0–1 d.c. milliammeter or lower-range microammeter.
The hard rubber tube is about two inches long to accommodate Lecher wires having two-inch spacing.

"The apparatus, exclusive of the sliding wire and L_1 and L_2, can be put in a metal can or box, making it easily portable. The small-sized flashlight dry cells were used for plate and filament supply as they could be employed to fit in odd shaped cans and increase the flexibility and portability of the locator. Of interest perhaps is the high value assigned to the grid condenser C_1. This value was found to give the greatest dip in plate

[1] Hull, Ross A. "Practical Communication on the 224-Mc. Band," *QST*, November, 1934.
[2] Yagi, Hidetsugu, "Beam Transmission of Ultra-Short Waves," *Proc. I.R.E.*, June, 1928.

current when the sliding wire L_1 was at the peak of a voltage node. The node could be detected within a probable accuracy of five millimeters.

"This method would also be useful in searching for unwanted standing-waves in transmission lines. Incidentally most of the parts are to be found in any ham's junk-box!"

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Antenna Coupling to the 56-Mc. Receiver

MANY hams on the u.h.f.'s spend a lot of time getting their transmitting antennas way up in the air or have elaborate directional affairs, but I wonder if they do the same for receiving? From observations in this locality I would say that there are very few fellows paying enough attention to it.

I am located in a valley, on sea level, one and a quarter miles from Long Island Sound, about forty miles air line from New York. With ordinary equipment, such as a super-regenerative receiver and a pair of 45s in transmitter, I think I'm having more fun per mile than a lot of fellows. My antenna is about 60 feet off ground. It is an 8-foot vertical with 44 feet spaced feeders going down into the shack. The same antenna is used for transmitting as receiving. Of course you can't duplex, but how many DX contacts on 5 are?

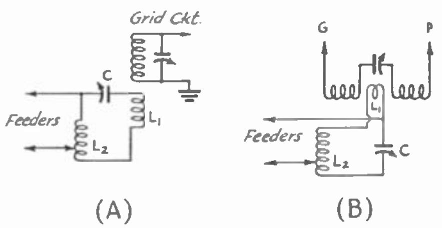

FIG. 3 — TUNED COUPLING FOR THE 56-MC. RECEIVER

L_1 — 3 turns No. 16 spaced 1/16th inch; coil diameter ½ inch.
L_2 — 6 turns No. 12 spaced 3/16th inch; coil diameter ½ inch.
C — 5-plate midget.
The circuit at A is for receivers having a single grid circuit coil; B for receivers using the split-coil circuit.

My fun started when I took advantage of a tuning scheme suggested by W1EYM, N. Bishop, shown in Fig. 3. It has worked well for all fellows who tried it. Make the receiving antenna just as high as the transmitting antenna — or use same one as we do around here. It makes the difference between no signals at all and signals of the S6 to S7 variety.

The feeders from the antenna are clipped on the circuit as shown. The clip on the 6-turn coil is set so that resonance will be obtainable at some setting of C, indicated by causing the receiver to stop regenerating. Signals will be best with C detuned just sufficiently to permit the receiver to return to the super-regenerative condition.

— *Ralph M. Bray, W1CDR*

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Car Antenna Kinks

MANY amateurs are confronted with the problem of trying to install a five-meter transceiver in a new car. I have one of the turret-top cars, which added to my troubles when working out the aerial problem.

The aerial itself is a factory-made telescope-type five-meter antenna, with four mounting holes very conveniently placed at the base. In these I placed four rubber suction cups, of the type one can buy at any automobile supply store. These make a very excellent support for the aerial. When wet these suction cups have an amazing strength and will resist the wind pressure very well.

By placing the aerial on the roof or any convenient place, the feed problem was very quickly overcome by the use of concentric feeders. For this I used low-capacity shielded wire, which works very well. This allows the transceiver to be placed anywhere in the car. Without marring the car in any way the aerial can be very easily and quickly put up and taken down. The connection of the concentric feed in my particular case was one and one-half turns from the cold end of the tank coil. Judging by reports, the aerial seems to be quite efficient.

— *John D. Woodlock*

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Five-Meter Antenna for the Car

NEEDING a method of supporting a 56-Mc. vertical antenna on a car so that the

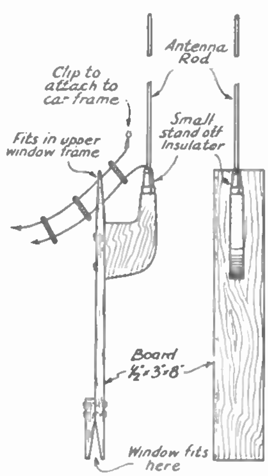

FIG. 4 — DEMOUNTABLE FIVE-METER ANTENNA FOR THE CAR

antenna would be readily demountable and not mar the car in any way, I devised the scheme diagrammed in Fig. 4. It worked very successfully, so I am passing it on to any of the five-meter gang who may be in the same predicament. The car window is cranked all the way down, the upper (sharpened) end of the flat wood piece is fitted in the groove where the glass usually goes, and the window is then cranked up into the groove in the lower end of the wood piece. For the antenna itself, a lath or bamboo flower stake supporting a wire would work just as well as the rod and stand-off combination, which is not very strong in a wind. I use a 46-inch rod with six-foot feeders spaced two inches, a combination which works out well for mobile operation where trees are low over the streets. A small battery clip grounds the odd feeder to the metal rain gutter around the roof of the car.

— *Edgar V. Seeler, Jr., W1BDF*

Five-Meter Interference to BCL's

How one case of interference to a modern all-wave receiver from a five-meter transmitter was cured is described in the following letter from Martin Schwartz, W2EPZ. It may help others.

"For eight months this station has been actively engaged on five meters with a rig consisting of a 53 long-line oscillator, modulated by a Class-B 53. The antenna is a matched affair fed from a line eighty-five feet long. Input to the oscillator is 12 to 14 watts.

"Recently one of the sixty-eight tenants in the building purchased a new Philco Model 29X all-wave receiver. The interference from W2EPZ on this receiver was terrific — no place on the dial was clear of me and the volume was greater than any broadcast station.

"A check on the receiving antenna showed it to be but six feet away from the transmitting antenna and at the same height. Disconnecting the antenna from the receiver reduced the QRM to about 75%. It was decided to convert the antenna to a regular doublet, replaced in the same position. This change removed 90% of the interference. Success was in sight, so a pair of small hand-wound chokes of fifty turns each on a quarter-inch dowel was installed in each of the feeders at the receiver. This eliminated all of the QRM. The new antenna increased the selectivity and sensitivity of the receiver, and needless to say the owner was very greatly pleased. No ground was used."

Shorting Link

In shorting the grid pipes in my stabilized five-meter oscillator, every system I tried only served to pull the pipes together or push them apart, thus throwing them out of parallel. However, I bought two 60-ampere fuse clips, five cents each, connected them with a piece of flexible copper strip, put them on the pipes, and there you are. The 60-ampere size gives a great contact on ⅝-inch outside diameter pipe.

— *Jack W. Turner, W3ERY*

Transceiver à la "Minute Man"

An adaptation of the popular "Minute Man" 56-mc. receiver, originally described in October 1935 *QST*, to make it into a transceiver for portable work has been made by B. P. Hansen, W9KNZ. The revamped circuit, which besides working well has the virtue of using about the minimum of parts, is shown in Fig. 5. Aside from following the specifications given, the constructor will find no special precautions necessary except the usual one of making all r.f. leads short. The various send-receive switches shown should of course all be on one handle — a triple-pole double-throw switch, in other words. The transformer *T* may be one of

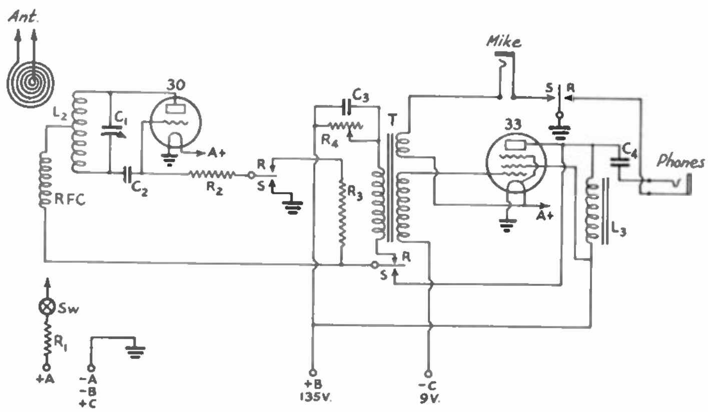

FIG. 5 — "MINUTE MAN" TRANSCEIVER

C_1 — Two-plate midget variable, low-loss.
C_2 — 100 μμfd.
C_3 — 0.25 μfd.
C_4 — 0.1 μfd.
R_1 — 3 ohms.
R_2 — 10,000 ohms.
R_3 — 5 megohms.
R_4 — 50,000 ohms variable.
L_1 — Four turns in flat spiral.
L_2 — 10 turns No. 14, ½ inch inside diameter, spaced diameter of wire.
T — See text.
RFC — 45 turns No. 25 cotton-covered wire, inside diameter ¼ inch, close wound and self-supporting.

the kind made from transceivers or a home-brewed gadget of the type made by W9KNZ, who adapted a midget audio transformer by winding 300 turns of No. 32 wire over the other coils for the microphone.

The antenna used with the transceiver consisted of two wires each about four feet long. These can be cut more nearly to resonance in the band if desired. The antenna coil, L_1, should be moved around in relation to L_2 to give optimum coupling, as judged by reception. One good feature of the rig is that as a receiver the radiation seems to be negligible.

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R.F. Amplifier for the "Minute Man"

A SUGGESTION for using a broadly-tuned r.f. amplifier with the "Minute Man"

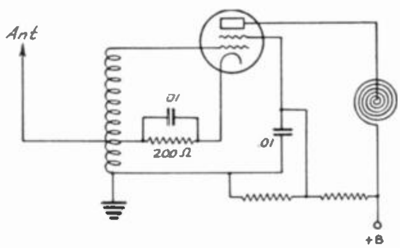

FIG. 6 — SELF-RESONANT REGENERATIVE R.F. STAGE FOR THE "MINUTE MAN" RECEIVER

The tap for cathode and antenna should be a few turns from the ground end — not far enough to permit the tube to oscillate.

receiver also comes from W9KNZ, these amplifiers being in wide use among the Colorado five-meter gang as a means for preventing radiation. He writes:

"The r.f. stage is nothing but a 36 with conventional values. The only unconventional thing is the antenna being brought into the cathode tap and the fact that the cathode is tapped up on the grid coil a little to give some regeneration. The primary of the r.f. transformer (interstage) is the spiral pancake coil mentioned in the original article on this receiver (Oct. '35 *QST*). The r.f. socket must be placed so that the plate lead is of negligible length, and the cold end of the plate coil must be by-passed to ground by a good mica condenser through the shortest possible path. Slotting both the detector and r.f. tube bases between all pins also will help. Everything the original article said about the operation of this receiver still applies. The r.f. grid coil is made of No. 18 bell wire, 22 turns ½ inch in diameter, close wound. By varying the turns a little one way or the other the coil can be made to peak pretty well over the five-meter band."

The circuit is given in Fig. 6.

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Two-Band U.H.F. Transceiver

FIG. 7 is the circuit diagram of a 5- and 2½-meter transceiver which has been used successfully by Eric W. Cruser, W2DYR. Its unique features are the elimination of the special audio-microphone transformer usually required by transceivers, and the provision of a method of monitoring the transmissions. W2DYR writes:

"The vital difference between this and the ordinary transceiver circuit is that no special combination mike and audio transformer is necessary so that the same tube may be utilized as both a modulator and audio amplifier. The circuit is simple and the parts required are of the variety that are usually found in a ham's junk box. The tubes used are a 56 oscillator-detector, and a 56 modulator-amplifier. 27's and 37's will undoubtedly give good results. However, on 2½ meters super-regeneration was only obtainable with certain tubes (evidently some of the newer models with solid plates and spiral heaters).

"To change from 'send' to 'receive' requires no more switching than in the ordinary transceiver, and a double-throw triple-pole jack-type switch does the whole job. Provision is made in the circuit so that the signal can be monitored while transmitting.

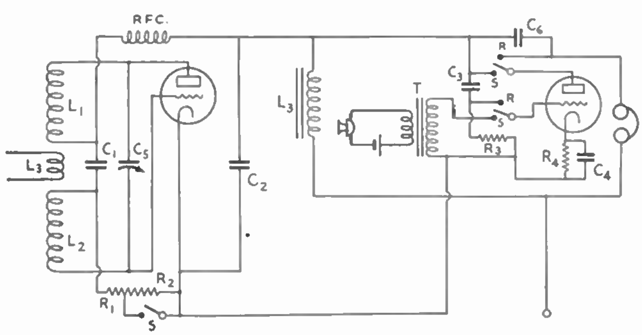

FIG. 7 — A TRANSCEIVER CIRCUIT WHICH REQUIRES NO SPECIAL TRANSFORMER

C_1 — 100 μμfd.
C_2 — .006 μfd.
C_3 — .01 μfd.
C_4 — 10-μfd. electrolytic.
C_5 — 5 meters: 20-μμfd. midget variable; 2½ meters: two half-inch copper discs mounted so spacing can be varied.
C_6 — 250 μμfd.
R_1 — 7000 ohms, 1 watt.
R_2 — 100,000 ohms, 1 watt.
R_3 — 300,000 ohms, 1 watt.
R_4 — 2500 ohms, 1 watt.
RFC — For 5 meters, 4 feet of wire wound on ¼-inch dowel; for 2½ meters, 2 feet of wire wound on ¼-inch dowel.
L_1, L_2 — 5 meters: 7 turns, ⅜-inch diameter; 2½ meters: 3 turns, ⅜-inch diameter.
L_3 — 1 turn, ⅜-inch diameter.
L_4 — 30-henry choke.
T — Single-button microphone transformer.

"When used on 2½ meters the tuning condenser which proved most satisfactory was one improvised from two small copper discs about ½-inch in diameter, one stationary and the other soldered to a screw and mounted so the distance between the two could be varied."

Condenser C_6 makes possible monitoring of the transmissions. A small amount of audio signal gets through C_6 to the 'phones, although with the small capacity specified the power consumed is so small as not to affect the modulation. C_6 has no effect on the operation of the set as a receiver.

The reader will be interested in some modifications which were later made by its designer, W2DYR, who wrote: "The revised circuit is given in Fig. 8. A 2A5 replaces the 27 modulator-amplifier in the 2.5-volt model and a 41 replaces the 37 for 6-volt operation. The biasing resistor was changed to 1000 ohms for these tubes. The grid leak used for transmitting was dropped from 7000 ohms to 5000 ohms, and for receiving from 100,000 ohms to 50,000 ohms. This made the rig operate with more stability on 2½ meters."

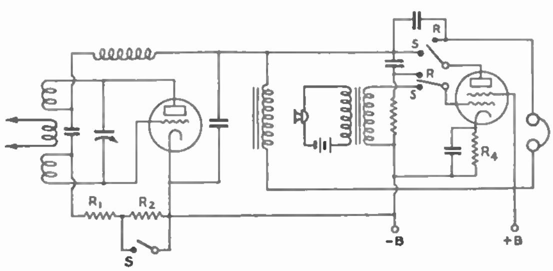

FIG. 8 — REVISED TRANSCEIVER CIRCUIT

The circuit, which requires no special transformer, is shown in its original form in Fig. 7 on page 123. Constants are the same except that R_1 is now 5000 ohms; R_2, 50,000 ohms; and R_4 1000 ohms. The audio tube is a power pentode.

BCL QRM from Five Meters

The following information was gathered after many experiments with BCL interference caused by 56-Mc. 'phone stations to receivers located on the same premises as the station but working from separate power supplies. I am passing it on with the hope that it may help others.

When the antenna was connected to the b.c.l. set the interference covered the entire broadcast band and did not appear to be tunable, but disappeared when the antenna was disconnected. Various methods of elimination were tried, including grid suppressors and by-pass condensers, but while the interference disappeared so did the broadcast program.

Finally a wave trap using a 20-μμfd. midget variable condenser shunted with three turns of bus bar wound to a diameter of ½ inch with turns spaced the diameter of the wire was tried and when tuned to the frequency of the station completely eliminated the interference.

This trap was inserted in series with the antenna lead-in of the b.c. set, but the lead from the trap to the set, while only 6 inches long, was sufficient to pick up the interference. This lead should be shielded and the shielding grounded to the chassis of the set.

This idea was tried on a completely shielded 10-tube receiver of the tuned-r.f. type and it completely eliminated all interference, except that on WABC it appeared to ride in on the carrier. However it was just barely understandable when no modulation was applied to the carrier of the b.c. station.

— *C. M. Spengler, W2BXW*

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VOLUME THREE

HINTS & KINKS

for the Radio Amateur

... A Symposium of 291 Selected Practical Ideas from the Workshops and Stations of Expert Radio Amateurs

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V O L U M E T H R E E

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Foreword

THE SUCCESSFUL RADIO AMATEUR is, by nature, an ingenious fellow. Without a high order of resourcefulness and an ability to improvise he could never overcome the ever-present problem of inadequate workshop equipment and the equally common handicaps of insufficient apparatus and money. Evidence of this inherent ingenuity is to be seen on all sides. One cannot visit any good amateur station without finding clever improvisations, either in the construction of individual components or in the manner in which the whole station is assembled. It may be just a different way to mount a coil, or a scheme for getting a broken antenna halyard back upon the mast, or a fabulous remote-control system. Whatever the idea, it is invariably of value to the rest of us.

With the object of putting the best of these "brain storms" into circulation there has appeared in *QST*, these many years, a department devoted to the general subject of "Hints and Kinks." This department has enjoyed great popularity. The ideas contributed to it by ingenious amateurs have helped us all in our search for ways and means to improve our equipment. Unfortunately this garnered gold of amateur experimentation often has been lost to sight, shadowed by some big article or forgotten in the excitement of some major development. Then, too, there has been the annoying business of vaguely remembering a squib bearing on the problem at hand but being unable to locate it when it is most needed.

These factors led us, in May, 1933, to publish a collection of the best ideas, schemes and methods offered by *QST* contributors during the three years prior to that date. The first edition of *Hints and Kinks* was well received and established definitely the value of a single grouping of selected "experimental expedients," carefully classified and indexed. In 1937 a second volume of Hints and Kinks was published, containing a larger and more comprehensive collection of newer ideas culled from the offerings of *QST* contributors in the period 1934–1937. This edition proved even more popular than the first, and has been accorded widespread acceptance up to this time.

Since 1937 amateur technique has been materially refined and much development of newer tubes, circuits and constructional techniques has occurred. This trend, of course, has been faithfully reflected in *QST*. Accordingly, this new volume of *Hints and Kinks* has been assembled to correlate the best of the prewar ideas. Much of the material has appeared in the "Hints and Kinks" department of *QST*. Some of it has been gleaned from larger articles where it was doubtless lost to the view of many. Arranged in its present form, the material should constitute a potent help both in new construction and reconstruction. It should suggest many intriguing possibilities for putting back to work prewar gear apparatus now gathering dust in the attic. Above all, it should enable each of us, in one way or another, in the planning and assembly of our postwar stations.

We express our thanks to those amateurs whose willingness to offer the result of their efforts to the fraternity as a whole has made this publication possible.

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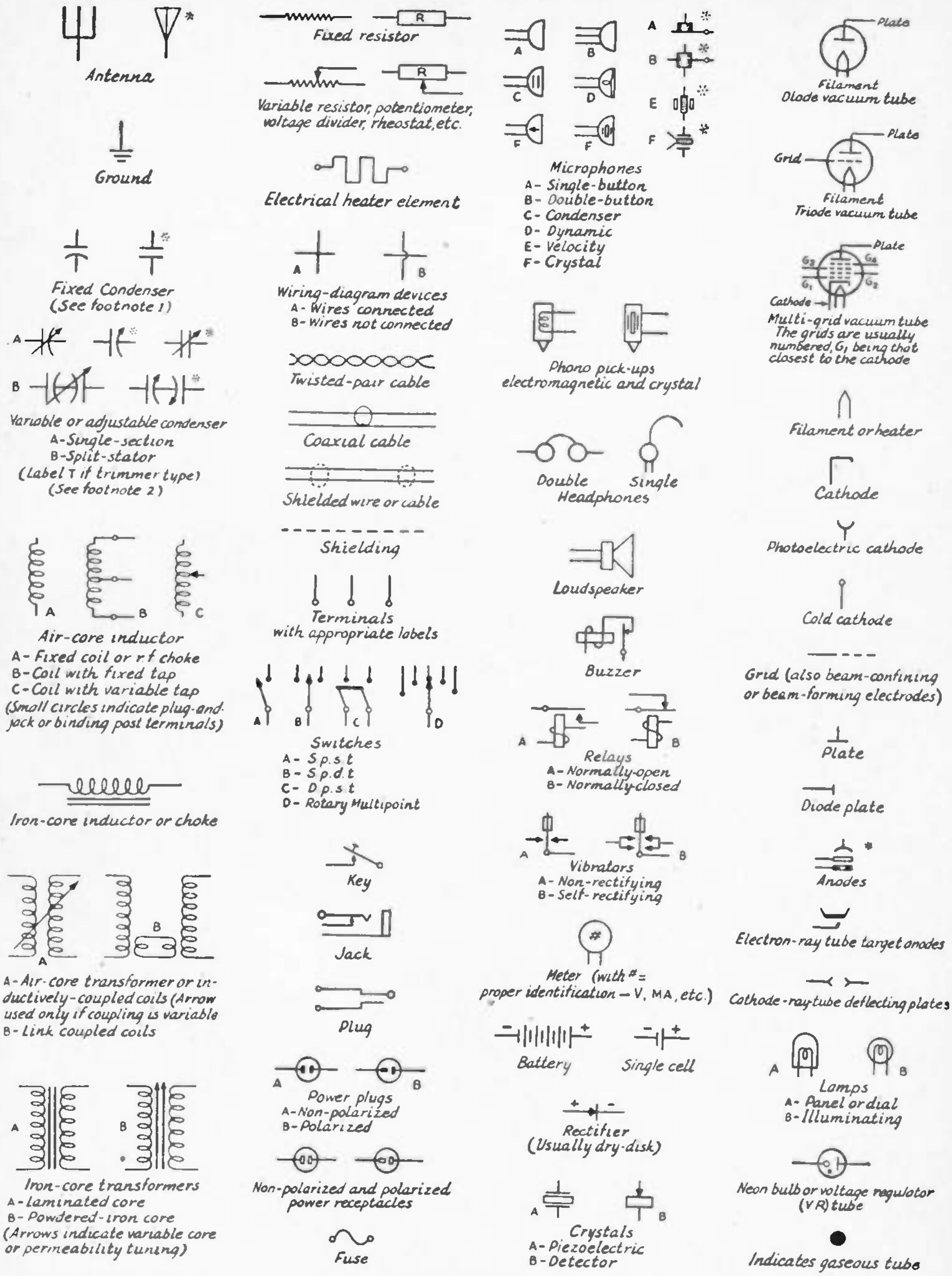
STANDARD SCHEMATIC SYMBOLS USED IN CIRCUIT DIAGRAMS



For convenience and simplicity, schematic wiring diagrams employing conventionalized symbols to represent various components, as shown above, are utilized to indicate the circuit connections used in radio apparatus. The symbols used in this *Handbook* follow the new standardized forms adopted by the radio industry under the ASA standardization program in 1944.

* Alternative symbols marked with an asterisk are the conventional radio forms used prior to mid-1944. These are included for reference information in instances where the original symbol has undergone appreciable change.

[1] Where it is necessary or desirable to identify the electrodes, the curved element represents the *outside* electrode (marked "outside foil," "ground," etc.) in fixed paper- and ceramic-dielectric condensers, and the *negative* electrode in electrolytic condensers.

[2] In the new symbol, the curved line indicates the moving element (rotor plates) in variable and adjustable air- or mica-dielectric condensers. To distinguish trimmers, the letter "T" should appear adjacent to the symbol.

In the case of switches, jacks, relays, etc., only the basic combinations are shown. Any combination of these symbols may be assembled as required, following

1. *Hints and Kinks . . .*

for the Workshop

SOLDERING-IRON REST AND HEAT CONTROL

Fig. 101 shows a soldering iron heat control that I have been using for the past ten years.

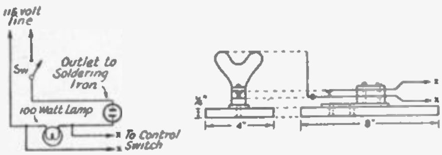


Fig. 101 — Soldering-iron rest and heat control.

In the original I used an old closed-circuit 'phone jack which, with all other components, was mounted on a 4 × 12 × ¼-inch piece of plywood. The rest for the iron is of sufficient size to dissipate heat rapidly enough to prevent burning of the contacts by conduction. The size of the bulb may be varied to obtain just the right degree of heat with the iron in use.

The leaves and contacts of the jack will have to be altered to correspond with the arrangement shown in Fig. 101. The tension of the lower spring contact should be adjusted so the weight of the iron on the rest just opens the points, putting the lamp in series with the iron and keeping it just hot enough to use but not hot enough to burn and pit. — *Harold F. Houtz.*

SOLDER KINK

A handy arrangement for wire solder can be made by winding the solder around a pencil for its entire length, starting at the point of the pencil. After removing the pencil, the end of the solder is passed back through the coil and out through the opening in the pointed end. The coil

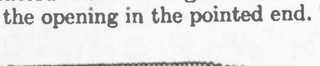


Fig. 102 — Convenient form for solder roll.

is then used as a handle. As solder is used, more may be pulled out. Solder in this form does not kink and is in convenient shape for getting into tight places. The roll is shown in Fig. 102.

SOLDERING-IRON PROTECTIVE WARNING

No doubt many members of the fraternity have at one time or another left their soldering irons with the current on and discovered the fact only after many hours. Even when one has rigged up a nice separate outlet and switch equipped with a pilot light he is likely to use the soldering iron at some other outlet or location and then forget all about it, only to find it hot a day or two later.

Here is a practicable method of avoiding such oversights which both my son, W9INN, and I have used with full success. First, we bought a plug-in multiple outlet which can be plugged into any wall socket. This one has a screw-socket opening into which one of the very small dime-store red bulbs can be screwed. Next, the soldering-iron plug also was plugged into this same outlet, as shown in Fig. 103. Now we have a

Fig. 103 — Warning light for soldering iron.

red light bulb at the plug end of the soldering-iron cord. This plug-in socket and bulb are never separated from the soldering-iron cord. When the iron is disconnected the whole assembly, plug-in socket and all, is just pulled out of the wall socket, and when the iron is used again the whole thing is simply plugged into the wall socket. Thus, no matter where the soldering iron may be used, the red light always shows when the current is on. If an outlet of the type described cannot be found there also is available in many dime stores a candelabra socket for Christmas-tree size bulbs, fitted with a two-prong base which may be plugged into a standard three-way plug-in outlet. — *H. A. Fanckboner, W9BPS.*

IMPROVISED SOLDERING TORCH

If a blowtorch or spirit lamp is not available for a heavy soldering job, an excellent Bunsen burner can be improvised for use on the kitchen gas range. An empty vegetable can, of a size which will make a snug fit, is inverted over a gas burner. A small hole is punched in the end of the can, the gas turned on, and a match applied at the hole. A pencil point of hot blue flame will result which will heat and make ready for the solder in jig time any job that can be moved to the burner. — *Frank Keefe, W1MTP.*

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A HOMEMADE GAS SOLDERING TORCH CONSTRUCTED FROM SCRAP COPPER TUBING

A HOMEMADE gas soldering torch which I have been using for a number of years is shown in Fig. 104. Such a torch is useful for jobs which are too large to be heated with an ordinary soldering iron. The torch may be made in any size. All of the required materials may be obtained readily and probably can be found by most hams in the junk box or a junk yard.

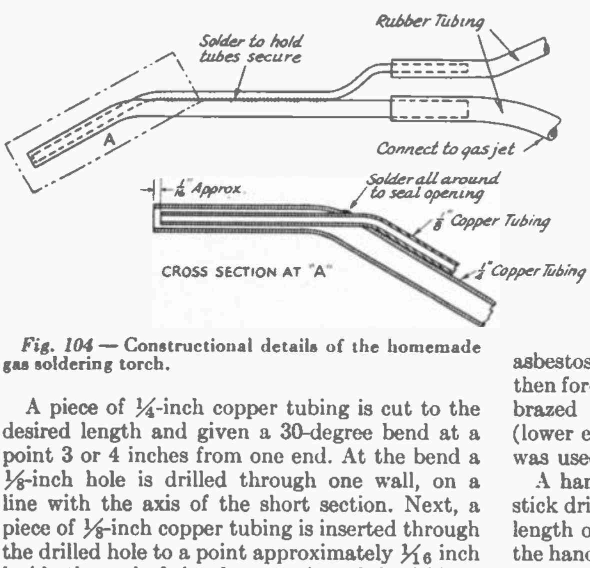

Fig. 104 — Constructional details of the homemade gas soldering torch.

A piece of ¼-inch copper tubing is cut to the desired length and given a 30-degree bend at a point 3 or 4 inches from one end. At the bend a ⅛-inch hole is drilled through one wall, on a line with the axis of the short section. Next, a piece of ⅛-inch copper tubing is inserted through the drilled hole to a point approximately 1/16 inch inside the end of the short section of the ¼-inch tubing. The external length of the ⅛-inch tubing is bent down to lie along the longer or shank section of the ¼-inch tubing. It then is soldered in place all along the adjoining length of the ¼-inch tube from a point an inch or so from the open ends of the shank sections. The joint at the drilled hole is also soldered, in order to make an airtight connection.

A length of automobile windshield wiper rubber tubing is slipped over the open shank end of the ⅛-inch copper tube, and a piece of rubber gas tubing is attached to the shank end of the ¼-inch copper tube.

The large tube is connected to a gas jet and the flame lighted at the mouth of the torch. The open end of the small rubber tube is placed in the mouth, and the breath is blown through it. The result is a cone-shaped flame of intense heat.

By increasing the gas flame to a length of 18 inches or so and delivering air from a compressor at 25 or 50 pounds pressure through the small tube, enough heat can be obtained to melt aluminum. By this means I have made successful aluminum castings in plaster forms, using the homemade torch. — *J. Hengel, Route 10, North Kansas City 16, Mo.*

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SIX-VOLT SOLDERING IRONS

EVER wish you had a soldering iron in the car? A. D. Hewett of Powell River, B. C., tells how he made a 6-volt soldering iron which can be used on either a.c. or d.c.

The tip was made of a piece of ⅜-inch copper rod about 3 inches in length, one end of which was bored to a depth of 2¼ inches with a ¼-inch drill.

The heating element is a 12-inch length of No. 25 Nichrome wire wound in a spiral to an outside diameter of 3/16 inch. The upper end of the spiral was led back through the coil and brazed to a piece of No. 12 copper wire about 10 inches long. Care was taken to see that none of the turns in the spiral was shorted out in the process.

The element is insulated with a piece of very thin mica rolled into a tube, which in turn is inserted in the hole bored in the copper tip. The lower end of the spiral is laid in a notch filed in the outer opening of the tip bore. This notch was made deep enough to pass the shank, which was forced into the bore after all other parts were in place.

The shank is a 9-inch length of ¼-inch steel tubing. The copper wire from the heating element was insulated with asbestos and led through the shank, which was then forced into the tip bore for about ¼ inch and brazed there, together with the ground lead (lower end) of the heating element. Silver solder was used for the brazing, with borax for a flux.

A handle was made from a section of broomstick drilled to accept the shank. Ends of a 6-foot length of No. 14 lamp cord were passed through the handle and soldered to the shank and the lead from the heating element. The shank then was forced into the handle. Battery clips were attached to the cord.

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A simpler device, limited to very light work, is described by J. R. LaCroix, Brockhurst, Templewood Lane, Farnham Common, Buckinghamshire, England. In this device a metallic mechanical lead pencil is used as one electrode, the lead being extended to project about 3/16 inch. The work itself forms the other electrode. Wire leads are brought from a 4- or 6-volt battery, one to the pencil and the other to the work. The circuit is closed by touching the spot to be heated with the pencil, at the same time applying rosin-cored wire solder.

The pencil lead will become red hot in a very few seconds. Care should be taken to avoid forming an arc at the contact since soldering, not welding, is the object.

SOLDERING-IRON REST TO DISSIPATE HIGHER TEMPERATURES

HIGHER temperatures are required to melt wartime solder because of the reduced proportion of tin. This means the use of a hotter iron. If the soldering iron is not protected by a thermostat, some means should be provided to dissipate the additional heat when the iron is at rest. A solid block of steel or cast iron may be used to good advantage as a rest for the soldering iron. The block should be sufficiently large to dissipate enough heat to prevent burning of the tip when the iron is not in use. A piece of asbestos should be placed under the rest.

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SOLDERING TIP FOR TIGHT PLACES

IT'S sometimes a bit hard to get the tip of a soldering iron into an overly crowded spot without unsoldering another spot by accident while trying to solder in the connection. I had an old tip for the iron, too badly worn to be much good, so I cut it off at just the right length to fit the iron barrel. Then I drilled a hole in it about an inch deep lengthwise. The hole should be just large enough to provide a tight fit when a piece of No. 8 or No. 10 copper wire is jammed into it. The end of the wire was flattened just a bit, and presto — we have a soldering iron tip which may be bent around corners or worked into the most congested spots without any trouble. See Fig. 105.

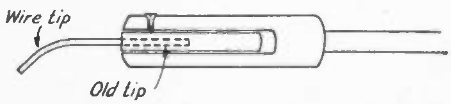

Fig. 105 — Small soldering-iron tip for tight places.

With either No. 8 or No. 10 wire the length of the piece is determined by how much can be used and still obtain sufficient heat at the end to be of any value. For most jobs it needs to be about 1½ inches long. — *Dayton Warner, W9IBC.*

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SIMPLE MAGNETIC HOLDER FOR FERROUS NUTS AND LOCK WASHERS

J. R. STEEN of Harvey-Wells Communications contributes the following suggestion which has been found useful in speeding up manufacturing production.

It is an old wrinkle to magnetize a screwdriver (and, in fact, there are many on the market so prepared), but a method of holding nuts and their closest companions, lock washers, has been quite neglected.

Here is a very handy method of assembling steel nuts and lock washers in hard-to-get-at places. Take your ordinary socket wrench or Spintite, wind about a dozen turns of insulated wire around it, and touch the ends of the wire across the storage battery. A single touch is enough to magnetize the wrench sufficiently so it will hold both the nut and lock washer.

CUTTING SQUARE HOLES

FIG. 106-A shows how a lot of filing can be avoided in cutting a square hole in a chassis.

The usual practice is to drill half-inch holes at opposite corners of the rectangle to be cut out and start sawing with the hacksaw immediately. This results in a long sweeping cut from the center of

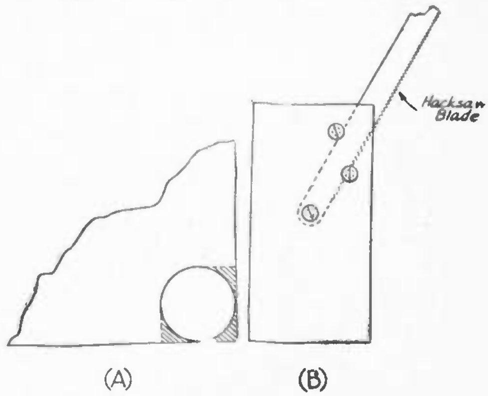

Fig. 106 — Showing how W8EOY avoids a lot of filing in cutting rectangular holes in a chassis.

the hole before the saw can be brought along the line marking the side of the rectangle. If time is taken to do a little filing around the holes before the hacksaw is started, the saw can be started in the line and the sides will then require only smoothing up with the file.

Fig. 106-B shows how a simple holder for a hacksaw blade may be made in case the regular frame cannot be used. — *Harold S. Davis, W8EOY.*

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DRILLING HINTS

IN PREPARING a metal chassis for drilling it has been suggested that a piece of wrapping paper be fastened about the chassis with adhesive tape. A better method, I have found, is to use a piece of very heavy brown paper cut about a half inch shorter than the length of the chassis. It should be flooded with a rather watery paste (flour and water will do) and then placed in position on the chassis. By smoothing with both hands from the center outward, all air bubbles and lumps can be removed and it will be found that the water has expanded the paper so that it extends to the edges of the chassis.

When dry, the paper will be perfectly smooth due to the tightening effect, even though a wrinkled sheet was used. To remove the paper after the work is finished, simply get permission from the XYL to soak the chassis in the bathtub for a half hour and the paper will drop off.

An added advantage of this method is that it becomes unnecessary to center punch to prevent the drill from walking. The drill will penetrate the paper instantly, of course, and the paper provides a "socket" for the drill.

When drilling socket holes of an inch or more in diameter with a fly-cutter, it is much more satisfactory to cut a little way in from both sides (the deeper you go the more metal in proportion to depth must be removed), and then strike it several times from both sides with a *flat*-headed hammer. In this way the time consumed in cutting is reduced by about three fourths and in addition there are no burrs to be removed later. A good clean hole results and since the drill has not been worked too much in the center hole there is much less likelihood of error in the size of the finished hole. — *W. T. Hodson, W2FJE.*

DRILLING TUBING AND ROD

The drilling of lateral holes through metal tubing or rod may turn out to be quite a problem unless the job is tackled properly. It is still more difficult to drill several holes and keep them in the same plane. It is hoped that the suggestions which follow will help to simplify the task a bit.

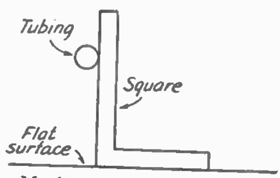

Fig. 107 — Marking a line for spotting holes to be drilled in tubing or rod.

The tubing first should be clamped horizontally in a vise, or be supported firmly by other means, over a flat surface. A square then is placed with one side resting on the flat surface and the other pressed against the side of the rod or tubing as shown in Fig. 107. With the square held firmly against both surfaces, the wall of the tubing is scratched as the square is drawn along its length. The scratch will be perfectly aligned even though the flat base is not parallel with the tubing or tilted at any angle in respect to it. The only important point is that the base must be flat.

The points at which holes are to be drilled are then marked with a center punch along this line. The punch marks should be made rather deep so that the side of the tubing may be flattened very slightly with a file without obliterating them. This flattening will prevent creeping of the drill when the holes are started.

The first hole must be drilled carefully by eye. When it is finished, a machine screw or a piece of wire which fits the hole is inserted. This will provide a "sight" by which the remainder of the holes may be lined up while they are being drilled. — *Vernon Chambers, W1JEQ.*

TEMPLATES FOR METER AND SOCKET HOLES

A handy template for setting up a circle cutter is suggested by W1JEQ. Each time a hole is cut in Presdwood or metal for mounting a large-diameter part, such as a socket, meter, or transformer, the circle removed from the material should be labeled and filed for future reference. A collection of metal and composition circles thus is soon obtained, from which one corresponding to the part to be mounted may be selected. In order to adjust the radius of the circle cutter the circle is then slipped on the drill point of the cutter, and the tool is fitted to the edge of the circle and set. In this way the time usually spent in setting up temporarily and cutting trial holes is saved.

REPUNCHING SOCKET HOLES WITH ACCURACY

We often find it necessary, after having selected a punch and knocked out a hole in a chassis, to make this hole larger so as to accommodate an electrolytic condenser or tube socket of larger dimensions. An easy, quick and accurate way of accomplishing this feat is to keep on hand a knock-out from each of your various punches. Then, say you punch a three-quarter-inch hole and find a larger hole necessary. All you need do is re-fit the three-quarter-inch knock-out, place the larger punch in the starting hole and punch away.

This method is particularly successful with screw-type punches, such as the Greenlee. Try it on a piece of scrap and see for yourself how simple it is. — *Thomas B. Moseley, Fort Worth, Texas.*

HOMEMADE CIRCLE CUTTER

Circle cutters for cutting holes up to 2 inches in diameter may be made quite readily from discarded flat files. The file first should be heated to a cherry red and allowed to cool slowly. This should soften the steel sufficiently to permit cutting it with a hacksaw.

The pattern of the cutter is shown in Fig. 108. Exact dimensions will depend upon the diameter of the hole desired. The end opposite the cutting end is shaped so that it may be clamped in the chuck of a carpenter's brace. The centering spindle, *S*, should be filed down to fit accurately a hole made by a drill of standard size, say ¼-inch. It does not necessarily have to be round, however, so long as it will turn in the centering hole without undue play. The cutting edge, *C*, may be filed roughly to shape before hardening.

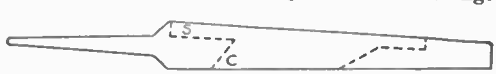

Fig. 108 — A hole cutter made from an old flat file. After it has been heated the steel may be cut readily with a hacksaw.

The hardening process consists merely of again heating the steel to a cherry-red color and immediately dousing it in water. I found that oil tempering made the steel too hard. It is advisable to temper only the cutting end back for a distance of an inch or so, since this prevents snapping off of the cutter up near the end held in the chuck.

After hardening, the cutting edge may be ground for proper cutting qualities. It is, of course, necessary to drill a hole to fit the cutter spindle at the center of the circle to be cut out. — *Robert B. Saylers, W8TUC.*

STARTING TOOL FOR DRILLS

Reading an article about polystyrene insulation, in which it is stated that a heavy blow with a center punch may cause a star fracture, prompts me to suggest the use of a tool which I have found extremely useful for starting holes in the construction of radio apparatus. The tool is easily made from a small triangular file, as shown in Fig. 109.

The file is ground similar to one half of an ordinary drill bit, but comes to a point in place

Fig. 109 — Tool for starting drills in metal or other materials.

of the web and has no twist. It is used in an ordinary hand drill. It cuts quickly and will not slip or run. Drills have no tendency to slip or run when the hole is started with this tool; it is not necessary to use a center punch. — *Gordon Crayford, Lacombe, Alta.*

DRILLING GLASS, PORCELAIN AND PYREX

The perennial problem of drilling holes in glass has many solutions. We present here one used successfully by H. W. Loney, ex-9DHO, and J. P. Gilliam, W9SVH. The special tool depicted in Fig. 110 is important in the process.

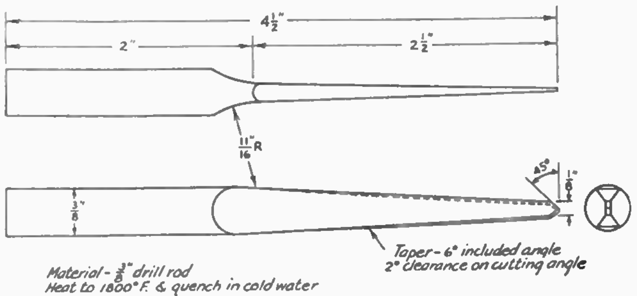

Fig. 110 — Drill for cutting glass.

The drawing gives all the necessary details for its construction. For the actual drilling, the authors write:

"Place the drill in a hand brace, engine lathe or slow-speed drill press. If the material to be drilled is flat, such as plate glass, make sure that the supporting surface is flat. Apply turpentine to the point of the drill and press firmly against the work in the desired location. Then turn the drill slowly and apply sufficient turpentine to keep the drill wet at all times. Use care when breaking the point through the work so as to avoid chipping. After the point has broken through, turn the work over and drill from the opposite side, repeating this operation as often as is necessary to keep the edges of the hole nearly parallel.

"This has been the most successful method of drilling these materials that we have been able to find. It is quite possible and practical to drill narrow strips of glass where the holes are close to the edge. Repeated tests have proved that when using a hand brace it is possible to drill ¼-inch diameter holes through 7/32-inch plate glass in 35 seconds.

"Pyrex is somewhat tougher than ordinary glass and will cut considerably slower. Four Pyrex custard cups were drilled in approximately four minutes. Ordinary porcelain such as is used for antenna insulators may be drilled with the same speed as plate glass."

A KINK FOR THE WORKBENCH

How many times have you wished for a third hand when you're trying to solder some small object? The sketch of Fig. 111 shows one

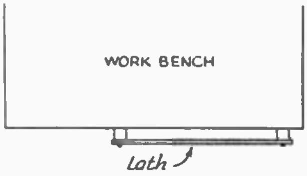

Fig. 111 — Convenient "third hand" for work bench for holding small objects suggested by W2LRT.

simple way of providing that third hand. Take a six-foot strip of one-inch by one-quarter-inch strip or a long lath and fasten it to the front edge of the workbench as shown. The strip should be spaced out from the bench about one-quarter inch at each end with spacing blocks of wood.

Now, when we have some small object we wish to be held, we can wedge it in between the lath and the edge of the bench. The center of the strip can be bowed out somewhat and the object can be slid toward one end until it is held firmly in place. — *Lewis C. Bohn, W2LRT.*

SOLDERING VISE FOR SMALL PARTS

A spring-type wooden clothespin makes a handy vise for soldering small work. Mount it in a vertical position on the workbench. — *W2OEN.*

USING A FLIT GUN AS A PAINT SPRAYER

An ordinary insect spray gun does an excellent job of spraying smooth or wrinkle-type finishes on chassis, racks, panels and other amateur gear. Such a sprayer has even been used to paint an automobile fender, although the covering of such large surfaces involves the application of a generous amount of elbow grease.

It is recommended that the paint sprayer be used only for painting; another spray gun should be used for flies. — *Robert Lewis, W8MQU.*

CONVERTING SHIM BRASS TO SPRING BRASS

While experimenting with the construction of parts for a transceiver, I discovered a handy kink. "Shim" brass, although normally too soft for use in leaf-type switches or as a vibrator reed, can be work-hardened into a passable substitute for spring brass. A strip of the shim brass is cut to a width about ⅛-inch greater than that required for the finished part. A piece of ¼-inch rod is gripped firmly in a vise. Both ends of the brass strip are grasped firmly by pliers and the strip is drawn back and forth over the rod. About 18 "cycles" are applied to each side of the strip in this manner. Then 1/16-inch is clipped off each edge of the strip. This gets rid of the little cracks which appear during the drawing process. If not removed, these would lead to failure of the piece if used as a vibrator reed. Shim brass of 0.01-inch thickness is relatively plentiful. Spring brass? Unh-unh! — *Gurdon R. Abell, jr., W2IXK.*

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LIGHT FOR THE WORKBENCH

Fig. 112 shows a handy light for the workbench which I have been using for some time. The shade is made from an ordinary two-pound coffee can. A hole is cut in the bottom of the can to fit a brass-shell pendant receptacle to which the can is soldered.

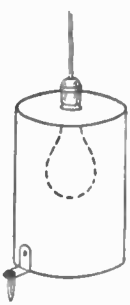

Fig. 112 — W9IBC's home-made lamp for the workbench. The reflector is a 2-lb. coffee can soldered to a brass-shell socket.

The light hangs by the cord which runs through an eyelet in the ceiling so that the light may be raised or lowered to the needs of the project at hand. The banana plug, fastened to the edge of the can with a small angle bracket, fits into a jack which is mounted with a similar bracket on the top shelf above the bench. This holds the light in a position high enough to provide good light for the entire bench. The beauty of the thing is that it can be lowered to provide a spotlight effect when working inside a transmitter or receiver chassis. — *Dayton Warner, W9IBC.*

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SOLDERING CONNECTIONS TO POLYSTYRENE SOCKETS

The low melting point of polystyrene often makes it difficult to make or remove soldered connections to sockets made of this material without damaging the socket. L. T. Fleming, W3HQP, suggests a scheme which will keep the socket cool while soldering the terminals. The idea is shown in Fig. 113. An old coffee can is filled with water. A small "C" clamp, obtainable at any dime store, is used to clamp the socket to

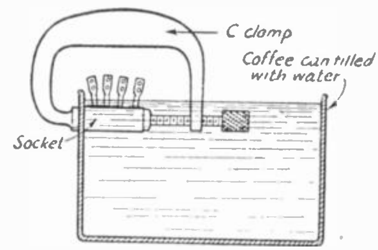

Fig. 113 — Immersing polystyrene socket in water prevents softening of socket while soldering.

the side of the can in such a position that the polystyrene is covered with water while the prongs project above the surface. Old solder then may be safely removed or, if new connections are to be made, long leads may be soldered to each prong and then cut to the appropriate length after the socket has been mounted. Polystyrene coil forms wound with enameled wire may be treated in a similar manner.

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WINDING SMALL SELF-SUPPORTING COILS

After playing around with h.f. receivers and transmitters for some years, I have found that the easiest, simplest and most-efficient method of constructing chokes and coils is to wind them on a thin glass tubing. The outside should be coated lightly with Amphenol cement (collodion will do in a pinch). Then, when the cement is dry, clamp the coil in a vise and slowly tighten the jaws until the glass breaks. Shaking out the glass completes the job.

Grid-leak glass can be used for r.f. chokes and tubes and vials of various sizes for larger coils. I have never yet injured the insulation on the wire in this manner. However, if the vise has grooved jaws, a piece of smooth aluminum should be placed on each side of the coil.

I have used this same method to wind coils of heavy wire on a cellophane core. — *Percy E. Buchtel, W8JTI.*

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HINTS ON WINDING COILS ON SMALL POLYSTYRENE FORMS

In winding a coil of large wire on a small-diameter polystyrene or bakelite form, the process can be simplified by first winding the coil on a smaller-diameter form with a few more turns than is necessary. The coil is then removed from the small-diameter form and worked onto the larger form. Once it is properly in place it can be doped on the form, and the result is a firm coil which will not be as subject to change as one that is wound only for the finished diameter. This method also has the advantage that no holes in the coil form are necessary for fastening ends of

2. *Hints and Kinks . . .*

for the Receiver

SERIES NOISE LIMITER WITH PLATE DETECTORS

You may be interested in publishing a revised circuit (Fig. 201) for the series diode noise limiter previously described in *QST*. The limiter, installed in an NC-100 receiver, has done an excellent job here at W2GQM, located just a few feet from one of the main arteries of traffic in northern New Jersey. Before the receiver was equipped with the limiter 28-Mc. reception was impossible and even 3.5-Mc. reception was difficult at times. Now, even the weakest signals on 28 Mc. may be copied practically 100 per cent. In fact, it seems that the weaker the signal the better the limiter works!

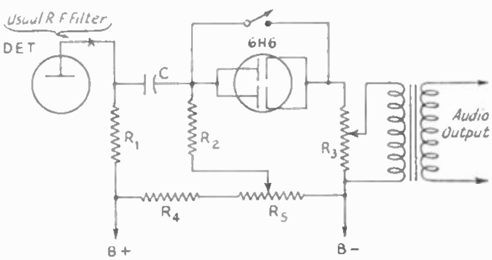

Fig. 201 — **Circuit of the series noise limiter as used with a plate detector.**

C — 0.1-μfd. paper. **R₂ — 0.3 megohm, ½-watt.**
R₁ — 0.1 megohm, ½-watt **R₃, R₄, R₅ — 50,000 ohms.**

The original circuit was tried without much success. The difficulty lay chiefly with the infinite impedance detector with which we attempted to replace the plate detector in the NC-100. Because the audio output from the infinite impedance detector was so low, the plate detector had to be reinstalled. Also, it was found that the diode used in our case, a 6H6 with cathodes paralleled and plates paralleled, required a much greater range of voltage than was provided for in the original circuit.

There is no sharp threshold position for the potentiometer. The best position for operation seems to be at the point where, for each individual station, the distortion introduced by the limiter is not too objectionable. If the limiting action is increased beyond this point there will be little improvement in noise reduction and a considerable impairment of audio quality will result. If the limiting action is carried in the other direction audio distortion will not be noticeable, but the signal-to-noise ratio will be lowered. The individual operator will find the position most suitable for him after a bit of experience. Because of the sharp cut-off action of the limiter, high-frequency distortion of both the signal and noise is present to a certain extent in the audio output when the limiting action takes place. If the tone control of the receiver is operated to reduce the high-frequency response, this effect will not be noticed. As was mentioned in the original article, when a strong beat oscillator signal is present the incoming noise will modulate it, and the limiter will have a harder job to do. In this case the limiting action can be advanced beyond a point which would be objectionable for 'phone work because the resultant distortion can be tolerated in c.w. reception.

Although the circuit as shown was designed for an NC-100 receiver, the same circuit may be applied to any transformer-coupled detector. The 100,000-ohm resistor in the plate circuit may be replaced by an audio choke of 250 henrys or more, but it was not deemed necessary because the d.c. drop through the resistor to the plate is negligible in most detectors. The switch shown across cathode and plate is provided so that the operator may disconnect the limiter without disturbing the setting of the potentiometer, although the same result may be achieved by setting the potentiometer to the extreme position away from limiting action. Contrary to what might be expected, there is no noticeable reduction in the audio volume of the receiver when the limiter is in normal use — although, of course, the extreme setting of the potentiometer will limit everything — and completely!

The limiter is most effective on auto ignition and least effective on vacuum cleaners and electric razors, although even on these latter it may mean the difference between reading and not reading a signal. — *Paul Rafford, Jr., W2GQM.*

SIMPLE NOISE-LIMITER ADDITION TO RECEIVER

Although much has been done to simplify noise silencers and reducers, there still are many who consider these devices too complicated or costly to be added to their receivers. Because of this fact much operating enjoyment on the high-frequency bands is sacrificed in regions of strong noise interference.

The circuit of a single-diode noise limiter is well known and extensively used with single- and parallel-diode second detectors. For receivers using full-wave diode detection, the two separate diodes of a 6H6 tube may be used in an equally simple circuit adapted from the one mentioned above. Typical circuit diagrams of the former type of noise limiter are shown at (B) and (C) of Fig. 202, while a diagram for use with a full-wave detector is shown at (D). In any case, the total list of parts to be added to the receiver (assuming that a suitable source of negative bias voltage is available) includes only a 6H6 tube and socket, a by-pass condenser, and a small potentiometer resistor.

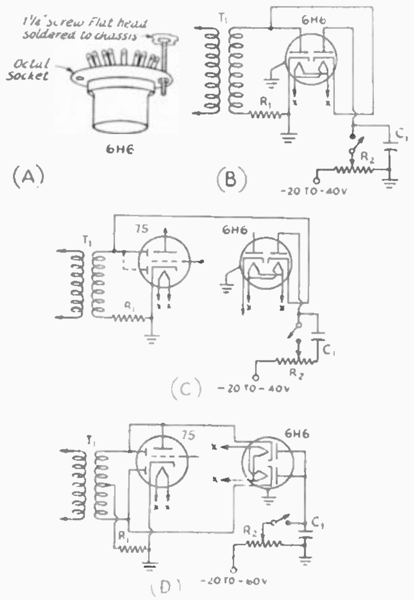

Fig. 202 **— Simple receiver circuit changes required to incorporate a noise silencer. The 6H6 is mounted in an inverted position beneath the chassis by means of a single flat-head screw.**

R_1 — Diode-detector load resistor in receiver.
R_2 — 25,000-ohm potentiometer.
C_1 — 0.1-μfd. paper.

Since the 6H6 tube and socket are light and compact, the assembly may be mounted beneath the chassis by means of a single long screw soldered in place. Alternatively, a longer screw may be substituted for one of the short screws or rivets holding a tube socket in place, and the lower extension may thus be used.

The 0.1-μfd. condenser should be mounted near the 6H6 socket. Many sets are equipped with fixed bias supply; in these, the negative voltage applied to the suppression-control potentiometer may be set to a desirable value at the voltage-divider resistor. This should not noticeably affect the other voltages taken from the divider, since the current through the control is only one milliampere, approximately. The potentiometer should be equipped with a switch and connected so that beginning rotation in a clockwise direction places the noise limiter in action, while further rotation increases the noise suppression.

Addition of the 6H6 tube to the circuit of the second detector may detune this circuit slightly. In order to check on this point, the 6H6 should be taken from its socket while a steady signal is being received, to determine whether a noticeable increase in output accompanies the removal. If a change is noticed, realignment of the i.f. transformer tuning condensers with the tube in operation should follow. It is important that the 6H6 tube be one in good condition; it might otherwise prove, because of leakage, to be a noise contributor rather than a noise limiter.

On very strong signals the noise limiter tube may cause noticeable audio distortion, although a limiter is seldom needed on signals of this sort. If such distortion is objectionable, however, a higher value of negative voltage may be applied to resistor R_2.

The cost of the suppressor is low and it can be used without seriously altering the receiver. The effectiveness has been checked many times on an oscilloscope and has been successfully demonstrated in practical use.

TEMPERATURE COMPENSATION TO REDUCE RECEIVER DRIFT

STUART BRIGGS, W1KHE, and Claude Moore, W9HLF, two inveterate DX hounds, have collaborated over the air on some interesting work in temperature compensation to keep their receiver calibrations on the nose, come rain or shine. While the work of both has been with the National 101X, the same principles applied to other receivers should form a basis for similar temperature compensation.

Without compensation, the drift would vary from 20 to 45 dial divisions, depending upon the temperature of the room when the receiver was turned on. All tests were made with the receiver "B" supply turned on one minute after the voltage was applied to the heaters.

They started out the tests by connecting a Centralab 10-μμfd. negative-coefficient condenser (type 913X) from ground to the grid leak of the high-frequency oscillator, placing the condenser very close to the top of the 6J7. To compensate for the added capacity, the capacity of the air trimmer in the h.f.o. coil compartment was reduced correspondingly. Using a temperature-controlled oscillator for checking the drift, it was found that the receivers ran off calibration by two or three dial divisions at the beginning of a cold start. Within 5 to 8 minutes, the calibration would return to the original position and remain there within a dial division or so over periods of several hours.

Next, the mixer and r.f. circuits were given the same treatment. The improvement in stability was immediately evident. The compensating action was speeded up, and, from a cold start, the calibration would deviate only about 15 dial divisions and return on the nose within three minutes. The more accurate maintenance of circuit alignment resulted in a noticeable improvement in the gain of the receiver.

More recently W9HLF replaced the metal tubes in the h.f. circuits with a set of three of the Hytron GTX series. Some slight changes were necessary to suspend the compensating condensers over the glass tubes, which are taller than the metal envelopes. This change resulted in an improvement in receiver sensitivity. W1KHE, following suit, experienced a similar improvement. With the new tubes it became necessary to readjust the compensation. By reducing the compensating capacity in each case from 10 μμfd. to 5 μμfd., the compensation was brought back into line. Since condensers with capacities of less than 10 μμfd. were unavailable, two 10-μμfd. units were connected in series.

By this time both operators had become supercritical in the matter of frequency drift. In observations over long periods of operation they noticed a slow drift upward in frequency which occurred after a run of ten to twelve hours. Although the drift was at the rate of only a dial division per hour, they decided to eliminate it, if possible. After a lengthy investigation it was determined that this secondary drift was caused by a lagging rise in temperature in the coil chamber. To compensate for this a negative coefficient condenser of approximately 7 μμfd. (25 μμfd. and 10 μμfd. in series) was connected directly across the air trimmer in the coil compartment with the condenser mounted right against the coil with the aid of a drop of Duco cement. This completed the job.

W9HLF says that he has run his receiver for as long as four and five days at a stretch without having the calibration vary more than one dial division. During 24 hours the temperature might have varied from 40 to 100 degrees. "I've become so used to being able to spot a certain signal day in and day out at the same zero-beat point on the dial and, after five minutes of warm-up, always finding my 100-kc. frequency-meter signal spotted at the same old dial division of the 101X that I take it all for granted now. Only when I get hold of some other fellow's receiver do I notice how unstable the best of them may be."

While most of this work has been done at 14 Mc., W1KHE has had similar success at the lower frequencies.

SOME HETROFIL SNAGS AND THEIR SOLUTION

No doubt many have constructed the Hetrofil described in the September, 1939, issue of *QST*. The original circuit is shown in Fig. 203-A. If the writer's experience is anything to go by, some will have found results not quite as satisfactory as they had hoped. Perhaps these few notes will assist those who have found snags.

In the first place, the Hetrofil will virtually eliminate any single audio frequency if properly constructed, but it cannot be expected to deal with an unsteady note or one that is heavily modulated. Given a really steady unmodulated frequency, it can and will eliminate it.

Those who have found that a balance cannot be obtained will be interested to know that the most likely cause of the trouble is in the ganged

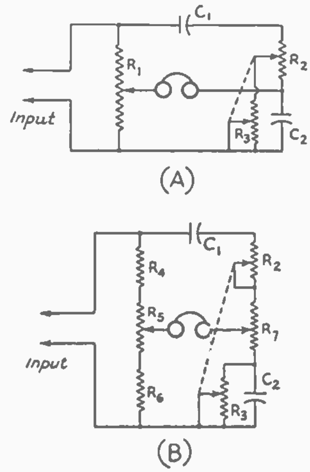

Fig. 203 — Suggestion for improving the performance of the Hetrofil. The original circuit is shown at (A). The addition of the resistance, R_7, in (B) permits compensation for differences in characteristics of the ganged resistors, R_2 and R_3, and the fixed condensers, C_1 and C_2.

C_1, C_2 — 0.05-μfd. paper.
R_1 — 5000-ohm potentiometer.
R_2, R_3 — Ganged 10,000-ohm potentiometers.
R_4, R_6 — 2000 ohms, ½-watt.
R_5, R_7 — 1000-ohm potentiometer.

resistors, R_2 and R_3; in fact, if one considers the matter for a moment, it would be rather surprising if these items were to track accurately. In practice they seldom do. Even supposing one obtained a satisfactory pair, there would still be a slight variation in the capacities of the condensers to be reckoned with. By the addition of one further component, the difficulty is overcome. This consists of a potentiometer of 1000 ohms, R_7 in Fig. 203-B, connected in such a manner that, when moved in either direction from its central position, it adds resistance in one leg and at the same time subtracts it from the other. A little thought will show that any failure to track correctly on the part of the ganged potentiometers is thereby compensated.

ANOTHER USE FOR THE MAGIC EYE

The resistance-coupled push-pull and phase-inverting types of audio amplifier are essentially made up of the same parts and are open to the same troublesome objection. In the absence of frequent testing, there is no assurance that good symmetry exists; and, without it, maximum power and minimum distortion cannot be realized. The 6E5 electron-ray indicator provides an inexpensive and convenient means of assuring that both power tubes receive the same signal in such an amplifier.

In Fig. 204 R_1 and R_2 are identical, their values of resistance depending on the service. R_3 and R_4 are determined by the tubes used. R_5, depending on the service, must be high enough so that, in the

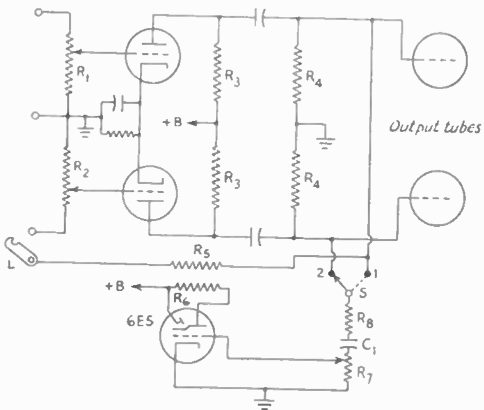

Fig. 204 — Using a 6E5 indicator tube as a balance indicator in resistance-coupled push-pull or phase-inverting amplifiers. See text for circuit constants.

phase-inverter connection, the setting of R_2 will not be too critical. R_6 is 1 megohm, R_7 is a 1-megohm volume control, R_8 is 0.1 to 0.25 megohm, and C_1 is 0.01 μfd. The 6E5 functions as a grid detector; its pattern closes at some given signal level, determined by the setting of R_7.

For push-pull operation, apply the signal across R_1 plus R_2, leaving link L open. Give, for example, R_1 an arbitrary scale. Then, for each setting of R_1, with the s.p.d.t. switch, S, in Position 1, set R_7 for exact closing of the pattern; and without changing setting of R_7, flip S to Position 2 and mark the setting of R_2 which gives exact closing. Repeat at various levels. This method gives balance independent of the whims of irregular carbon volume controls. Once calibrated these are set to like readings, and the calibration is checked as often as necessary.

For phase inverter operation, apply the signal across R_1. Close link L. At any convenient level, set R_7 for exact closing and adjust R_2 so that S may be flipped back and forth without change in pattern. R_1 is the volume control and R_2 is not touched again unless necessary on a later check.

It should of course be recognized that there is no compensation for dissimilarity of power tubes, such as when half the filament of a 2A3 burns out unnoticed! — *A. H. Taylor, Cornell University, Ithaca, N. Y.*

Editor's Note. — It is desirable to avoid loading the speech-amplifier tubes, insofar as this is possible, with a grid detector connected across the output circuit. To this end, the sum of R_7 and R_8 should be large compared to the value of R_2. This condition is met by the values specified when the speech amplifier tubes are triodes, as shown in the circuit diagram.

REGENERATIVE AUDIO AMPLIFIER FOR C.W. SELECTIVITY

The circuit of Fig. 205 is effectively an audio oscillator with speaker volume. Omit R_1, T_1 and C_1, which form the input from the receiver, and the audio oscillator is left. In the audio oscillator circuit C_2 is the variable condenser which controls the tone of the audio note, while R_2 is a variable volume control which acts as a sensitivity control.

In operation this control is advanced until audio oscillation is obtained. If no sound is heard, reverse the connections of T_2 on the secondary side. After sound is obtained, C_2 is adjusted to give a desirable pitch, and R_2 is then backed off until audio oscillation just ceases. Any input through T_1 of the same pitch or tone as that to which the audio oscillator has been adjusted will cause an audio output of far greater amplitude than the exciting signal and, although other tone frequencies will be heard through the loud speaker, there is an enormous increase in volume

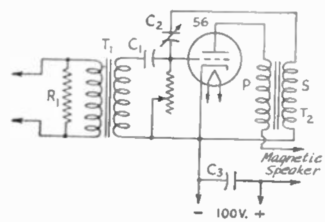

Fig. 205 — A regenerative audio amplifier-oscillator for c.w. selectivity.

C_1 — 250-μμfd. mica.
C_2 — 100-μμfd. variable.
C_3 — 1-μfd. paper.
R_1 — 100,000 ohms, ½-watt.
R_2 — 100,000-ohm volume control.
T_1 — Audio transformer (1:1 ratio).
T_2 — Audio transformer (3:1 ratio).

when the receiver is adjusted to give the exact pitch to which the audio oscillator is tuned. Unwanted signals of equal or greater strength but of slight difference in tone pitch practically disappear, while atmospherics and other forms of static also are down.

R_1 is a one-watt carbon resistor for howl suppression. As built this unit has its own power supply, which is separate from the receiver, being connected to the receiver at the headphone jack. It can be used with any receiver which will give c.w. signals. Care must be used in the initial adjustment; after that, all that is necessary is to turn the receiver dial. Tuning of the receiver should be slow, since the tone peak can be passed very quickly. In some cases the band can be first searched for a call and the audio selector then plugged in. — *Chas. E. Diehl, W6EVF.*

RECEIVER-OPERATED RELAYS

It is often found desirable in the amateur station to make use of received carriers for relay operation. This may be applied to interstation noise suppression, where relay contacts may be used in series or in shunt with the voice coil of a speaker, or it may be applied to automatic reception of code with a fast-operating relay.

Two simple and thoroughly practical circuit arrangements for carrier-operated relays are shown in Fig. 206.

The circuit shown at (A) is that of a grid-leak detector the plate current of which is decreased by reception of a carrier. The armature of the relay is thus held down until a carrier is received, at

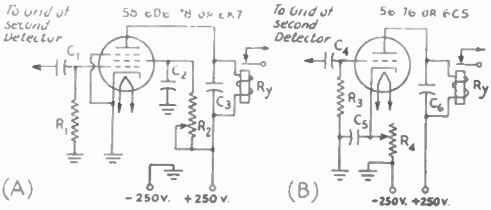

Fig. 206 — Receiver-operated relay arrangements.
C_1, C_2, C_4 — 0.01-μfd. paper.
C_3, C_5, C_6 — 0.1-μfd. paper.
R_1 — 1 megohm, 1-watt.
R_2 — 0.5-megohm potentiometer.
R_3 — 0.5 megohm, 1-watt.
R_4 — 10,000-ohm potentiometer.

which time the grid bias of the tube increases, the plate current decreases, and the armature is released. The type of relay shown — single contact closed with no current — may be connected in series with the voice coil of a speaker to make the latter inoperative during no-carrier periods. This type of relay contact also is suitable for keying an automatic recorder or for retransmission of telegraph signals.

R_y is a small d.c. relay designed to operate at approximately 8 milliamperes. Resistor R_2 is adjusted to give sufficient screen voltage to maintain the relay contact open without any received carrier.

Fig. 206-B is the circuit of a plate detector arrangement which operates in the reverse fashion. The plate current of the tube normally is insufficient to operate the relay, but reception of a carrier results in an increase sufficient to pull down the armature. In this arrangement resistor R_4, the bias resistor, is used to control the plate current for proper operation of the relay. If this is used for keying another transmitter, or for other devices requiring a circuit-closing effected by carrier, a relay which makes contact with increased current should be substituted for the type shown. — *James A. Eberhart, W8KKW.*

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AUTOMATIC STOP FOR BAND-SET CONDENSERS IN SUPERHETS

In any receiver using electrical bandspread, with the padding condensers controlled from the front of the panel, the padders must be set very accurately at a predetermined capacity for each band. The sketch of Fig. 207 shows an attachment for the oscillator-padder knob which has neatly solved the band-setting problems at W3HQP. For these padders the usual small dial or pointer, knob and scale has its limitations. An error of a small fraction of a degree in resetting it by eye may throw the bandspread dial calibration off by several kilocycles — enough so that when it's time for a schedule it's necessary to hunt back and forth across the dial until the station wanted comes in.

The automatic stop shown in the sketch makes it possible to set the padder right "on the nose" for any band. A flat spring is made from a piece of spring-bronze weather-stripping (approximately 24 gauge) about ¾ × 1½ inch. The small hump at its left-hand tip bears against the rim of the knob. For each setting of the band-set knob, a notch is filed in the rim. At the right setting the spring clicks into place in the notch —

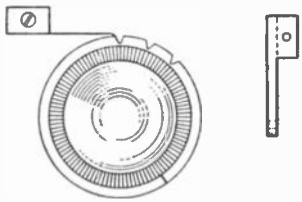

Fig. 207 — An automatic dial stop for controlling the band-set condenser in a communications receiver.

and there you are! The notches need be only 1/32-inch deep or less, and there seems to be no advantage in using a knob of larger diameter unless the notches have to be very close together.

The stop may be useful in many other pieces of gear — in transmitters for example, to speed up the process of retuning for different bands. If appearance is important, the notched knob and its spring might be located in back of the panel, out of sight on an extension of the condenser shaft, and the control of the condenser effected by another knob on the front of the panel. — *Lawrence Fleming, W3HQP.*

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REPLACING A MAGNETIC SPEAKER WITH A D.C. DYNAMIC

Fig. 208 shows a simple method of replacing the old magnetic speaker with an electrodynamic without adding a field supply or modify-

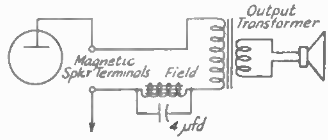

Fig. 208 — Using a d.c. field-type dynamic speaker on sets built for magnetic speakers.

ing the receiver in any way. The field is simply connected in series with the primary of the output transformer and by-passed with a 4-μfd. condenser, thus using the plate current going to the output tube of the receiver to excite the field. — *C. W. Leeds, jr., W3AIU.*

PLUG AND JACKS FOR CHANGING FROM BANDSPREAD TO GENERAL COVERAGE

ALMOST every ham would like to have a receiver that would cover the entire short-wave spectrum and yet give complete dial-spread of the amateur bands. In some receivers this is accomplished by winding separate coils for each purpose. However, this procedure involves quite a bit of expense. The thoroughly practical and inexpensive idea diagrammed in Fig. 209 is offered as a better solution.

Five- or six-prong coil forms are necessary for the windings, and small trimmer condensers should be provided inside the coil forms — air trimmers are preferable but mica may be used. Hammarlund XP-53 or similar forms are satisfactory. The large coils are easy to handle and have adequate space inside for the midget trimmer condensers.

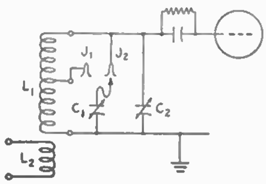

Fig. 209 — General coverage and bandspread tuning by the use of a plug and jacks.

The winding is made so that resonance of the coil alone falls a few kilocycles higher in frequency than the ham band to be spread. The small trimmer condenser in parallel with the winding is then used to set the high-frequency edge of the tuning range so that only a slight margin higher than the high-frequency end of the band is available on the dial.

In the immediate vicinity of the coil socket, two banana-plug jacks are mounted in the chassis in such a position that connections to the grid pin and the coil tap pin lugs of the socket will be short and direct. Making the bandspread tap on the coil is an experimental job, since the position of the tap depends on the capacity of the condenser used for tuning and on the width of the band to be covered. The tuning condenser stator is connected with a flexible wire to a banana plug.

All that is needed to make the receiver full-coverage tuning rather than bandspread is insertion of the plug in the jack connected to the grid-pin lug of the coil socket. The cost of the arrangement is only a few cents; results are excellent; and the convenience is comparable to that of separate plug-in coils for bandspread and general coverage. — *Roy R. Campbell, W4DFR, Lenoir City, Tenn.*

ELIMINATING I.F. SHIFT—A HETEROTONE CIRCUIT

HOW many amateurs have noticed an apparent shift of i.f. alignment amounting to several kilocycles when the gain control of a superheterodyne is varied? In a receiver under investigation, the input capacity of the i.f. amplifier tubes seemed to change when the bias voltage was changed by the usual variable cathode resistor plus bleeder system.

A look at the properties of tubes shows that the effective input capacity is the sum of several fixed capacities and another which is a function of the voltage amplification and the grid-plate capacity of the tube. From this it appears that a variable-μ tube must have a variable input capacity, since the amplification decreases as the grid bias is increased. The 6K7 has a grid-plate capacity of 0.005 $\mu\mu$fd. and the 6L7 only 0.0005 $\mu\mu$fd., but the maximum gain is nearly the same for both tubes. Therefore, a 6L7 should perform as well as a 6K7 as an i.f. amplifier, with the advantages of increased stability and only one-tenth the change of input capacity.

So a 6L7 was substituted in the receiver, and it functioned even better than expected. But a problem arose. What about the oscillator coupling grid? By connecting it to the a.v.c. circuit, the a.v.c. action of the set was materially improved. Heterotone was tried, coupling into the oscillator grid, with immediate approval.

Fig. 210 shows the modified amplifier and heterotone oscillator. Most values, while not critical, are subject to variation depending on the a.f. transformer used in the oscillator circuit.

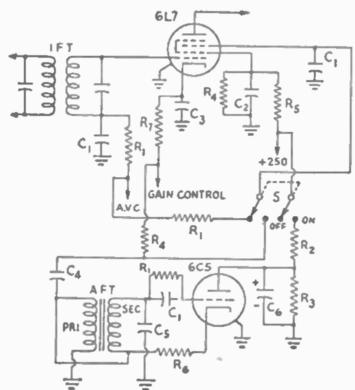

Fig. 210 — Heterotone oscillator coupled to 6L7 i.f.

C_1 — 0.01-μfd. paper.
C_2 — 0.1-μfd. paper.
C_3 — 0.5-μfd. paper.
C_4 — 0.25-μfd. paper.
C_5 — 0.002-μfd. paper.
C_6 — 8-μfd. 450-volt electrolytic.
R_1 — 100,000 ohms, ½-watt.
R_2 — 100,000 ohms, 1-watt.
R_3 — 25,000 ohms, 1-watt.
R_4 — 15,000 ohms, 1-watt.
R_5 — 10,000 ohms, 10-watt.
R_6 — 5000 ohms, 1-watt.
R_7 — 400 ohms, 1-watt.
AFT — audio transformer.

The circuit and values were found by cut-and-try. If the 6C5 does not oscillate, reverse the connections to the a.f. transformer primary. The oscillator grid of the 6L7 is connected to the a.v.c. circuit only when the heterotone oscillator is off, in order to maintain a fairly constant percentage of tone modulation. Screen-grid coupling of the oscillator to the 6L7 was found less stable in tone frequency and percentage of modulation than oscillator grid coupling, when the gain control was varied. If the set has one voltage divider to supply all screen voltages, it may be advisable to make changes to keep the screen voltage near 100. — *Wilfred H. Conley, W8CZD*

CRYSTAL FILTER FOR 'PHONE WORK

I BUILT a receiver here at W6VS using a regenerative preselector, regenerative first detector and one stage of 456-kc. i.f. The receiver had very good sensitivity and output, but lacked selectivity on the crowded 14-Mc. 'phone band. So I purchased a Meissner crystal-filter unit and installed a second i.f. tube — a 6K7. It was found that the selectivity for c.w. was perfect, but much too sharp for understandable 'phone work. A variable condenser across the input coil of the

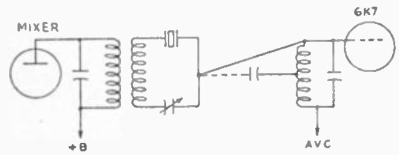

Fig. 211 — Broadening crystal filter for 'phone work. Coupling is shifted from the center-tap to the grid.

crystal bridge helped very little. I read an article by D. K. Oram in December, 1938, *QST* and decided that I would try that circuit. I removed the tap from the crystal to the center of the i.f. grid input coil and connected a wire directly to the grid of the i.f. stage. I found that this connection gives just about the right amount of selectivity for 'phone use with good discrimination and understandable quality. The circuit change is shown in Fig. 211. — *W. S. Davis, W6VS.*

REGENERATION CONTROL

THE performance of the two-tube receiver described in the October, 1937, issue of *QST*, can be improved markedly by operating the screen of the detector at a constant voltage and varying the r.f. feed-back, as shown in Fig. 212.

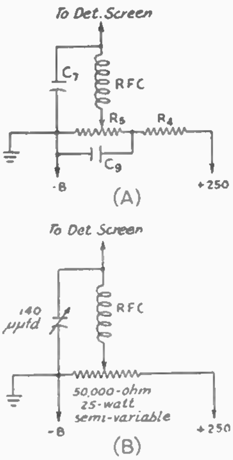

Fig. 212 — Revised regeneration control for the two-tube receiver. (A) is the original circuit; (B) the revised circuit. The values for (A) are the same as those in the original article in the October, 1937, issue of *QST*.

The semi-variable resistor replacing the potentiometer and fixed resistor may be of almost any convenient value, but should be of such physical dimensions that the screen voltage may be easily controlled. A screen voltage of about 25 volts was found to be optimum, a higher voltage causing an annoying and persistent fringe howl.

The electrolytic condenser, C_9, was found unnecessary in the modified circuit, since there is no possibility of scratch from moving contacts.

The advantages of this method of controlling regeneration are: greater stability, since the detector is operating under constant conditions; noiseless control of regeneration with no moving contacts, and fewer necessary parts, making for greater compactness. There is an almost imperceptible transition into and out of oscillation, with complete absence of back-lash.

This method of regeneration control may be adapted to any regenerative circuit with but minor circuit changes. — *Edmond L. Piesen, 48 Franklin Ave., Saranac Lake, N. Y.*

REGENERATIVE R.F. STAGE USING 6L7 PENTAGRID MIXER

THE circuit shown in Fig. 213 resulted from an attempt to use regeneration in a t.r.f. receiver for best reception of c.w. signals. As the circuit also provides greatly increased gain and is stable in operation, it should interest those amateurs who prefer to use a t.r.f. receiver.

Regeneration is maintained by means of feedback to the injector grid of the 6L7 r.f. amplifier.

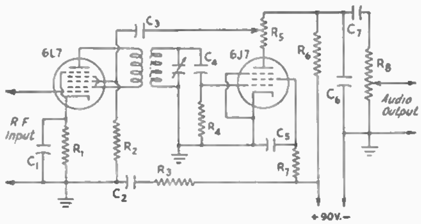

Fig. 213 — Diagram of a regenerative t.r.f. circuit for c.w reception and additional r.f. gain.

C_1 — 0.05-µfd. paper.
C_2 — 0.1-µfd. paper.
C_3 — 100-µµfd. mica.
C_4 — 250-µµfd. mica.
C_5 — 0.03-µfd. paper.
C_6 — 0.002-µfd. paper.
C_7 — 0.01-µfd. paper.
R_1 — 250 ohms, ½-watt.
R_2 — 0.5 megohm, ½-watt.
R_3 — 1000 ohms, ½-watt.
R_4 — 2 megohm, ½-watt.
R_5 — 10,000-ohm potentiometer (regeneration control).
R_6 — 0.25 megohm, ½-watt.
R_7 — 1 megohm, ½-watt.
R_8 — 0.5-megohm potentiometer (volume control).

Using the values shown in the diagram a tremendous amount of regeneration is available, so that it is necessary to reduce it to a practicable degree. This is done by experimenting with the primary of the r.f. coil to secure proper coupling and impedance.

Proper phasing is also important in the r.f. coil. If the circuit will not regenerate, the primary leads should be reversed.

Among the advantages of this circuit is the fact that the regeneration control will have no effect upon circuit resonance. Since the method of feedback is primarily that of a multivibrator, synchronization with the input signal is easy if the latter is quite close to the resonant frequency. As a result, a wide channel is available for the reception of voice (or even of music) frequencies, even while the circuit is actually oscillating. The zero-beat point will be found to be quite broad.

If the size of the regeneration control is reduced, the circuit will not function as it should. In order to reduce regeneration by any method other than that of adjusting the r.f. coupling and impedance, it is necessary to add a resistor in series with the regeneration control of such a value as to maintain a total of 10,000 ohms in the circuit when the setting of the control is reduced. This method is not practicable on an all-wave or multiband receiver, since the adjustment would have to be varied for each band. Only pruning of the coils would permit a setting for each band such as to secure satisfactory all-wave operation with this method.

Some sort of sensitivity control should be used with the input tube, since this circuit will block easily. One method of accomplishing this would be the use of an a.v.c. circuit, requiring a separate a.v.c. tube. — *L. G. Genung.*

A PUSH-PULL INFINITE-IMPEDANCE DETECTOR

Although the diode detector is widely used as the second detector in superheterodyne receivers, because it is capable of handling large signal voltages and also because it provides a ready means of obtaining a voltage for a.v.c. purposes, its low resistance greatly reduces the selectivity of the transformer feeding it.

Results comparable to those obtained with the diode detector can be realized by the use of cathode coupling in an infinite input-impedance detector. However, a.v.c. voltage is not readily obtained with this type of detector.

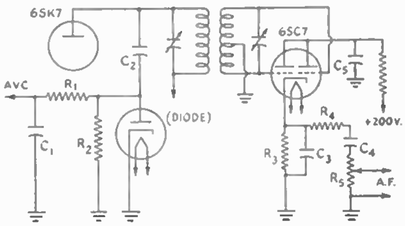

Fig. 214 **— A push-pull infinite-impedance detector with a.v.c. voltage obtained from a separate diode.**

C_1, C_4 — 0.1-μfd. paper.
C_2 — 50-μμfd. mica.
C_3 — 100-μμfd. mica.
C_5 — 8-μfd. 450 volts electrolytic.
R_1, R_2, R_4 — 1 megohm, ½-watt.
R_3 — 0.1 megohm, ½-watt.
R_5 — 1-megohm potentiometer.
R_6 — 10,000 ohms, ½-watt.

In the circuit shown in Fig. 214, a push-pull infinite-impedance detector is used in connection with a separate diode which supplies a.v.c. voltage from the plate circuit of the i.f. amplifier. This circuit gave good results when installed in a Meissner all-band receiver. It accepts signals of relatively high amplitude without overloading or distortion.

The detector tube used is a 6SC7 dual triode, operated close to cut-off. Suggested circuit values are given in the caption for the diagram. — *C. W. Moorhouse, P. O. Box 242, Chilliwac, B. C.*

THE SW-3 AS A PRESELECTOR

Receivers of the regenerative-detector and r.f.-amplifier type which have been retired from service with due honors often are recalled to work as preselectors ahead of superhet receivers, where they usually do excellent jobs.

In the usual arrangement, a tuned circuit and link are required in coupling the output of the preselector to the input of the receiver. Fig. 215 shows an arrangement which has worked out successfully in which the need for the tuned circuit and link is eliminated by using the audio tube in the regenerative receiver as a low-impedance coupling tube. Only a few changes are necessary in converting the National SW-3 to suit the new requirements. The audio coupling impedance between the detector and audio amplifier is removed. The plate of the former detector is then coupled to the grid of the former audio amplifier through a 500-μμfd. mica condenser and the grid connected to ground through an r.f. choke. The plate of the former audio amplifier is by-passed to ground and the plate voltage fed to it through an r.f. choke. The audio cathode resistance and by-pass condenser are removed and a 1000-ohm resistor to ground substituted. The output of the preselector is then taken off across this resistor with a 500-μμfd. condenser in series as shown in the diagram. The link to the input of the receiver preferably should be shielded. It also might be well to substitute a ceramic or other low-loss socket for the bakelite socket in the audio amplifier circuit. — *Louis N. Seltzer, W3COG.*

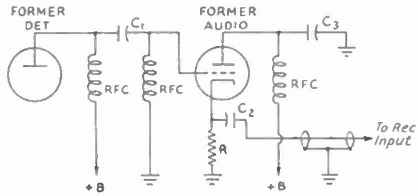

Fig. 215 **— W3COG's arrangement for using an audio amplifier as a low-impedance coupling tube when an SW-3 or similar receiver is used as a preselector, C_1 and C_2 are each 500 μμfd.; C_3 is 0.02 μfd. R is 1000 ohms.**

NOVEL SECOND-DETECTOR CIRCUIT

A 6H6 diode used as the second detector of a superheterodyne receiver is arranged as a voltage doubler in Fig. 216. I have used this circuit with very pleasing results. It is especially effective where greater automatic volume control is found to be desirable It also produces slightly more audio output than the usual arrangement. — *Allistair Towle, Mt. Royal, Que.*

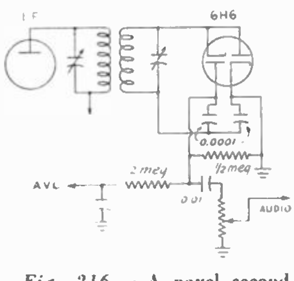

Fig. 216 **— A novel second-detector circuit using a voltage-doubling circuit.**

A VERSATILE REGENERATIVE-DETECTOR RECEIVER

I BUILT a small regenerative receiver using a 1S4 miniature tube with 9 volts on the plate and the screen. Here are some of the uses which I have found for it:

First, it can be used as a regenerative r.f. stage on a superhet. Both receivers are connected to the same antenna and ground leads, and are tuned to the same frequency. Adjusting the regeneration control will cause the gain of the superhet to increase amazingly. Stations that were inaudible before come up to comfortable volume. The better the regenerator is tuned and the nearer to oscillation it is set, the greater will be the gain. Signal-to-noise and signal-to-image ratios also are improved.

Second, it may be used for code instruction. Recently I was asked to give a code demonstration before a group of about 30 people. The a.f. oscillator I had was a small battery rig for headphone use only. Not desiring to build a larger rig, I let the regenerator oscillate and plate-modulated it through a 3-to-1 transformer, the code oscillator furnishing the audio signal. I tuned this in on a b.c. receiver and had volume to spare.

Third, it may be used as an "induction" transmitter. With the set oscillating and a magnetic speaker, hooked in the positive "B" lead, serving as a microphone, the signal may be picked up on the b.c. set for the amusement of friends.

Fourth, by checking the frequency against a receiver of known calibration, the oscillator may be used to align other receivers.

Last, it is an excellent receiver for portable use, giving good headphone strength on most signals.

The size of the gadget is 4 × 4½ × 2¾ inches. Two standard flashlight cells are used for the 1½-volt "A" battery, while six penlite cells are used to obtain 9 volts of "B" supply. I have wound coils to cover all frequencies between and including the 19-meter and standard broadcast bands. All in all, it is a cheap, useful and interesting device to have around. In fact, I often wonder how I got along without it! — *Robert Price, Laurel, Miss.*

IMPROVING VOLTAGE/FREQUENCY STABILITY OF THE H.R.O.

I RECENTLY made a couple of changes in my HRO which greatly improved the stability of the high-frequency oscillator, the instability of which had been annoying me when using maximum selectivity on c.w. signals. Slight changes in line voltage, such as those produced by taking more or less power off the line, had a perceptible effect on the oscillator; but more annoying was the fact that adjustment of the r.f. gain control had a marked detuning effect. Also, a strong incoming signal had quite a pulling effect on the h.f. oscillator frequency.

The h.f. oscillator is affected by the position of the r.f. gain control and by strong signals, because the oscillator-screen and mixer-screen voltages are taken off the same high-resistance voltage divider. When the r.f. gain is turned up or when a strong signal is tuned in, the mixer draws more screen current. Thus the voltage drop through R_1 increases, the voltage on the oscillator screen goes down, and the oscillator frequency is thereby changed. Also, of course, turning up the r.f. gain or tuning in a strong signal causes the r.f. and i.f. tubes to draw more plate and screen

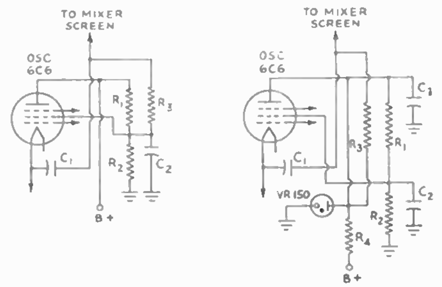

Fig. 217 — HRO receiver circuit changes suggested by W3JVJ for improving voltage-frequency stability.
Left — Original circuit. Right — Modified circuit.
C_1, C_2, C_3 — 0.1-µfd. paper.
R_1 — 50,000 ohms, ½-watt.
R_2, R_3 — 100,000 ohms, ½-watt.
R_4 — 3000 ohms, 5-watt.

current. The total load on the power supply increases, and so the voltage on the plates of all tubes, including the h.f.o., drops. The suggested changes, shown in Fig. 217, take care of this, too.

Regulation of the plate voltage to the oscillator was effected by putting a VR150 into service with a 3000-ohm resistor in its supply lead. The plate of the oscillator must then be by-passed to ground. The effect of the common screen resistor was eliminated by connecting the detector screen to the oscillator plate through the 100,000-ohm resistor already in the set.

The original circuit is shown at the left, while the revised circuit is shown at the right. The improvement effected has been very gratifying. — *John D. Edgerton, W3JVJ.*

OPERATING KINK FOR SUPERHET RECEIVERS

IN A superhet receiver the high-frequency oscillator beats with the incoming signal to produce a resultant signal of a frequency equal to that to which the i.f. amplifier is permanently tuned. This principle is well known. It is, of course, possible to receive, simultaneously, signals differing appreciably in frequency by the use of two high-frequency oscillators, each tuned to produce the required i.f. beat.

I have used this idea in an arrangement which makes it unnecessary to retune the receiver when engaged in a "three-way" QSO with two other local hams. The signal from one of these stations is tuned in in the usual manner. An external local oscillator is then used to beat against the signal from the second station to produce the same i.f. If the strength of the signals from the second station and the local oscillator are sufficient, it will not be necessary to provide direct coupling between the local oscillator and the mixer. I use an old regenerative detector as the oscillator and resistance-capacity couple its grid to the antenna terminal of the superhet. All that is necessary then is to tune the regenerative-receiver oscillator until the second signal appears at the same setting on the superhet receiver, when it is unnecessary to retune the superhet to receive either signal although they may be on frequencies in different parts of the band.

The scheme may not work so successfully on more distant stations or on local signals with superhets having a lot of preselection, but it is worth trying. — *J. C. Nelson, W8FU.*

AUDIO ATTENUATOR FOR NC100 AND NC101 RECEIVERS

My NC100X receiver has a rated audio power output of 10 watts, which is entirely too much for a small room. When the gain is turned down to a comfortable level, however, a certain amount of hum and distortion is introduced.

To overcome this I inserted a small T pad between the output transformer and voice coil, as shown in Fig. 218. The results were remarkable. The quality is very much improved and the hum is no longer noticeable. Although the tubes are still working near maximum output, the speaker does not blow me out of the room.

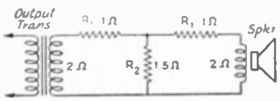

Fig. 218 — Circuit for T attenuator to maintain quality audio from NC100 and NC101 receivers at low-output levels. Values are for a 2-ohm voice coil.

The resistance values shown in Fig. 218 are selected to give 10 db. attenuation with the 2-ohm speaker furnished with the NC100 and 101 receivers. Two-watt resistors are capable of dissipating the required power. I used two 3-ohm units in parallel to obtain the 1.5-ohm value.

Resistor values for 10-db. attenuation with other impedances may be determined from the following equations:

$$R_1 = 0.52\,Z \qquad R_2 = 0.17\,Z$$

where Z is the speaker impedance. — *J. B. Hill, jr., W9OPJ.*

AIR VENT MAKES HEADPHONES MORE COMFORTABLE

If a small hole of about No. 50 drill size is pierced through the side of each cap of a pair of headphones, as shown in Fig. 219, an appreciable increase in comfort is secured for the wearer. The vents serve to equalize the air pressure between the 'phone diaphragms and the ear diaphragms. The holes are small enough so that no additional outside noise is admitted, nor is there any noticeable acoustic leakage through them. The effect is to eliminate that drumlike sound and to relieve the stuffy feeling that comes from wearing headphones for long periods of time.

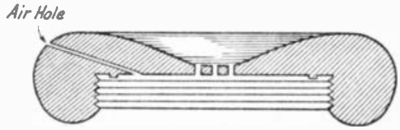

Fig. 219 — Headphone cap with vent drilled through the side to equalize air pressure for comfort.

This "operation" has been performed for about twenty hospital patients who wear 'phones in bed. All report a big improvement in comfort. — *B. P. Hansen, W9KNZ.*

HEADPHONE CONNECTIONS IN B.C. RECEIVERS

A good method of connecting headphones into a receiver without upsetting the normal plate load is to place a switch in the voice-coil circuit so that the voice coil may be cut out and

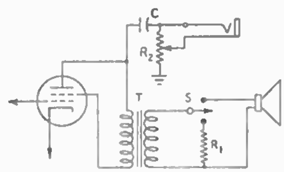

Fig. 220 — Circuit diagram showing another method of connecting headphones in the b.c. receiver output.

C — 0.01-μfd (or larger) paper.
R_1 — Resistance to match speaker voice coil; usually 4 or 5 ohms, 10 watts.
R_2 — 0.1-megohm potentiometer.
S — S.p.d.t. toggle switch.
T — Receiver output transformer.

an equivalent resistance substituted, as shown in Fig. 220. The headphones may be connected in all the time, since they do not impose much additional load on the tube. Alternatively the volume control, R_2, may be fitted with a switch to open up the circuit. — *Roy Usher, VE4EA.*

LISTENING ON 600 METERS

Some of the gang who like to take a listen on 600 meters may be somewhat disappointed with the results. Here at WPDO we have an NC200 which just covers the distress frequency of 500 kc. With the receiver connected to an average antenna the results were very poor. Even when the 2808-kc. transmitting antenna was used very little improvement was noticed. Signals picked up greatly, however, when a series-tuned circuit was added in the ground lead. This consisted of a 3-inch coil of 75 turns and a 4-gang condenser from an old t.r.f. b.c. set, with all sections tied in parallel.

Reception at night is excellent. I have heard Argentine coastal stations at good strength. No interference is experienced from the local b.c. stations nor from the 250-watt police transmitter operating in the same room.

The importance of a tuned antenna for receiving on the low frequencies is well known to some of the older gang, but some of the younger fellows may not be as well acquainted with the point. — *C. Belvin, W8LVV.*

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Re listening on 600 meters. I thought I would try the use of parallel condensers to pad the main tuning gang of my RME-69 communications receiver to get response at the lower frequencies. In my case, it worked out great. Small fixed condensers are connected with clips, since the leads are easy to get at — and they can be taken out just as easily. — *Bert Brown, W9FS.*

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TONE CONTROL BY NEGATIVE FEED-BACK METHOD

An exceptionally wide-range control, from high treble to deep bass, is obtained with the circuit shown in Fig. 221. With the arm of the potentiometer at "*A*" the 250,000-ohm grid resistor is shorted out and the 0.05-μfd. plate condenser is connected as a by-pass to ground, giving maximum bass. With the arm at "*B*" the 0.05-μfd.

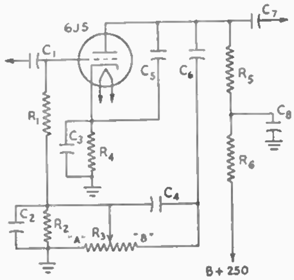

Fig. 221 — Circuit for wide-range tone variation.

C_1, C_4, C_6, C_7 — 0.05 μfd. paper.	R_1, R_2 — 0.25 megohm.
C_2 — 0.006-μfd. paper.	R_3 — 2-megohm potentiometer.
C_3 — 10-μfd. electrolytic.	R_4 — 3000 ohms.
C_5 — 100-$\mu\mu$fd. mica.	R_5 — 50,000 ohms.
C_8 — 0.5-μfd. paper.	R_6 — 0.1 megohm.

by-pass is high above ground and the feed-back voltage is maximum, with feed-back taking place only at low frequencies due to the 0.006-grid shunt. The high audio frequencies are passed and the lows attenuated at "*B*." — *Willard Moody.*

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AUTOMATIC BIAS FOR BATTERY TUBES

Many transceiver and transmitter-receiver circuits for 1.4-volt tubes specify a "C" battery as the grid-bias supply for the power-output tube. Space and weight may be saved by using a biasing resistor in place of the battery.

As shown in Fig. 222, the biasing resistor, *R*, is connected between "B" — and the grounded side of the filament, while the grid return is made to negative "B." Thus the voltage drop across the resistor is applied as bias to the grid, in the same manner as cathode bias in a.c. circuits. The plate voltage is reduced by the amount of the biasing voltage, of course, but this reduction will be negligible for the small value of bias required for most types of tubes used in portable battery rigs. A value of resistance should be selected which will produce a voltage drop equal to the required bias. The total "B" battery current

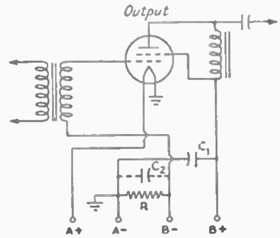

Fig. 222 — Circuit diagram showing a method of applying resistor bias to battery tubes in transceivers.

drawn by all tubes must be used in calculating the resistor value.

The same bias may be applied to the grid of a driver tube by connecting its grid return at the same point. If the driver tube requires a lower bias than the output tube, this may be obtained by returning the grid of the driver tube to a tap on the resistor or by using two resistors in series.

Aside from eliminating the need for a "C" battery, the use of resistor bias has the added advantage of automatically maintaining the grid-bias plate-voltage relationship in proper proportion as the "B" battery voltage drops off with use.

C_1 is the usual plate by-pass provided to offset the conditions caused by increasing internal resistance of the "B" battery C_2 (an electrolytic low-voltage high-capacity midget), shown in dotted lines across the bias resistor, is used only if the improvement in audio quality justifies its use. — *Loyal S. Fox, ex-W2AHB.*

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PROTECTIVE DEVICE FOR BATTERY-OPERATED RECEIVERS

In order to prevent burning out filaments of battery-operated tubes while trying out bread-board layouts and general experiments, put a resistor in series with the "B' battery right at its terminal, as shown in Fig. 223. A value of about 2500 ohms per 45 volts of "B" battery will not appreciably lower the voltage supplied to the load but will prevent the passing of sufficient current to burn out any filament in case of short circuits and slips. It will also protect the "B" battery itself. — *V. L. Robbins, Esquimalt, B. C.*

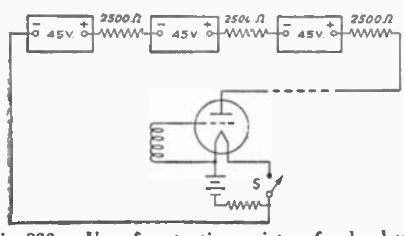

Fig. 223 — Use of protective resistors for dry-battery receivers. A 2500-ohm resistor in series with each block will prevent burning out tubes in case of accidental shorts, and will also help protect the "B" batteries.

RESONANCE INDICATOR FOR F.M.

A CIRCUIT which has been developed commercially is shown in Fig. 224. At resonance, the shadow angle is zero, since the 6E5 is biased to cut-off and no voltage is delivered by the 6H6. A voltage regulator tube insures stable operation, and the accuracy is practically equivalent to that obtainable with the more costly zero-center galvanometer method. — *Willard Moody.*

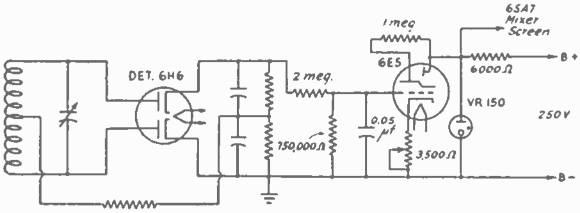

Fig. 224 — Diagram of inexpensive resonance indicator for f.m.

GANGING VOLUME CONTROLS

IT SOMETIMES arises that a ham has need of a special dual or triple volume control for which a satisfactory substitute cannot be found in the catalogs. By use of the following method, any values of resistance and taper may be combined in any number of controls up to four or five, depending on the length of shaft desired.

It so happens that the Mallory-Yaxley type of volume control is easily ganged in the home workshop. The first step is to remove the shell (including the cover plate) of the control which is to be in front. This is done by prying out the three ears holding the shell on the main assembly. The cover plate should be soldered to the shell at several points around the edge.

Then measure carefully to find the center point of the cover plate. Scribe a cross on the plate at the exact center. With a pair of dividers, scribe a ⅜-inch circle about the center. As a substitute, measure 3/16-inch in four directions and trace around a volume control bushing or other similar-sized object. Punch the center mark with a sharp center punch and drill through carefully, using the smallest drill you have, to reduce errors which might be caused by "walking" of the drill. Gradually increase the size of the drill until the ear of the coverplate falls off. The hole should now be finished with a small rat-tail file. If drilling or reaming is continued, the unbalance of metal on the two sides of the drill will move the drill considerably to one side of center. The final appearance and performance will depend upon how accurately this hole is drilled.

The next thing is to remove the shell from the other control. Then remove the C washer which holds the shaft in place. The shaft and wiper assembly now may be removed (being careful not to lose the roller contact), followed by the resistance strip. This leaves the front plate and bushing. The bushing should be cut down to about ⅛ inch long, leaving only two or three threads on it. This plate and the rear shell of the front control now may be assembled with a ⅜-inch nut. A washer or two probably will be required between the two, to take up the space where the bushing is not threaded. Now replace the resistance strip in the rear control and insert the wiper shaft through the bushing.

The shaft and wiper of the front control should now be removed and the wiper assembly pried off the shaft, being careful not to crack the phenol fiber insulation. The hole in this piece should be reamed out to ¼ inch. Go easy when nearing the final diameter! Ream from both sides and try it on the knob end of the shaft at intervals, stopping when it can be just wedged on without forcing.

The next move requires some dexterity. Insert the roller contact in the rear wiper assembly. Hold the control in the left hand, pushing against the wiper (back) end of the shaft with the index finger to provide about the same spring tension as a new control would have. Slide the resistance strip and front plate of the front control into position onto the shaft. Then, holding the tension to its final value, scribe the location of the end of the bushing on the shaft. Remove the shaft (watching the roller contact), clamp the shaft in a vise, and saw a slot around the shaft about 3/16 inch or so deep at the scribed mark to accommodate the C washer.

Now comes the final assembly. Re-insert the shaft and slide on the front wiper. Align the two wipers to the same relative position on the shaft, then turn both wipers to about middle position. With the roller contacts placed in both wipers (holding the control shaft up will help to keep them in place), slide on the resistance strip and front plate of the front control. The position of the front wiper should now be adjusted to exert about the same pressure on its resistance strip as the rear one, with the control held together. A drop of cellulose cement on the front wiper will hold it in place on the shaft. If the wiper is tight enough, this should not be necessary; if it is done, however, the wiper and shaft should be cleaned with carbon tetrachloride. After the alignment of the two wipers is checked, the C washer should be snapped on the shaft and clinched. Now the ears on the front control may be bent over and the rear shell attached in the same manner.

A switch may be attached to the gang with no modifications using the ordinary procedure. If reasonable care is exercised in its construction, a workable unit with good tracking of resistance can be obtained which is suitable for Hetrofils and Wein bridge, *R/C* oscillator circuits, and L, T and H pads. — *Cpl. David A. Kemper, W2NTX.*

'PHONE CORD HINT

To keep my 'phone cords from twisting, I bought one of those twisted rubber cords which are used on telephones. It fits over the 'phone cord in the manner in which it is used with telephone cord. I paid a dime for the one I use. —*W9YGR.*

3. *Hints and Kinks . . .*

for the Transmitter

GETTING RESULTS WITH THE PIERCE CRYSTAL OSCILLATOR CIRCUIT

Many of us are attracted by the simplicity of the Pierce crystal oscillator circuits. However, there seems to be an abundance of grief connected with getting them to operate properly. Extremely active crystals such as AT or Y cuts usually work satisfactorily but the ordinary variety of X-cut plates display a marked tendency to do just nothing. The following suggestions may be of help to those having trouble with the circuit.

Fig. 301-A will be recognized as the usual type of Pierce oscillator. With many crystals this circuit performs perfectly. With many others of good make it absolutely refuses to produce any output. A 50-μμfd. variable condenser connected between the grid and the cathode, as shown, will permit the use of any crystal. The adjustment of this condenser is fairly critical and should be made with care so that the crystal r.f. current will not rise to a value sufficient to fracture the crystal. The smallest amount of capacity which will cause reliable operation should be used. The same idea applies to the ordinary triode version of this circuit, except that perhaps a larger condenser may be needed.

Fig. 301-B also is a well-known circuit and is often recommended for harmonic operation. More frequently than not the second harmonic is absolutely nil. This is because the Pierce triode circuit utilizing the screen grid for its "plate" must be capable of oscillating of its own accord when delivering output on the second harmonic. The regular plate circuit is merely an amplifier of the second harmonic. The crystal circuit should oscillate even if the plate coil is removed. If it does not, there will be no second harmonic output in a properly operating circuit. The answer again is to place a small variable condenser between the grid and cathode of the oscillator tube. The adjustment of this condenser is rather critical and, as with the Tri-tet circuit, it should be set to give the greatest output consistent with the lowest crystal current. When operating on the fundamental frequency, this condenser should be set at zero or preferably removed from the circuit. All the usual rules that apply to Tri-tet circuit operation should be observed.

Only tubes with negligible plate-to-grid capacity should be used for fundamental operation unless provision is made to reduce greatly the amount of regeneration in the circuit.

A word about the crystals and their holders would not be out of place. The crystal holder plates should be ground to a smooth flat surface the same as the crystal itself. Warped plates are the cause of many crystal troubles. Both the crystal and the plates should be thoroughly cleaned with carbon tetrachloride and great care taken not to touch them with the fingers afterward. The pressure exerted by the crystal holder spring often causes erratic operation. Ready-mounted crystals are usually adjusted at the factory. When crystals are changed from one holder to another it would pay one to experiment a little with the pressure of

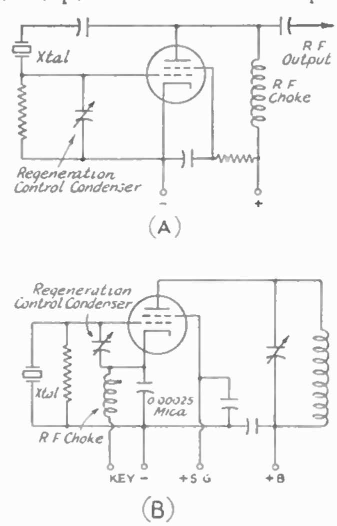

Fig. 301 — **Circuits for increasing regeneration in the Pierce and grid-plate oscillators to obtain more reliable operation with stubborn low-activity crystals.**

the spring in the holder. In some cases failure to oscillate may be caused by excessive capacity between the plates of the crystal holder. The remedy is to replace one of the plates with one of smaller size. Disks or square plates about one-half inch across have proved very satisfactory with 80-meter crystals. — *Ed. Preston, W8CSE.*

COMPOSITE OSCILLATOR

The composite oscillator shown in Fig. 302 should prove attractive to the amateur to whom the smell of soldering reacts as a perpetuating tonic — the circuit-changer eternal and the experimenter.

Primarily the chief advantage in the arrangement is its extreme flexibility in adapting itself to purposes for which modern oscillators are generally designed. Each of the various circuits is well known, but the combination of these oscillators into a composite circuit is probably new and justifies its presentation.

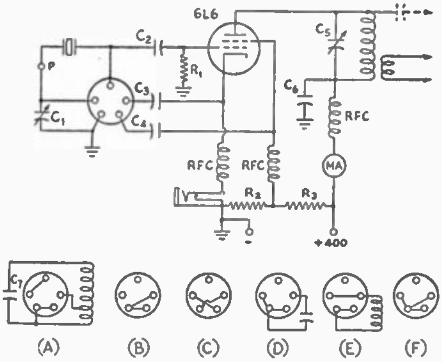

Fig. 302 — **Experimental oscillator circuit suggested by W6SM and W7HXM. By inserting different plug-in units in the socket, six different circuit combinations are obtained: (A) e.c.o.; (B) variable-frequency crystal; (C) screen feed-back crystal; (D) grid-plate crystal circuit; (E) Tri-tet circuit; (F) tetrode circuit.**
C_1 — 300-$\mu\mu$fd. variable.
C_2, C_8 — 250-$\mu\mu$fd. mica.
C_3, C_6 — 0.01-μfd. paper.
C_4 — 0.002-μfd. paper.
C_5 — 100-$\mu\mu$fd. variable.
C_7 — 0.001-μfd. mica.
R_1 — 20,000 to 50,000 ohms, 1-watt.
R_2 — 50,000 ohms, 1-watt.
R_3 — 15,000 ohms, 10-watt.
P — 60-ma. pilot lamp.

By merely selecting the proper coil or plug-in unit for the grid or cathode circuit, it is possible to secure any one of six types of oscillator circuits, as follows: straight tetrode or pentode crystal oscillator, Tri-tet, regenerative crystal with choke in cathode (the grid-plate oscillator), regenerative crystal with screen-grid feed-back, electron-coupled oscillator and variable-crystal oscillator.

Tuning of the various oscillator circuits has been covered in *QST* and *The Radio Amateur's Handbook*, and therefore needs no repetition. It might be mentioned, however, that tuning of regenerative types of crystal oscillators requires careful adjustment of the regeneration condenser to a setting that will promote good output with safe crystal current and stable keying.

The electron-coupled oscillator is used chiefly for emergencies, but may be used for regular fixed-station work, provided oscillator voltage is regulated and mechanical, thermal and electrical constants are stabilized. Much has been written of late on the e.c.o. and its ills and cures, but for the most part, the proper construction of this type of oscillator calls for isolation, stabilization and complete shielding of the oscillator itself from the following stages of the transmitter. Unless these precautions are taken, the e.c.o. circuit, shown in Fig. 302, is recommended for experimental work only.

The condenser, C_1, tunes the e.c.o. and Tri-tet coils and is used for regeneration control of the screen-grid feed-back oscillator. Therefore it should be of sufficient size to cover its various uses. A condenser of smaller capacity than that recommended probably would cause erratic operation in regenerative crystal oscillators. It may be as high as 500 $\mu\mu$fd., although some difficulty might be encountered in setting frequency with the e.c.o. while doubling or quadrupling.

A fixed high capacity is connected across the e.c.o. coil for stability and is mounted inside the coil form. The crystal need not be removed when using the e.c.o.

If a 6L6 is used, sufficient output should be obtained to drive a buffer-doubler or amplifier requiring a driving power of approximately 10 to 20 watts, which should be ample for most applications. — *L. H. Dunning, W7HXM, and R. H. Lindquist, W6SM.*

ANOTHER HARMONIC-OUTPUT OSCILLATOR CIRCUIT

In the oscillator circuit shown in Fig. 303, the tube may be either a tetrode or a pentode with suppressor connected internally or externally to cathode. This choice was made because electron coupling could be employed and the output circuit has little effect on the grid circuit with screen and plate coupled in this fashion. The screen and cathode together with condensers C_2 and C_3 form the oscillator proper. With no separate tuning coil employed in the oscillator portion of the circuit, band changing is simplified and fewer parts are used.

If the operation of the oscillator is confined to use with 160- and 80-meter crystals, a 50- to 75-$\mu\mu$fd. fixed condenser may be substituted in the circuit for the 100-$\mu\mu$fd. variable condenser

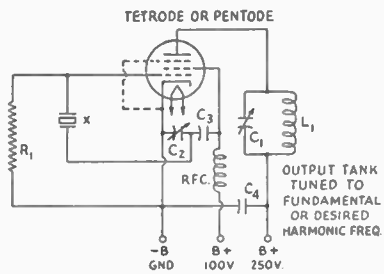

Fig. 303 — **A harmonic-output type of crystal oscillator with one tuned circuit.**
C_1, C_2 — 100-$\mu\mu$fd. variable.
C_3 — 50-$\mu\mu$fd. mica.
C_4 — 0.002-μfd. mica.
R_1 — 40,000-ohm, 2-watt carbon.
L_1 — Output tank coil, determined by frequency band.

shown, reducing the cost of the oscillator and simplifying adjustment.

Excellent harmonic output can be obtained with this arrangement. The second harmonic nearly equals the fundamental output, and the fourth-harmonic power is appreciable.

The oscillator operates in the following manner: The screen grid acts as a plate (similar to Tri-tet operation), the 50-μμfd. condenser blocking the direct current and providing one part of a capacity voltage divider for the r.f. voltage developed in the screen circuit. The 100-μμfd. variable condenser acts as a by-pass for the screen circuit and the crystal grid circuit, being common to these two circuits but not to the plate circuit, thus providing the feed-back from screen to grid necessary for oscillation. Experiments have shown that the plate-circuit isolation is excellent. Interaction from tuning and loading is reduced to a minimum. Frequency change with tuning of the plate-circuit is negligible.

The size of the grid-leak resistor may be determined experimentally for best fundamental or harmonic output, depending on the major use of the oscillator. The 40,000-ohm resistor shown should be satisfactory for harmonic operation. Voltages as low as 160 on the plate and 75 on the screen, and as high as 480 volts plate and 250 volts screen have been used with entirely satisfactory results. The simplicity of construction and adjustment makes this oscillator a very worth-while unit for the amateur station. — *Donald A. Bush, W8ONW.*

6E5 CRYSTAL OSCILLATOR AND METER SUBSTITUTE

While designing a portable transmitter it was discovered that the 6E5 would function as a crystal oscillator and at the same time act as an indicator of r.f. resonance. The final transmitter, consisting of a 6E5-802 r.f. line-up with suppressor grid modulation, proved to be an excellent one. Naturally in such a stand-by outfit simplicity and ruggedness are paramount, hence the elimination of the crystal plate milliammeter is quite an item.

Referring to the circuit in Fig. 304, when *L* and *C* are not in resonance with the crystal the fluorescent disc of the tube shows a triangle formed by overlapping of the edges. This segment is a brighter green than the rest instead of showing the customary shadow. When *L* and *C* resonate with the crystal the triangle becomes twice as large and has the appearance of being "misty."

This circuit will oscillate if the crystal is removed. This condition will be obtained only if there is no coupling between the plate coil and the r.f. choke. This choke should be made by removing turns from the secondary of an ordinary b.c. transformer until the fundamental of the coil is in the neighborhood of 1700 kc. if the low-frequency band is used, and to corresponding proportions for the other bands. Under these circumstances, with the crystal plugged in, the circuit functions as a locked oscillator with the very desirable property of staying in step with the crystal through ten or fifteen degrees of dial rotation. Crystal locking is easily observed, since the shadow is definitely larger when the crystal takes control of frequency.

In the design of an outfit likely to be used for emergency service, this locked crystal circuit has several advantages over a straight crystal circuit; the transmitter will never be without excitation even though not on crystal frequency, and QSYing to dodge QRM is also possible.

Good output can be secured on the crystal frequency without utilizing the locking system by coupling the grid choke to the plate coil (with the crystal out of the circuit) inversely or in the degenerative direction. Use just enough coupling to kill self-oscillation throughout dial rotation. Then, when the crystal is plugged in, the output will be only on crystal frequency and of surprising strength.

A fortunate feature of this circuit is that nothing is critical about the whole set-up; the output is so stable that the plate terminal may be touched with the finger without stopping oscillation. The adjustment of the degeneration coil likewise is not critical; it is not the hair-breadth setting that the old style regenerative receivers required. While the "magic eye" pattern shows the characteristic crystal dip, the dial setting is several degrees broader than with a conventional pentode oscillator. The power output, as measured roughly with light bulb loading and also by exciting a suitable transmitter, compares favorably with the power from a 41 oscillator used at the same plate voltage.

This circuit worked so beautifully right from the start that no particular pains were taken to develop its possibilities to the fullest extent. A little experiment may bring out other advantageous features. One thing that was done was to attempt to use it in the conventional circuit using a resistor in series with the grid choke. This resulted in very low output, regardless of the value

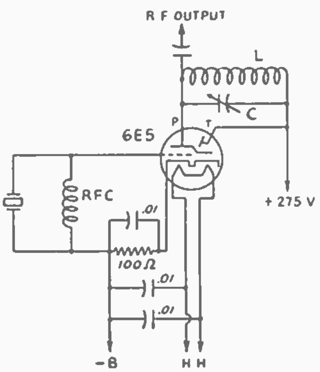

Fig. 304 — A 6E5 crystal oscillator, using the "magic eye" section as a resonance indicator. *L* and *C* are the ordinary resonant circuit capable of tuning to the crystal frequency. The "r.f. choke" is actually a t.n.t. type coil used to provide regeneration and self-oscillation; the circuit is that of a locked oscillator.

of the resistor. This use of the 6E5 does not result in shortened life, apparently, since the circuit has been used as an exciter in a transmitter here for a period of two months with no indication of tube weakening. No attempt was made to use the tube with more than 275 volts; a little experimenting here may or may not be worth while. — *A. R. Richards, W8NFM.*

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VARIABLE CRYSTAL FREQUENCY WITH AN 815 LOCKED OSCILLATOR

FIG. 305 shows the circuit of a locked-oscillator arrangement which has been giving a very good account of itself at W8KDG. The circuit consists of a conventional push-pull, tuned-plate tuned-grid oscillator circuit with the controlling crystal connected across the grid tank circuit.

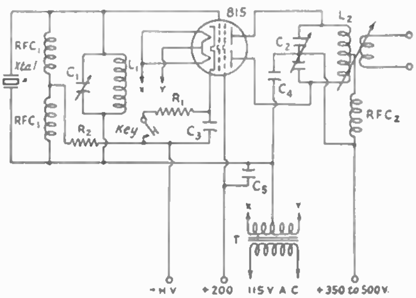

Fig. 305 — **Circuit diagram showing use of the 815 as a variable-frequency locked oscillator.**
C_1 — 100-μμfd. variable.
C_2 — 100-μμfd. per section.
C_3, C_4, C_5 — 0.01 μfd.
R_1 — 250 ohms, 10-watt.
R_2 — 15,000 ohms, 1-watt.
RFC_1 — 2.5-mh. r.f. choke.
RFC_2 — 1-mh. 300-ma. r.f. choke.
L_1 — 56 turns, 1½-inch diameter, 1¾-inch long (National AR80, no link).
L_2 — 40 turns No. 20, 1⅞-inch diameter, 2¼-inch long (B & W JCL-80).
T — 6.3-volt filament transformer.

A type 815 is used, since its low-excitation requirements eliminate danger of possible high crystal currents.

With any good X-cut or low-drift crystal, the output frequency at 3.5 Mc. may be varied over a range of 7 to 10 kc. without losing the characteristics of crystal control.

In first adjusting the circuit the plug-in coil, L_1, is removed, the grid tank condenser set at minimum, and the circuit tuned up as a straight crystal oscillator. The crystal is then removed and L_1 replaced. Then, without touching the tuning of the plate tank circuit, the grid tank is tuned to give output, as a self-excited oscillator, at approximately the same frequency. The crystal is then replaced and the signal monitored to determine the range of tuning of the grid tank circuit over which crystal-control characteristics will be obtained. This is readily determined, because the note becomes rough as soon as the lock is broken. When one has become accustomed to the tuning of the circuit, the separate steps will not be necessary and it will be simply a matter of plugging in the crystal and grid coil and tuning up.

The unit at W8KDG is built up in two decks, with the grid components below and the plate-circuit elements above. This permits short leads and keeps the two circuits isolated, which is desirable for best results.

For greatest variation in frequency, the input should be limited to 25 watts. Inputs as high as 60 watts may be used without danger to the crystal, but the lock does not hold over so great a range of frequencies.

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NOTES ON E.C.O. DRIFT

AFTER building the v.f.o. described by W6CUH in the September, 1939, issue of *QST* following the diagram as closely as possible, I found it had a tendency to drift to a higher frequency after plate voltage was applied. It shifted approximately 5 kilocycles in a period of 3 minutes, and no amount of temperature compensation would eliminate the drift.

To cure it the filament coil, which W6CUH uses interwound with the cathode or grid coil, was removed and one side of the filament grounded

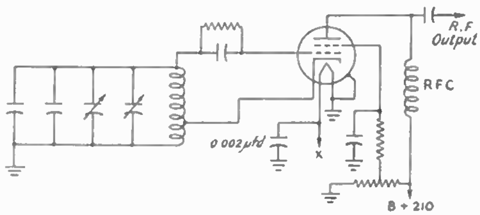

Fig. 306 — **Alteration made by W7ETK in his crystal-e.c.o. circuit to reduce frequency drift.**

directly. The other side was by-passed through a 0.002-μfd. mica condenser, both connections being made right at the tube socket. The drift was reduced to a 30-cycle change in 75 minutes of continuous operation. This may be of help to others who may run into same problem. The circuit diagram is shown in Fig. 306. — *Walter King, W7ETK.*

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E.C.O. COUPLING CIRCUIT

I HAVE found the circuit shown in Fig. 307 very efficient for coupling an e.c.o. to an existing crystal oscillator. Coupling the e.c.o. to the rig is

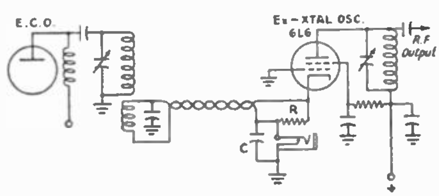

Fig. 307 — **Modified link coupling circuit between e.c.o. and crystal oscillator used by W9ERN to eliminate the need for a tuned input circuit and prevent oscillation in the crystal-oscillator circuit.**

somewhat of a problem when the transmitter is located some distance away. Ordinary link coupling, while efficient, requires the use of an additional tuned circuit at the transmitter which, in this case, is eliminated with good coupling efficiency. Since the control grid of the crystal oscillator is grounded, there is no danger of oscillation when the 6L6 is operated as a straight amplifier. — *John Clemens, W9ERN.*

ADAPTING THE 6L6 "GRID-PLATE" OSCILLATOR FOR FUNDAMENTAL AND HARMONIC OPERATION

The "grid-plate" crystal oscillator is very popular because it will stand loading to a degree which would prevent the operation of a straight pentode or tetrode oscillator. It will key smoothly under these adverse load conditions and, best of all, it will work with almost any crystal.

The circuit is sometimes suggested for harmonic operation but in the majority of cases the only result is disappointment. Unless a crystal of extremely high activity is used, there is seldom satisfactory harmonic output. Even with very active crystals, it is usually impossible to key the oscillator when the plate circuit is tuned to a harmonic. In various issues of *QST* and the *Handbook*, a very excellent solution to the problem has been set forth, namely, the changing of the crystal oscillator from the "grid-plate" circuit for fundamental operation to the Tri-tet circuit to obtain harmonic output.

The circuit acts exactly like the regular Tri-tet when a small capacity is connected between the grid and the cathode of the "grid-plate" oscillator and the output compares very favorably with it. With the Tri-tet the cathode coil must be removed from the circuit when it is desired to operate on the crystal frequency. In the case of the "grid-plate" oscillator, the extra grid-to-cathode capacity must be cut out. Fig. 308 shows how this simple change may be made with a s.p.s.t. switch which may be of either the toggle or rotary type.

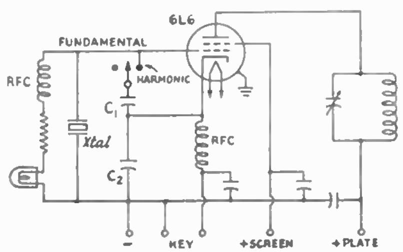

Fig. 308 — Circuit diagram of the "grid-plate" oscillator arranged for improved harmonic output. C_1 is a 70–88-μμfd. mica trimmer, while C_2 is a 250-μμfd. fixed mica. *RFC* is a standard 2.5-mh. r.f. choke. Other values are usual for this type of circuit.

In a small oscillator-transmitter built by the writer, shifting from 3.5 to 7 Mc. and tuning the rig were done with a single knob. The plate tank circuit was designed to cover both bands with a single coil. One band was reached near the maximum setting of the condenser and the other band near the minimum end. The condenser was of the type with a shaft at both ends of the rotor. A toggle switch was coupled by a spring coupling device to the rear shaft of the tuning condenser so that as the condenser was turned toward maximum or minimum the switch was operated and the proper circuit was in use for either fundamental or harmonic operation. — *Ed Preston, W8CSE.*

IMPROVING THE PIERCE CRYSTAL OSCILLATOR

In common with a great many amateurs, the writer has a "portable-emergency" transmitter employing the popular 6C5 untuned Pierce oscillator driving a 6L6 amplifier. After extended periods of transmission, it was noticed that the crystal holder became very hot. When a 150-ma. pilot bulb was placed in series with the crystal, it was lighted to more than full brilliance. Reducing the plate voltage to a point where the crystal r.f. current was brought down to a more reasonable value caused a great reduction in output. Just as I had decided to abandon the idea of the Pierce oscillator, I ran across a solution to my problem in the *RCA Guide for Transmitting Tubes*. It is a very simple solution, since it necessitates only the substitution of a resonant coil, L_1, for the usual plate r.f. choke (see Fig. 309). This coil is resonant at a frequency somewhat lower than the crystal frequency. Where crystals on several bands are used, the coil is wound for the lowest-frequency band and turns are shorted-out for the higher-frequency bands. Since different amateurs may not use the same circuit layout, coil-form size, or wire size, it would be difficult to specify a certain coil for all occasions. However, the adjustment of the coil is simplicity itself. If it is too large, the crystal current will be high; if too small, the circuit will not oscillate. The best procedure is to place a 60-ma. pilot bulb in series with the crystal and use a plate voltage *not greater than 150 volts*. Start with a coil of 200 turns or so for 160 meters, or about 125 turns for 80 meters. One coil which worked satisfactorily in my transmitter consisted of 85 turns of No. 24 enameled wire, close-wound on a 1-inch diameter form. Turns should then be removed, a few at a

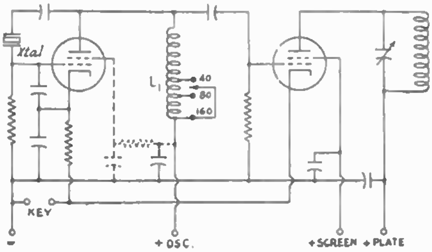

Fig. 309 — W8CSE replaces the usual plate-circuit r.f. choke with a self-resonant coil in his Pierce crystal oscillator to obtain reduction in crystal r.f. current. Other values are usual for this type of circuit.

time, until the pilot bulb barely ceases to glow. If the coil is to be tapped for operation on more than one band, the tap will be located at a point which gives reliable operation with the lowest crystal current.

In addition to the reduction of crystal r.f. current, it will be found that the circuit has greater output for a given plate voltage. The circuit will key smoother with "cranky" crystals and the value of the feed-back condenser will not be at all critical. It is recommended that the article in the *RCA Guide for Transmitting Tubes* be read for further information.

With this circuit properly adjusted it has been found possible to operate a 6L6G with 600 volts on the plate with less than 60 ma. crystal r.f. current! — *Ed Preston, W8CSE.*

OBTAINING PROPER CAPACITY RANGES ON DIFFERENT BANDS

Use of a split-stator condenser for a circuit requiring a wide range of capacities, and switching the sections of the condenser automatically with a four-pin plug-in coil, is suggested by Harold Johnstone, W7GDB.

The two sketches at the top of Fig. 310 show the manner in which the sections are used in a plate tank circuit. From the diagram at the top left in the figure, it can be seen that both stator and rotor of this condenser should be insulated from the base or chassis upon which the condenser is mounted and, in addition, that the condenser should be well separated from the panel unless the latter provides thorough shielding. An excellent method of mounting this condenser would be the use of stand-off insulators as mounting feet and of an insulated shaft with flexible coupling for the purpose of adjustment.

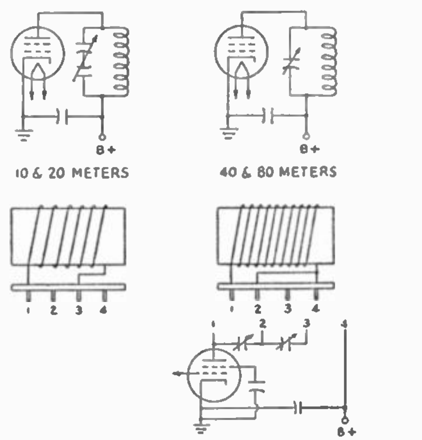

Fig. 310 — W7GDB's method of obtaining two capacity ranges with a split-stator condenser.

The condenser used by W7GDB in this arrangement has a maximum capacity of 100 μμfd. per section. On 28 and 14 Mc., this gives a maximum capacity of approximately 50 μμfd. across the tank circuit, and a minimum capacity of approximately half the single-section minimum capacity. For these bands, furthermore, the insulation in the variable condenser provides a longer leakage path than on the lower-frequency bands. The maximum and minimum capacities specified on 7 and 3.5 Mc. are the values for a single section.

The sketches in the middle of Fig. 310 show the manner in which the four contact pins of the coil are utilized for switching the condenser sections, and the circuit at the bottom of the figure shows the corresponding socket connections. As will readily be seen, this method will work equally well with tube-socket plug-in coils as with the type shown in Fig. 310.

A THREE-BAND COIL

If you are bothered with a multiplicity of plug-in coils for your exciter or portable and don't care to go to band switching, this compromise may solve the problem.

The coil form is made in the time-honored manner using a 7- or 8-prong octal base from one of the "G" series of tubes. The coil is wound for the lowest-frequency band desired and tapped for the two next higher-frequency bands. The plug and socket are wired as shown in Fig. 311. The socket must have two keyways cut in it, one

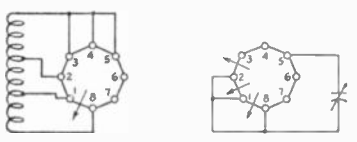

Fig. 311 — Diagram of the base and socket connections for the three-band plug-in coil.

between pins 1 and 2 and one between pins 2 and 3. This can be done with a small hacksaw blade or file. To change bands, merely pull out the coil and plug it in another keyway. Unused turns are automatically shorted.

Should the base have insufficient length for the necessary winding, a section of tubing of the correct diameter may be cemented over the base. — *Arlo Sullivan, W7CMY.*

NEUTRALIZING R.F. STAGES WITH A MODULATION MONITOR

While changing bands in the old rig, I always tuned the buffer stages with the final plate power off and, in so doing, I noticed the modulation monitor's carrier-level meter showing a reading. After a little thought I realized I had a very sensitive neutralizing indicator.

With this method I reneutralized all the r.f. stages and was surprised at the amount of neutralization that was necessary to eliminate all the r.f. in the various tank circuits.

For a high degree of accuracy, the monitor can be rather tightly coupled as the tubes become more perfectly neutralized. Also, the percentage-of-modulation indicator will register any audio frequency that might be introduced in the various stages by hum or feed-back.

Try it sometime and see if your stages are perfectly neutralized. — *Phillip F. Jones, Jr., W4FWD.*

PARALLEL FEED IN GRID AND PLATE CIRCUITS

W4AYE suggests the use of parallel feed in both grid and plate circuits to remove d.c. voltages from the neutralizing condenser. The neutralizing condenser is connected to the side of the voltage-blocking condenser opposite that to which the grid is connected as shown in Fig. 312.

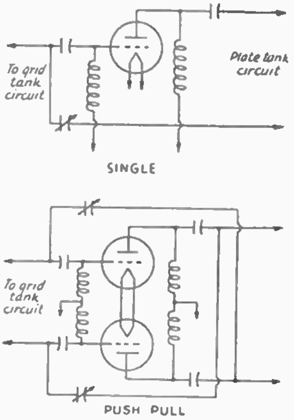

Fig. 312 — **Circuits showing that it is feasible to remove d.c. voltages from the neutralizing condensers by using parallel feed in both grid and plate circuits.**

The same idea may be applied to capacity coupled systems, provided parallel feed is used in the preceding-stage plate circuit. The blocking condensers may have any capacity from about 100 μμfd. upward.

NEED MORE NEUTRALIZING CAPACITY?

The capacity and the breakdown voltage of a neutralizing condenser may be increased by insertion of high-dielectric material between the plates. Two somewhat similar methods for doing this have been suggested by contributors, and are given below.

"The range of those neutralizing condensers which lack sufficient capacity to neutralize 203-A and 212-D tubes may be increased by insertion of ⅛-inch bakelite sheet between the plates," writes Will A. Bell, W6JXS. "The bakelite should be cemented securely to one of the plate surfaces to insure that all effective areas be parallel. The condenser air gap (distance between surface of the bakelite and the metal surface opposite) ordinarily should be approximately 1/16 inch. Other dielectric materials may be used, but consideration of the dielectric constant and power factor should be used in their selection."

Erwin Aymar, Tegucigalpa, Honduras, C. A., provides the following additional note on this same topic:

"To raise both the maximum capacity and the breakdown voltage of a transmitter neutralizing condenser, such as one of the National NC series, it is only necessary to place a piece of window glass on the lower plate. The glass should be cut so as to extend a quarter of an inch or so beyond the edge of the plate to prevent flash-over."

A table of breakdown voltages and dielectric constants of other suitable insulating materials is given on page 458 of *The Radio Amateur's Handbook*, 1945 edition.

SUBHARMONICS

Class-C oscillators with fixed bias are unstable. Decreasing the feed-back below a certain level results in a sudden cessation of oscillation. This trait is sometimes troublesome, but may be useful for certain purposes.

Occasionally a subharmonic of a given frequency is desired. It is possible to "lock" an oscillator near one of its harmonics, if the oscillator has a stable frequency. Control of such a condition is, however, uncertain.

If the negative fixed bias is increased until oscillation ceases, then a high frequency applied to any of the electrodes of the oscillator tube will renew oscillation at a subharmonic of the exciting frequency.

Strong feed-back gives good output but requires a large negative bias and a high excitation voltage. These conditions are necessary for foolproof operation when the ratio of frequency division is as high as one to ten. — *2nd Lt. Herbert Brooks, ex-W9SDG.*

SIMPLE TREATMENT FOR B.C.I.

Interference to local b.c. receivers may be eliminated easily by connecting a series-tuned wave trap from the second-detector grid to ground. This does not affect the tuning appreciably at any frequency nor the sensitivity of the receiver.

In case the set uses diode rectification, the trap may be connected across the last intermediate plate or grid to ground, but be sure the condenser will not break down under the normal plate voltage or you may have a set to replace.

Antenna wave traps have been useless in most of my cases, but this really is effective. — *Ellery Plotts, Chicago, Ill.*

Note. — This will hold true only if the capacity is sufficiently small to produce appreciable reactance at broadcast frequencies. The capacity should be no larger than that which will permit retuning of the circuit with the trimmer condenser. Somewhat larger capacities will be permissible for the 3.5- and 1.75-Mc. bands. — Editor.

ON ELIMINATING B.C.L. INTERFERENCE

After spending a lot of dough on equipment and putting in a lot of time building the rig, I found that I had key clicks, blanketing, and feed-back into the power lines. Otherwise the ole rig worked swell!

First of all, I started to work on the feed-back which was helping to blanket the b.c.l. receivers in the neighborhood. Fig. 313-A is the hook-up I used. The coil is wound on a large General Radio ceramic form, and the wire size is No. 12. This coil had enough impedance to act as a choke and it stopped the feed-back. To make this a good job and be sure that no r.f. was getting past the choke, I grounded the "ground" side of the power line close to the transmitter and by-passed the hot side to ground. This did surprising things in helping to get rid of a lot of blanketing.

With the feed-back now gone, the blanketing came next. After a little search, I found in the *Handbook* data on some low-pass filter systems. Perhaps this was just the thing I was looking for! So I built one just to see if the durn thing worked and — lo and behold — it did! The diagram and coil data are given in Fig. 313-B. I might add that the filter system must be designed for the lowest frequency used. If you are working on 160, the filter system must be designed for complete cut-off at 1600 kc. The one shown in the diagram for this purpose is recommended for working in several bands.

Now for the key clicks which were really doing some damage. I used two types of filters, but the second one was the one that did the best work for me. In Fig. 313-C is the one I tried first. That helped, but it just didn't come up to what I thought it should. The second was simpler, and really worked the best for me. I use block-grid keying and a b.c. power pack supplies the necessary voltage. The transformer is a Bell telephone transformer which came out of a connection box. The variable resistor was adjusted until the oscillator began to draw plate current, or rather adjusted until the highest-biased tube started to draw current. In my case it happened to be the oscillator. The diagram for the one I'm now using is shown in Fig. 313-D. But the filter of Fig. 301-C really is a good one. The choke there is the primary of a bell-ringing transformer. The 0.006-μfd. condenser across the input of the filter may be tried, although in some cases it may not be needed. The *Xs* are for r.f. chokes. The filter may be built without them since they are needed only in extreme cases.

The stuff I've described has worked very well for me, and would probably give someone else a galloping start toward getting his troubles ironed out. — *Eugene L. Fegley, W8MPB.*

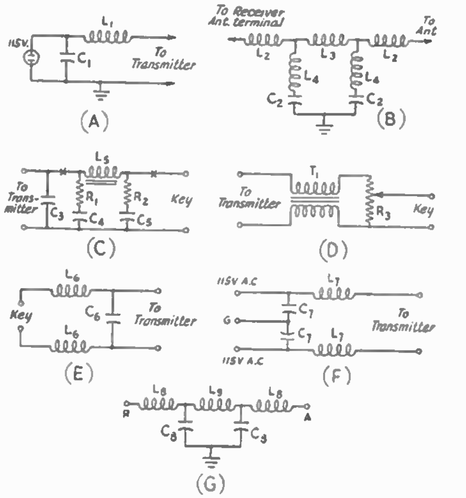

Fig. 313 — (A) a simple line filter designed to prevent feeding r.f. from the transmitter back into the power lines. (B) a low-pass r.f. filter to be inserted in series with the antenna of the b.c. receiver. It eliminates the necessity of tuning a wave-trap. (C) and (D) two types of lag circuits for eliminating key clicks. (E) a key-click filter of the r.f. type. (F) another power line filter. (G) a simple low-pass r.f. filter for the b. c. receiver.

C_1 — 0.25-μfd. paper.
C_2 — 25-μμfd. mica.
C_3 — 0.006-μfd. mica.
C_4, C_5 — 0.5-μfd. paper.
C_6 — 0.01- to 0.05-μfd. paper.
C_7 — 0.1-μfd. paper.
C_8 — 500-μμfd. paper.
R_1 — 100 ohms, 1-watt.
R_2 — 100 ohms, 1-watt.
R_3 — 500–25,000-ohm wire-wound potentiometer.
L_1 — See text.
L_2 — 18 turns No. 28 d.s.c. 1⅜ inch diameter.
L_3 — 29 turns No. 28 d.s.c. 1⅜ inch diameter.
L_4 — 24 turns No. 28 d.s.c. 1⅜ inch diameter.
L_5 — Primary winding of bell-ringing transformer.
L_6 — 2.5 millihenry r.f. chokes.
L_7 — 180 turns No. 12 enamelled, 1¼ inch diameter.
L_8 — 33 turns No. 24 d.s.c. 1⅝ inch diameter.
L_9 — 54 turns No. 24 d.s.c. 1⅝ inch diameter.

CURING NOISE FROM THE TRANSMITTER

I have just finished clearing up a source of noise which might be of interest to others. I had first thought the mercury-vapor rectifiers to be responsible, but a check showed that the source of noise was somewhere else. I purchased two new filter condensers on the assumption that they might be leaking. These condensers were installed and the supply turned on without being connected to the transmitter. No noise appeared in either the communications receiver or the broadcast receiver. However, on connecting the supply to the transmitter, this machine-gunning again started, this time at a more rapid speed and much louder than before.

I started with the tubes and removed parts from the final amplifier. After removing tank coil, grid coil, r.f. choke and by-pass condenser, I removed the leads from the final-amplifier plate meter. At this time the noise stopped. I removed the meter from the panel and opened the case. I found that the shunt consisted of a short length of about No. 20 resistance wire, the only irregularity being that two turns of the wire were touching. The insulation on this wire is single cotton and was burned brown. I moved the turns of wire apart and reinstalled the meter. The interference completely disappeared.

It appears that there may have been some leakage across this point, but this leakage was not sufficient to cause any variation in the plate current reading of the meter. This might possibly be a good suggestion for others who are experiencing similar trouble. It shows that the mercury-vapor tubes are not always to blame. — *J. P. Gilliam, W9SVH.*

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CURING FILAMENT HUM

Hum in the receiver caused by leaving transmitter filaments connected during reception is a common complaint. The only sure cure seems to be that of opening the grid circuit in the transmitter during receiving periods. A method for doing this automatically, suggested by Robert Berler, W2EPC, is shown in Fig. 314. W2EPC writes as follows:

"A three-watt neon lamp was purchased and its base was removed by heating over a flame. The

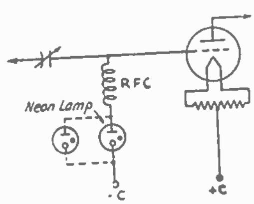

Fig. 314 — Using a neon lamp in the grid circuit for curing hum from the transmitter during reception. A 3-watt lamp with the base resistor removed is required. In a stage where heavy grid current is drawn, two or more lamps should be connected in parallel.

internal wire resistor was removed from the base of the lamp and then the base was replaced. The 'C' bias lead to the final amplifier is broken at the cold side of the r.f. choke and the lamp is connected in series at that point. The neon lamp can safely pass 65 milliamperes, but if more current is drawn it is advisable to connect two lamps in parallel."

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KINKS FOR PORTABLE TRANSMITTERS

Here are a couple of suggestions which may be of interest.

The first suggestion is that of using flashlight lamp bulbs as resonance indicators in low-power rigs where either cost or space eliminates meters. On my portable I placed lamps in series with the tank tuning condensers and they worked out well with no noticeable bad effects, even though I was afraid one in the oscillator tank would cause poor keying. A 6N7 is used as a v.f.o. and double-buffer. With a plate voltage of 300 volts, 2.5-volt lamps light to about three-fourths full brilliance at resonance.

Mounting the lamp sockets right on the tank condensers helps to keep leads short.

In order to eliminate the grief caused by microphone batteries being either run down or forgotten, it was decided to eliminate them. It was reasoned that, since the modulated amplifier plate load was constant, microphone voltage could be taken from the drop across the cathode resistor. In this case a pair of 807s was used. A 100-ohm wire-wound resistor was installed as indicated in Fig. 315. A variable resistor was used to accommodate various single-button microphones, and checks

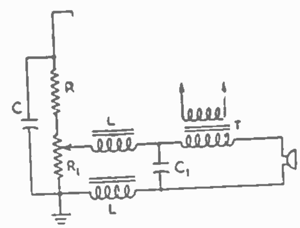

Fig. 315 — Circuit used to eliminate the microphone battery in a portable 'phone transmitter.

C_1 — 25-μfd. 50-volt electrolytic.
R, C — Usual values of cathode resistor and by-pass condenser.
R_1 — 100-ohm 25-watt wire-wound.
L — W. E. Co. 46-N retardation coil. (Small 2-winding chokes, 100 ohms per coil. Almost any small iron-core chokes may be used, such as old high-resistance doorbell or buzzer coils.)
T — Usual microphone transformer.

on an oscilloscope and on the air have indicated operation to be just as satisfactory as with dry batteries.

If the original cathode resistor is of the slider type, and only one microphone is to be used, the 100-ohm variable resistor may be eliminated. In either event, adjust the tap or slider for correct button voltage at no signal input and final running at normal rating. The filter was required to eliminate motor-boating. While I do not recommend its universal use, the idea does provide a very satisfactory substitute for batteries in a portable where high-fidelity operation is skipped in favor of simplicity.

The combination of the two ideas described above contributes to the cause in more ways than one, as you can see. Extra and unattached parts are easily forgotten, broken or a dozen other things when you grab the portable for a hurry-up day afield. — *Herb Walleze, W8BQ.*

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SIMPLIFIED I.C.W. OPERATION

For i.c.w. operation I simply connect a conventional high-frequency buzzer in series with the microphone winding. Even though the resistance of the microphone winding is a few hundred ohms, I have had no trouble in getting the buzzer to key well with only 2 or 3 volts. A 4.5-volt "C" battery works best. The audio output is very high with this arrangement. Reports on the performance have been very complimentary. Only a few parts are required for this system and the audio-frequency tone can be varied over a wide range. — *Michael A. Ziniuk, W8PZL.*

NON-SHORT-CIRCUITING COIL CLIPS

A very simple and effective clip is shown in Fig. 316-A. This idea was submitted by W2-HNX. It may be made by folding a strip of phosphor bronze or similar material and forming the end around a nail or drill of suitable size. Similar clips are obtainable from certain manufacturers of transmitter coils.

To prevent the clip from twisting far enough to short-circuit turns, a hole is drilled about halfway up the clip and a small rod of insulating material such as bakelite or celluloid from a knitting needle is inserted in the hole and cemented fast.

At (B) a somewhat different arrangement utilizing the same principle is suggested by VE4AJQ. The clip, in this case, is made of two pieces of heavy spring brass or phosphor bronze bent at right angles, formed at the ends, and fastened with machine screws to a strip of insulating material.

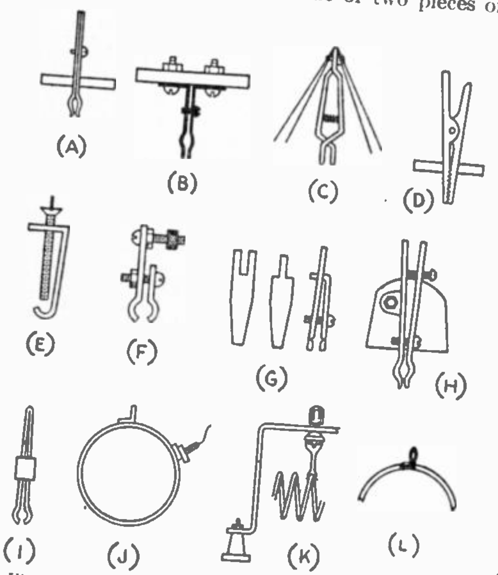


Fig. 316 — Non-short-circuiting types of coil clips.

W8QPS uses a "pee-wee" clip of the "bulldog" type with the jaws filed down to permit use on coils with closely spaced turns. The clip is fitted with celluloid strips as shown at (C) to prevent tipping too far. The same idea was suggested by W8OWL.

Along the same line is the "alligator"-type clip, shown at (D). Each jaw is fitted with a peg of insulating material. This design was submitted by Harold W. Hartman of Los Angeles.

Three types of "pressure" clips are shown at (E), (F), and (G). In each case, sufficiently firm clamping is possible to prevent the clip from turning and short-circuiting turns, even with a strong pull. The design shown at (E) was submitted by K4EDS. The metal piece is ¼ to ⅜ inch wide. The hole at the top is tapped to accommodate the flat-head machine screw. A small piece of sheet metal is soldered in the screwdriver slot to form a wing-screw which may be turned by hand. Two simple types which require the use of a screwdriver are shown at (F) and (G).

The first suggestion was submitted by W2DC and the second method, which is designed to prevent any possible twisting while tightening, was suggested by W2BXJ.

In case anyone feels that he must have absolute insurance against twisting, the design at (H) by W9SZN should fill the bill. The metal pieces should be cut from stiff brass of as great thickness as practicable. An "ear" is cut as shown on one of the pieces to permit fastening to the small piece of insulation which effectively prevents tipping. The bottom screw should not be tightened completely as it is only a sort of pivot. The clamping action is obtained chiefly by means of the upper screw.

A rather novel clip is suggested by W6GFK and is shown at (I). The clip itself is first formed from a piece of spring brass. A narrow band of soft brass then is bent around the upper part of the clip. Sliding this band up and down on the clip will loosen or tighten the clamping.

Another highly satisfactory tapping arrangement is shown at (J). This idea was suggested by W4PL and E. Ottney, Peterboro, Ontario. Its most serious drawback is that it requires soldering, although it has the advantage that it may be used with coils of very closely spaced turns. While an ear or tab of No. 12 or 14 wire may be used for the tap, W4PL prefers to file down the head of a No. 6–32 machine screw and also to file out the screwdriver slot to fit the wire. The head then is soldered to the wire at the point where the tap is desired. A standard 'phone tip is just the right size to take a 6–32 tap, so the tip may be threaded onto the screw. If a tap is not available, the threads of the screw may be filed off until the 'phone tip may be slid on over the screw and soldered in place. Contact to the tap is made by means of a standard 'phone jack which also will fit on the No. 12 or 14 wire.

Still another scheme is shown at (K). This idea comes from W2GSI. A contact from a small knife-switch, properly formed to fit the wire, is fitted to a standard Eby binding post. This post has a hole passing through the shaft which will pass No. 12 wire. The clip may be slid along the wire to the desired point and tightened by the clamping action of the binding post. The wire support, which also serves as the lead to the tap, holds the clip at right angles to the axis of the coil.

A clever tapped coil is shown at (L). An ordinary small soldering lug is soldered to the wire and then almost any type of clip will provide good contact with little danger of its falling over on adjacent turns. The wire may be fastened on with a machine screw. If taps must be made on every turn, the lugs may be staggered. This idea comes from W8NDV.

Editor's Note. — In making the clips shown above, or in constructing any other type of adjustable clip for coils, it is important that no ferrous metal be used. Phosphor bronze, copper or spring brass fittings are required.

MOUNTING TRIMMER CONDENSERS

WHEN rebuilding my rig I decided to mount the grid tuning condensers inside the coil forms (link-coupled circuits) to save space. To eliminate loose wires inside the coils I ran across this very helpful kink which saves plenty of time and trouble.

Instead of using the usual four- or five-prong coil form, I purchased the six-prong type (some of which have a mounting shoulder for mica or air trimmers). Hook the twisted pair for the link to the large terminals, and the ends of the grid coil winding to plate and cathode prongs. This leaves the two top prongs free for connection to the tuning condenser. The connections may be pulled tight and cut off, as indicated in Fig. 317. This permits easy removal or installation of the tuning condenser. Connections between the condenser and the two sides of the grid coil are made on the socket. Don't forget these! — *R. N. Eubank, W3WS - W3AAJ.*

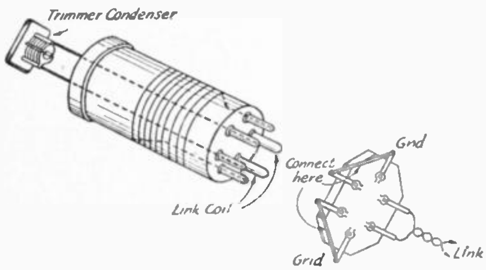
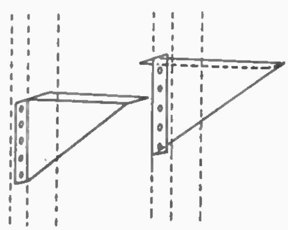


Fig. 317 — **Wiring arrangement for easy removal of a trimmer condenser mounted in a coil form.**

SUPPORT FLANGES FOR HOLDING STANDARD RACK UNITS

A RECENT visit to a military station disclosed a handy gadget to facilitate mounting and removal for replacement or servicing of single units in standard-rack installations. Two simple flanges, as shown in Fig. 318, are permanently attached to the rack, either by flat-headed screws or rivets or by welding them on. These provide surfaces for holding a chassis or cabinet, which is slid onto or off the flanges, without the necessity of holding the unit in place while panel screws are being inserted and tightened. Thus one man can install heavy equipment which would otherwise require the aid of another.

Fig. 318 — **Simple flanges attached to a standard rack make for easier handling of heavy units.**



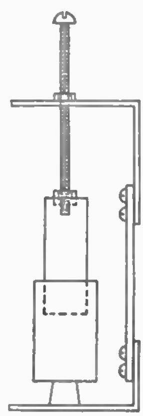
The flanges are of very simple design and any ham could make them up from scrap sheet metal. If it is desirable to avoid any projection of the flange supports on the front of the rack, they may be mounted behind the front edge of the channel or attached at the rear of the rack members by drilling the necessary holes. — *W1CBD.*

A HOMEMADE NEUTRALIZING CONDENSER

IN BUILDING my new rig I needed neutralizing condensers for my 809 buffer and HF100 final. Not wanting to wait too long for delivery, I made a dive into the junk box and came up with enough odds and ends to make a pair of very acceptable substitutes for the commercial product.

A sketch of one of the condensers is shown in Fig. 319. It is patterned after the well-known coaxial cylinder type. The cylinders are cut from defunct electrolytic condensers. The inner one is one inch in diameter and was taken from a 4-μfd. condenser, while the outer one, taken from an 8-μfd. unit, is 1⅜ inches in diameter. For a maximum capacity of 10 μμfd., the cylinders should be approximately 2 inches long. For the same diameters, other maximum capacities will be proportional to the length of the cylinders.

Fig. 319 — **Neutralizing condenser made from old filter condenser cans by W8VTC.**



Care should be taken to drill the hole for the adjusting screw for the movable cylinder at the exact center and to mount the stationary cylinder centrally in respect to the movable cylinder. The air-gap should be sufficient to prevent breakdown when used in a plate-modulated amplifier operating at plate voltages up to 1500.

Pieces of metal strip are used to mount each cylinder. The upper strip is tapped to fit the long machine screw used for adjusting the capacity. The two metal portions are insulated by a strip of insulating material, such as polystyrene. — *Samuel A. Balaban, W2KVA–W8VTC.*

PREVENTING VOLTAGE BREAKDOWN IN 6L6 OSCILLATORS

HERE is a method for preventing arcing in 6L6 tubes, and thus saving power supply components. Trouble was experienced with a 6L6 operating with 400 volts on the plate, indicating that the power supply was being shorted within the tube itself. Since the operation was normal (the tube was used as a tetrode crystal oscillator with medium load), an arc within the elements was considered highly improbable. Therefore, the connection between the *shell* and *ground* was removed, and this was found to remove the shorting load. Since the point of lowest breakdown voltage in this type of tube seems to be between connections for the elements and the shell, use of a 0.01-μfd. 600-volt condenser between metal shield pin No. 1 and ground is recommended. — *Edwin F. Ehlinger, W8BBP.*

A SIMPLE BAND-CHANGE SWITCH

An easily constructed and inexpensive switch of the coil-shorting type, devised by J. Stanley Brown, W3EHE, is shown in Fig. 320. The contacts are bronze fuse clips, the shorting contact a length of quarter-inch brass rod. The

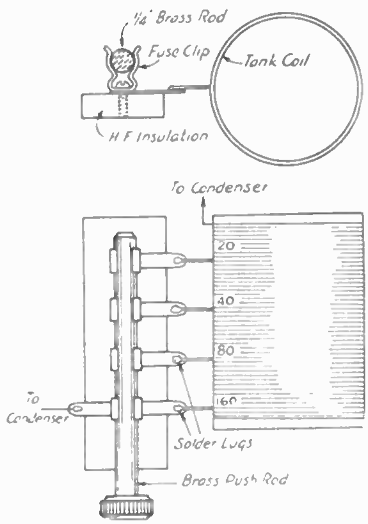


Fig. 320 — **An easily constructed home-constructed shorting-type switch for band-changing.**

parts should be mounted on good high-frequency insulating material such as Victron (which is easily worked) to prevent power loss.

A switch of this type has high current-carrying capacity, low electrostatic capacity between contacts, and permits laying out the circuit so that the shorting leads have negligible length.

STAND-OFF INSULATOR KINKS

Recently we were faced with the problem of getting some feed-through insulators quickly and cheaply. Since we had none on hand but did have several ordinary 2¼-inch stand-off insulators, we rigged up a very satisfactory substitute by boring a ¾-inch hole through the chassis and bolting the stand-off insulator in place, as shown in Fig. 321-A. Not only are the electrical

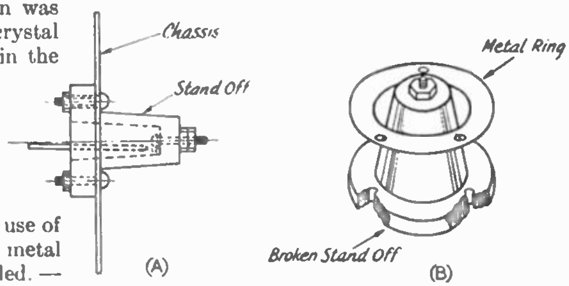


Fig. 321 — **(A) stand-off insulator used as a feed-through. (B) repair for circular-base stand-offs.**

and mechanical characteristics of this arrangement entirely satisfactory, but the final appearance also is good.

This brings up another idea in relation to stand-off insulators which might prove useful. A good many hams have in the junk box some of the old circular-base insulators with three-hole mounting. Since the base is very fragile, they usually have one or more of the mounting holes chipped away. We have found that we can use stand-offs of this type which have two or even three mounting holes gone, by cutting a metal ring of the same diameter as the base and placing the ring over the stand-off before bolting it, as shown in Fig. 321-B. — *Dale Scarbrough, W6UCM, and Laverne Hixson, W6TZY.*

A METHOD FOR LOWERING CRYSTAL FREQUENCY

I'd like to pass on a suggestion I have hit upon regarding crystals. It applies to one of those little tragedies so common in the life of the ham who grinds his own crystals. I mean those crystals which have been pushed a kilocycle or two too far and are irretrievably past either the desired frequency, or perhaps, the band edge. Various means have been tried to bring them back. I think the best one is still the expedient of having them silvered, but this process is quite a chore, whereas the stunt I will suggest takes but a moment and works equally well.

Briefly, the idea is to paint the surface of the crystal with either iodine or mercurochrome. Either the tincture or the aqueous solutions will work. The iodine gives the most pronounced effect although the mercurochrome will probably be more permanent, since there is a possibility that the iodine will undergo what is called sublimation, somewhat like evaporation. Thus far this has not happened to the several rocks I have treated, but it is mentioned for what the observation may be worth.

The best way to apply either treatment is first to clean the crystal thoroughly in soap and water, then rinse thoroughly in warm clean water. Next, lay the crystal flat on a level surface and, placing one drop of either solution in the center of the surface, guide it around over the crystal face until the whole surface is covered. Let it dry and then repeat the job on the other side. The effect may be increased, up to a certain limit, by repeating the treatment two or three times. Before replacing the crystal in the holder, it should be wiped with a very soft cloth, or a piece of lens tissue, to remove any particles of lint or dust which might have settled on it.

This treatment usually will move a 3.5-Mc. crystal three or four kilocycles. I moved one 7-Mc. AT-cut crystal nearly thirteen kilocycles. Instead of impairing the crystals, as do most of the hit-or-miss treatments such as India ink, this one seems actually to improve the activity of the crystal up to a certain point.

I don't recommend this stunt as a substitute for proper grinding but, as an emergency measure, it is well worth while, particularly for the fellow who has a good frequency-measuring device. I've managed to get several of the boys around here to try it out and they all report good results. Except for silvering, it is the only thing I've ever found that will do any good. — *B. P. Hansen, W9KNZ.*

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A COMPACT MULTIPLE CRYSTAL HOLDER

I HAVE just completed a simple and compact multiple crystal holder. A sketch is shown in Fig. 322. *B* is a strip of metal, preferably brass, 3/16 or 1/4 inch thick, 1 inch wide and 6 inches long. The strip forms a common plate for one side of all crystals and the surface should be made as flat as possible. The individual top plates, *A*, are made from pieces of brass angle stock. The surfaces next to the crystals also are ground flat. These pieces are mounted on a sheet of bakelite, or preferably polystyrene, 3 inches wide and 6 inches long. The mounting holes are filed or drilled-out to form a slot so that the positions of the top plates are adjustable. Holes for the 6-32 mounting screws are tapped in the base.

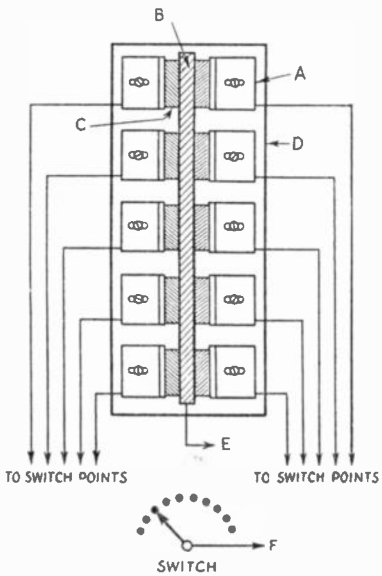

Fig. 322 — A compact multiple crystal holder. *A* indicates the individual adjustable top plates. *B* is the contact plate common to all crystals. *C* indicates the crystals. *E* and *F* are external connections to the circuit.

It is not necessary that the common central bar be fastened to the base. Before installing the crystals, loosen all the mounting screws and pull the two end pairs up tight against the bar and tighten the mounting screws. Then tighten-up the remaining pairs in like manner. Each top-plate then may be loosened up individually while inserting the crystal.

The unit is wired up as shown in the sketch, soldering the top-plate connections directly to the plates. The whole thing may be built for a few cents and will take up very little space in a crystal oven. — *Ronald Patrie, W9CWD.*

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AN INEXPENSIVE CRYSTAL SELECTOR SWITCH

ALTHOUGH there are several types of crystal-selector switches on the market, they are relatively expensive. The simple switch assembly described here can be constructed easily from spare parts on hand in the average amateur station. The materials required are:

10 General Radio type jacks (see note below).
1 single-gang 6-point switch (Yaxley No. 6263).
1 3/16-inch bakelite strip 1½ × 5½ inches.

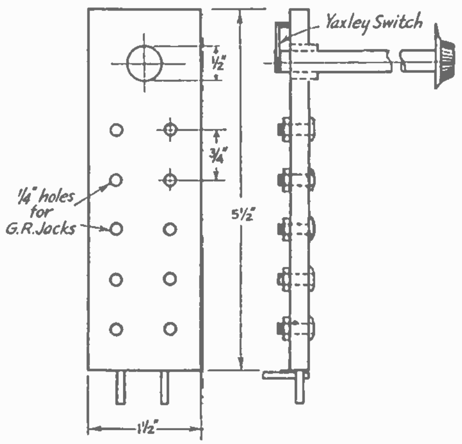


Fig. 323 — An easily constructed plug-in base and selector switch arrangement for crystal switching.

(EDITOR'S NOTE. — These jacks will fit the standard pin plugs used on the plug-in type of crystal holder. If a round-type crystal holder is used which plugs into the standard 5-prong tube socket, tube-pin type jacks should be used.)

The jacks are assembled on the bakelite strip as shown in Fig. 323 so that the crystal holders will plug in horizontally (flat). The distance between adjacent levels of jacks will depend on the thickness of the crystal holders used. The ¾-inch separation shown in Fig. 323 is based on the thickness of the regular rectangular type of crystal holder.

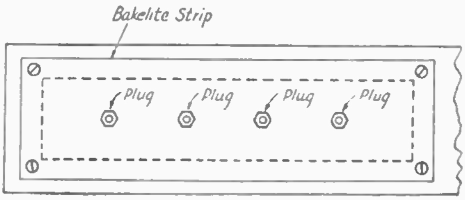
All leads should be kept as short as possible, especially the wire going to the crystal oscillator tube's grid, in order to minimize the distributed capacity.

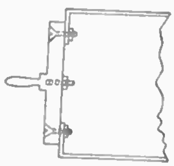
If your present transmitter is already equipped with a five-prong socket mounting for the crystal holder, this crystal selector switch can be arranged to plug into the socket by adding a 1 × 1-inch bakelite strip, equipped with two tube pins for plugging into the socket. This small bakelite strip is attached to the bottom of the switch mounting by means of two small brass angle brackets.

The crystal selector switch described above was used at W2PF-WLNA for over a year and a half without any trouble. It was indispensable in changing almost instantaneously from the special Army Amateur 3497.5-kc. frequency to the 3510-kc. amateur frequency and back again, which was often required during AARS drills or in handling traffic. Adjustments of tank condensers usually are not required for frequency shifts not exceeding 20 kc. — *David Talley, W2PF.*

PLUG-IN CHASSIS CONNECTIONS

While rebuilding my transmitter, I devised the following method of making the chassis connections to the cabinet wiring and found that it made quite a neat-appearing job. The plugs used on the chassis are similar to plugs used on





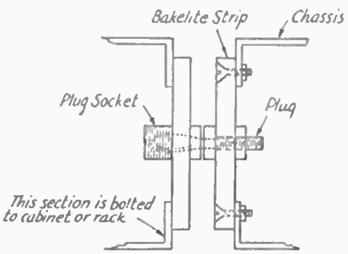


Fig. 324 **— Plugs and jacks for power supply connections in chassis-type rack-mounted transmitters.**

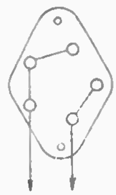
coil forms and are mounted on a strip of bakelite which is set over a section of the back of the chassis which has been cut out. The plugs on the bakelite base then fit into plug sockets mounted on bakelite in the back of the cabinet. The wiring to these plug sockets can be cabled or put in pipe according to the desire of the builder. The general idea is shown in Fig. 324.

This proves a quick method for removing the chassis from cabinet or rack for inspection or repair. — *Charles F. Yung, W2GAU.*

A THREE-WAY CRYSTAL SOCKET

Here is a simple idea that may save other amateurs much trouble in finding out why their

Fig. 325 **— When the crystal socket is wired in this manner, correct connections will be made whether the crystal is inserted in any of the three possible ways.**



crystals do not oscillate, only to discover that the crystal was plugged in the wrong way when using the regular two-point connection.

By wiring the conventional five-prong socket as shown in Fig. 325, the crystal will be properly connected in the circuit regardless of how it is plugged into the socket. — *D. H. Fowler. W1ACV.*

USING A VOLTMETER AS A SENSITIVE NEUTRALIZING INDICATOR

A voltmeter makes an excellent indicator of perfect neutralization. It is considerably more sensitive than the usual indicators such as neon bulbs, flashlight bulbs and grid current meters. The meter used should have a range of several hundred volts and should be connected as shown in Fig. 326. Notice that the connections are reversed; that is, the positive terminal of the meter is connected to the negative power-supply terminal of the amplifier and vice versa. The radio-frequency current present in the tank circuit is rectified by the tube, and thus is indicated by the meter.

Medium- or high-power amplifiers may be neutralized in the usual manner with one of the ordinary indicators while finishing touches are put on with the meter connected. With connections to

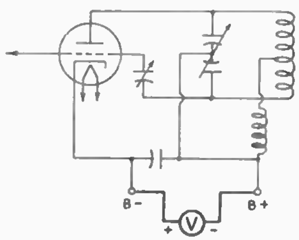


Fig. 326 **— How a d.c. voltmeter may be connected to serve as a sensitive neutralizing indicator.**

the power supply removed, the neutralizing condenser should be adjusted for minimum voltmeter reading. With low-power amplifiers the whole process can be done with the voltmeter.

In our amplifier it was found that the voltmeter would register several volts even when the grid meter showed that the amplifier was perfectly neutralized, and even a fraction of a turn of a "micrometer"-type condenser would make a very noticeable change in the voltmeter reading. This permits very accurate neutralization of even flea-power rigs, which themselves prove to be a problem in this respect. — *Donald Clark, W1MJU.*

KINKS FOR REDUCING HAZARDS IN NEUTRALIZING

In most of the articles on safety which have appeared in past issues of *QST* the point of removing all voltages before working on the transmitter has been stressed. Although it is possible to neutralize an amplifier by removing all voltages, making an adjustment of the neutralizing condenser, applying excitation, checking grid current

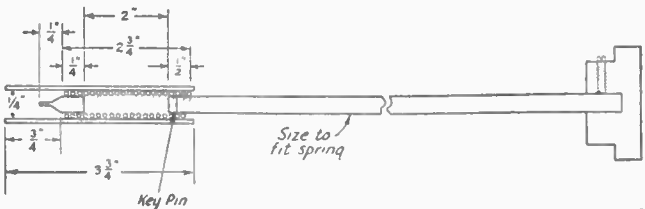


Fig. 327 — **Homemade insulated flexible screwdriver designed for adjusting neutralizing condensers safely.**

while tuning the plate tank circuit through resonance and repeating the process until stationary grid current is obtained, this method is rather laborious and additional check by the neon-bulb method is often desirable. Neon-bulb tests with

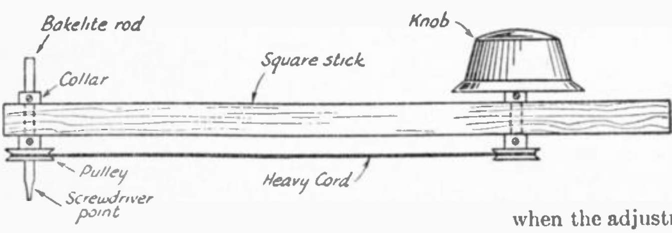


Fig. 328 — **Another simple gadget which may be used for adjusting neutralizing condensers with safety.**

plate voltage applied are often helpful in determining the presence and nature of parasitic oscillations.

In following the usual practice of holding the neon bulb against the tank coil with one hand while adjusting the neutralizing condenser with a screwdriver held in the other, the hazard is not so great from the tank circuit itself, since the plate voltage is removed from the amplifier being neutralized, but there is always the danger of the hands coming in contact with live

Robert Murray suggests the insulated flexible screwdriver, illustrated in Fig. 327, for adjusting neutralizing condensers from a safe distance, after a screwdriver slot has been cut in the end of the

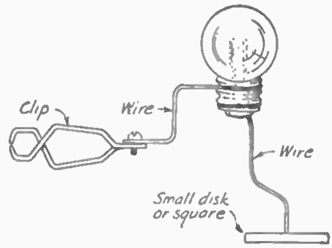


Fig. 329 — **The danger of holding a neon bulb in the hand when making neutralizing adjustments can be avoided by clipping it on one end of the tank coil. The small plate compensates for the usual hand capacity.**

shaft of the neutralizing condenser. A length of brass rod is filed to a screwdriver-edge at one end, and the other end is soldered to a length of coil spring. The other end of the spring is fastened to a length of hard rubber or bakelite rod fitted with a standard knob as the handle. A piece of rubber tubing, cemented over the screwdriver tip and the spring, serves as a locator guide. The screwdriver may be bent at any angle so that it may be used regardless of whether the neutralizing-condenser shaft is running vertically or horizontally.

Mr. Murray suggests mounting the neon bulb on a battery clip by means of a few turns of heavy wire wound about the shell of the base, so that it may be clipped on the end of the tank coil or plate terminal of the tube, making it unnecessary to hold the neon bulb in the hand. This may work successfully if the neon bulb is near the chassis but, in some cases, it may be necessary to attach a small metal plate to the central terminal of the bulb. This plate, shown in Fig. 329, should be connected by means of a length of rather heavy wire which may be bent so that the metal plate is near, but not touching, the chassis. This will provide enough capacity to ignite the bulb even when the adjustment is near the point of neutralization.

Another remote-control screwdriver idea is shown in Fig. 328. It consists of a light stick of wood, or other insulating material, with a pulley

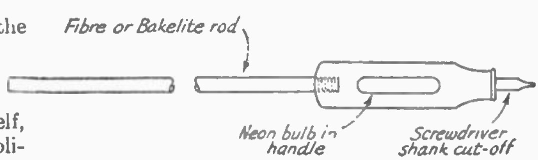


Fig. 330 — **Combination insulated screwdriver with neon-bulb indicator in the handle. Such screwdrivers**

mounted on a shaft at each end. The two pulleys are connected with a heavy cord belt. The shaft at one end is ground down to a screwdriver-edge and the other shaft is fitted with a knob. The pulleys may be of the type found in toy constructional outfits. The gadget will work with horizontal or vertical shafts and will keep the hands well out of danger.

Dr. R. J. Kasper suggests the arrangement shown in Fig. 330. The screwdriver is the type which has a neon bulb built into the handle and used frequently in testing automobile ignition systems. The shank is cut off short and ground to an edge and a length of insulating rod is fitted into a hole drilled in the end of the handle. To use this idea, the shaft of the neutralizing condenser always must be connected toward the plate circuit of the tube.

NEUTRALIZING THE AMPLIFIER WITH SAFETY

Fig. 331 shows an arrangement I have been using successfully for some time in neutralizing amplifiers equipped with link output coupling. A flashlight bulb is simply connected across the link and the neutralizing condensers adjusted for

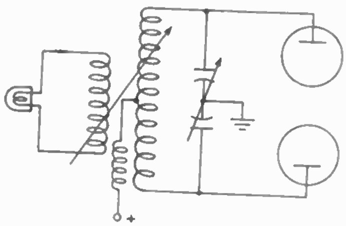


Fig. 331 — W8RBL uses a flashlight bulb connected to variable link for safe neutralizing.

no indication, or minimum indication. This system has the advantages over the neon-bulb method that it does not unbalance the circuit and that it is entirely safe in operation.

If coupling to the output coil is variable, the most sensitive bulb available should be used, starting with very loose coupling and increasing the coupling as the point of neutralization is approached. With fixed links, start with a less sensitive bulb and finish up with the more sensitive one. — *R. E. Span, W8RBL.*

SWITCHING ON OR OFF FROM FOUR LOCATIONS

Some of us remember the first time we wired our rigs so that we could switch them on or off from either of two positions. For a while we had a feeling of real satisfaction. Of course, our wiring was nothing more than the common "three-way" switching circuit used in hall lighting in dwellings.

Many occasions arise when it would be most convenient to be able to switch from more than two positions. The circuit shown in Fig. 332 permits control from four locations and requires only standard switches found in knife, toggle and snap-switch types.

Two single-pole double-throw switches and two double-pole double-throw switches (wired as reversing switches) are needed. Note that in the

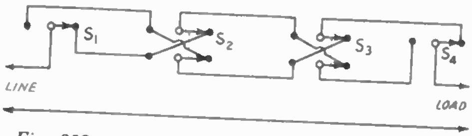


Fig. 332 — Circuit for controlling a transmitter or other device from any one of four separate positions.
S_1, S_4 — S.p.d.t. toggle switch.
S_2, S_3 — D.p.d.t. toggle switch.

diagram all switches are shown switched to the right and that the circuit as shown is off. Switching at any of the four positions puts the circuit on. This may be followed by switching to "off" from that or any other of the four positions. — *Charles F. White, USNR, New York, and Robert J. Hearon, Austin, Texas.*

A SURE-FIRE INTERLOCK

In connection with precautions which may be taken to reduce danger of injury while working around the transmitter, the use of an enclosed cabinet with door-interlocks is often suggested. The interlock system usually consists of a spring switch mounted against the door in such a way that it springs open whenever the door is opened. The switch contacts usually are connected in series with the primary winding of the high-voltage plate transformer or in a relay circuit controlling the transformer primary circuit. While these switches are nearly foolproof there is always the possibility that either switch or relay will stick without opening the circuit.

For some time I have been using a very simple and inexpensive interlock arrangement which seems to be entirely foolproof. The idea is shown in Fig. 333. An ordinary 115-volt outlet, mounted on a metal-strip bracket, is fastened inside the cabinet. A 115-volt plug is fastened to the door by means of a machine screw which also may be used to fasten the doorknob in place.

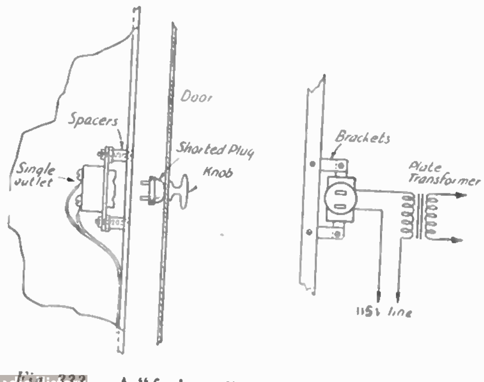


Fig. 333 — A "foolproof" interlock switch circuit.

The outlet is connected in series with one side of the 115-volt line and the high-voltage transformer primary and the two prongs of the plug on the door are connected together. Care should be taken to make sure that the nut holding the plug in place does not ground the plug contacts to the door or knob.

It is difficult to conceive of any means by which this system could fail because the circuit is broken manually when the door is opened and no dependence is placed upon springs. The plug and outlet also serve as a door catch. — *Milton Mix, W1IPL.*

A NON-CHATTERING OVERLOAD RELAY WITH ELECTRICAL RESET

It is easy to revamp an old battery-charger relay into an overload relay that will cut the final amplifier stage input to low power and hold it there until a front-panel switch is flipped, resetting the relay. Rewind the old relay with

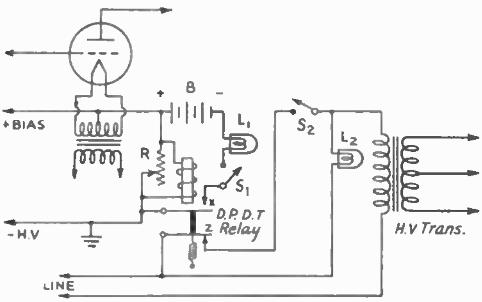


Fig. 334 — Non-chattering overload relay circuit. The relay may be made from a rewound charging relay.

enough turns of small wire so that it will throw on less current than your final draws in normal action, then shunt it with a rheostat to enable it to be adjusted to the exact current value at which you want it to go into action. Connect it to your final as shown in the diagram of Fig. 334. *R* is a rheostat, 20 ohms. *B* is 3 volts of flashlight cells. L_1 is a 2.5-volt dial-light bulb in a front-panel pilot-light socket. S_1 is the re-set switch. S_2 is a switch enabling the operator to cut to low power for tuning-up. L_2 is a 115-volt light bulb (200 watts for my rig) to reduce the voltage applied to the high-voltage transformer primary. Both switches are kept closed for normal operation. Adjust contact *X* so that it will make as soon as there is the slightest break of contact *Z*. The purpose of battery *B* is, of course, to further energize the relay coil and hold contact *Z* open until the reset switch is flipped. — *Carl C. Drumeller, W9EHC.*

METER SWITCHING WITH TOGGLE SWITCHES

Fig. 335 shows various circuit combinations for a simple and safe meter-switching system which requires nothing more than a s.p.d.t. toggle switch to make a single milliammeter serve for checking two circuits.

At (A), the meter and switch are connected so that either grid current or plate current of the same stage may be checked. When the switch is thrown to the left, the meter reads grid current; when thrown to the right, it reads plate current.

The circuit at (B) shows connections for two meters. The first reads grid current of either doubler or final, while the second reads plate current of either stage. As the circuit is shown, both doubler and final tubes may be operated from the same filament transformer, but separate high-voltage supplies are required. In the arrangement at (C), separate filament transformers are required but both stages may be operated from the same plate supply. In each stage, grid return should be made to filament center-tap rather than to ground. It will be noticed that neither the meter nor the switch is at high potential above ground in any of these circuits.

The meter-shunting resistances should be 10 to 25 ohms each if no scale multiplication is desired. If a change in the meter range is desired, when switching from one range to another, the shunting resistances may be adjusted to give the desired multiplication. If the resistance of the meter is known, the shunting resistance required to give the desired multiplication may be calculated by the following formula:

$$R = \frac{R_m}{n-1}$$

where *R* is the shunt resistance, R_m the resistance

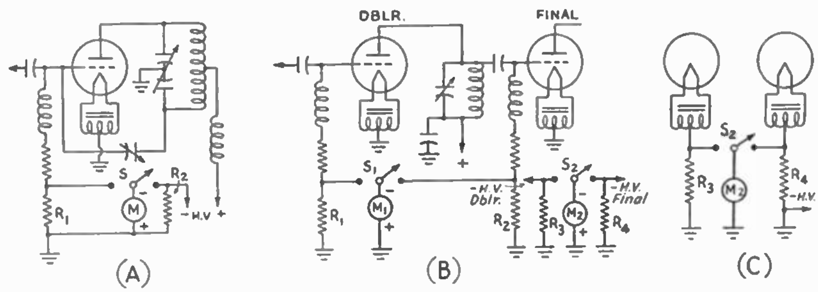


Fig. 335 — Toggle-switch meter switching. (A) circuit for switching meter from grid to plate circuit of same stage. (B) circuit for switching grid meter between two stages and plate meter between two stages. (C) is an alternative circuit, similar to (B), in which separate filament transformers permit the use of a common plate supply. R_1 and R_2 are grid-circuit meter shunt resistors, while R_3 and R_4 are the plate-circuit shunt resistors.

of the meter and n the scale multiplication factor. The required resistance also may be determined experimentally by connecting the meter in series with a low-voltage battery and rheostat and adjusting the rheostat so that the meter reads full scale. Various shunt resistances then may be tried across the meter terminals until a value is found which will cause the meter reading to fall to that fraction of full-scale deflection which is the reciprocal of the multiplication factor desired. The meter reading should fall to 1/10 for a multiplication of 10, to 1/5 for a multiplication of 5, to 1/2 for a multiplication of 2, etc.

In all cases the resistors should be of adequate current rating to prevent any possibility of burning out under heavy overload. In most cases, it will be practicable to make up the multiplying resistors from ordinary copper magnet wire. — *Howard E. Gullberg, W5GGS.*

ILLUMINATION FOR METERS

Fig. 336 shows the method I use to illuminate meters mounted behind the transmitter panel. A hole is cut in the panel of such a size that the scale of the meter may be seen clearly. The

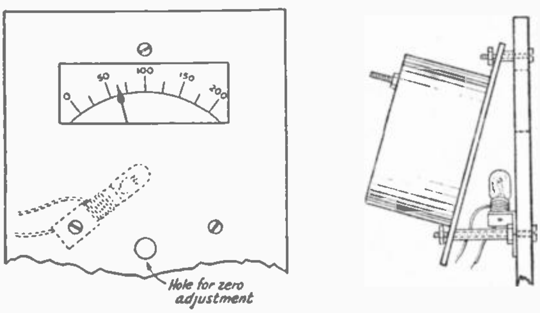


Fig. 336 — A novel method of mounting ordinary meters to obtain indirect illumination. It also removes danger of contact with the zero-adjusting screw when the meter is in a high-voltage circuit.

meter is then mounted at an angle by using long spacers on the mounting screws at the bottom of the meter and a short spacer on the top mounting screw. The ends of the spacers should be filed to correspond to angle of tilt.

The bracket for the dial light may be fastened underneath one of the lower mounting screws and a hole drilled at the center for inserting a screwdriver for setting the zero-adjust screw whenever this becomes necessary. The position of the light should be varied until there is no reflection from the meter glass.

Incidentally, this is one way of mounting meters so as to comply with the ARRL safety code. — *J. E. Greenbaum, W1LIG.*

AUTOMATIC OVERLOAD PROTECTION FOR 807 AND OTHER TUBES

I have been using a trick here at W9BPS with such success that I feel sure that others would be glad to know about it. My rig is a small affair ending up with an 807 in the final. I key the final and use plain grid-leak bias, since I have found that any amount of cathode resistance

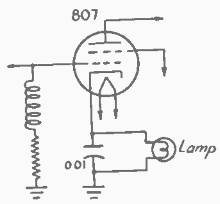


Fig. 337 — Series cathode lamp for automatically protecting an 807 against overload, as used by W9BPS.

which will give the tube any adequate degree of protection during adjustments, or in the event of failure of excitation, also limits the power output more than I like.

However, after losing one 807 and almost losing another, I cast about for some answer to the problem. I finally hit upon the idea of using an ordinary low-power lamp bulb as a cathode resistor, as shown in Fig. 337. The resistance of such a bulb when cold or at low temperature is quite low, of the order of 50 to 100 ohms, while the resistance of a 15-watt lamp will increase to 600 or 700 ohms when at normal brilliance. The result was perfect! With normal plate current flowing, the filament shows just a perceptible glow, but as the current increases above normal, the glow increases in brightness. With excitation removed entirely, the plate does not show color. Thus, not only does the lamp protect the tube effectively by automatically increasing the bias with high plate current, but the lamp gives a visual warning. — *H. A. Fanckboner, W9BPS.*

RECEIVER AS NEUTRALIZING INDICATOR

Did you ever try to neutralize an amplifier without a neon bulb or any of the other usual indicating instruments? Here is a simple but satisfactory method which requires no equipment other than the station receiver:

Turn on the oscillator only. Tune the receiver to the frequency of the oscillator and listen to the note while the amplifier neutralizing condenser is being adjusted. Each time a small change is made in the neutralizing condenser setting, swing the amplifier plate tuning condenser slowly through its entire range. If the note produced in the receiver by the oscillator changes, reset the neutralizing condenser. Do this until a setting of the neutralizing condenser is found at which no change in the note may be detected while tuning the tank condenser.

Remember that, when tuning any amplifier, the plate supply must be disconnected; but don't attempt to disconnect the plate supply by taking the clip off the top of the tube (if the amplifier tube uses a top-cap plate connection), because this breaks the r.f. circuit.

A TUBE TIME-DELAY CIRCUIT FOR REMOTE TRANSMITTER CONTROL

FIG. 338 is the circuit diagram of a two-wire transmitter control and keying circuit.

Relay Ry_1 is a small four-contact (normally open) single-throw relay, operating on a small current at 6 volts. This relay is operated by the closure of the telegraph key by the operator at the sending position.

When the key is depressed, this relay closes its four contacts, a, b, c, and d. Contact c closes the circuit from the 115-volt supply line through plate and filament transformer primaries; contact b closes the circuit of battery B_1 and the filament of

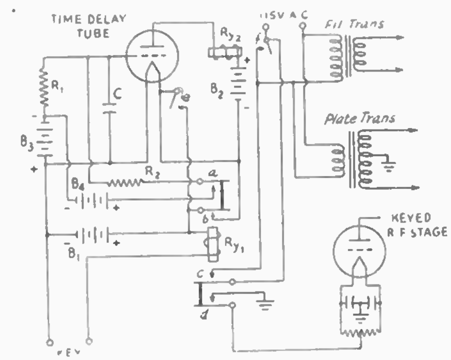


Fig. 338 — Circuit of the vacuum-tube time-delay remote-control system suggested by W8VK.

the time-delay tube, placing this tube in operating condition; contact a introduces the voltage of battery B_4 to cancel out the cut-off bias of B_3 applied to the time-delay tube, permitting plate current to flow through this tube and thus closing relay Ry_2. Contacts e and f of Ry_2 short contacts b and c of Ry_1; and since the resistance and capacity circuit in the grid section of the time-delay tube are designed to maintain Ry_2 closed for a period of 15 seconds after the release of the key, the filament and plate transformers, as well as the filament of the time-delay tube, remain turned on until a pause of fifteen seconds occurs in the transmission. When this length of time has elapsed, relay Ry_2 opens, turning off all power.

Starting the transmitter for each transmission is accomplished by holding the key down for about one second which allows time for the tube filament to heat and relay Ry_2 to become operative.

The convenience and certainty of operating without the necessity for pushing buttons or throwing switches will be appreciated by the amateur who has never used such a system, and the practicability of controlling the transmitter from a number of points, remote and local, through paralleling any number of keys, will be well worth the effort expended. — *P. J. Eubanks, W8VK.*

By a slight addition to the circuit, so that 115 volts would be applied to the primary of the plate transformer by contact f on relay Ry_2 alone, whereas the primaries of all filament transformers would be closed by both contact c and contact f as shown, the filaments of the rectifier and transmitting tubes may be heated before application of plate voltage, using the same two-wire system. Furthermore, an indirectly heated cathode tube of the six-volt type may be used for the time-delay circuit, insuring that the filament heating time will be ample. — EDITOR.

A CONTROL FOR HIGH-POWER RIGS

I FOUND it just about impossible to obtain a relay capable of handling the inductive load of the primaries of the plate transformers in the big rig. Finally I succeeded in picking up a three-phase 5-hp. motor starter of the contactor type, together with the usual push-button control. By adding a small double-pole relay it was possible to provide for push-to-talk operation, as well as control, with a minimum of wiring complications. Provision also was made for the operation of signal lights at the operating position. The circuit is shown in Fig. 339. The system will work on either the three-wire 115–230-volt lines or on single-phase 115-volt circuits. If the rig is operated from the latter, the jumper indicated by the dotted lines should be used.

Referring to the diagram, momentary closing of contacts A of S_4 by the starting button closes the circuit to the coil of the relay, Ry, causing contacts D to short-circuit and starting contacts A, and to hold the relay closed through the stopping contacts, B. When Ry closes, it actuates the power contactor, S_1, through the relay contacts,

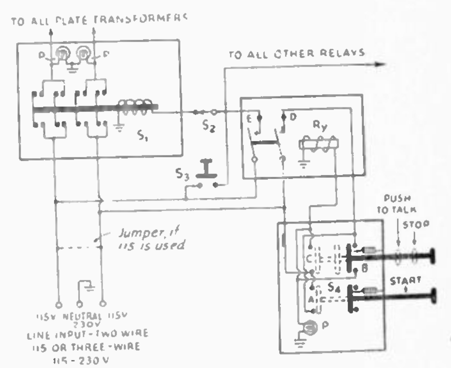


Fig. 339 — Transmitter control for high-power rigs.
P — Warning light.
R_y — Double-pole relay, normally open.
S_1 — 3-phase 5-h.p. contactor-type motor starter.
S_2 — S.p.s.t. toggle switch.
S_3 — Push-button type switch for testing.
S_4 — Push-button type control for S_1.

E. When the contacts at B are broken by pushing the stopping button half way, the circuit through the relay winding is broken, Ry opens, opening the power switch, S_1, and also opening the holding contacts, D.

When the stopping button is pushed all the way in, contacts C close the circuit to operate the relay, but since contacts B are open, the holding circuit through the relay contacts D are open and the holding circuit does not operate. In this manner, the system may be operated for push-to-talk communication.

S_2 is a safety switch located at the transmitter, which, when open, prevents application of the power from the operating position. S_3 is a push-button type switch, also located at the transmitter, for tuning. — *Alvin U. Haugen, W9PRZ.*

ANOTHER SINGLE-SWITCH CONTROL SYSTEM

In the diagram of Fig. 340 a simple throw of the switch automatically disconnects the transmitting antenna from the receiver and throws it into the transmitter antenna tank system. It also disconnects the receiver for transmitting and throws the transmitter plate voltage transformer into operation. A flip back disconnects the transmitter power and antenna, turns on the receiver, and connects the antenna to the receiver. Thus, a single switch performs all the operations for changing between transmitting and receiving.

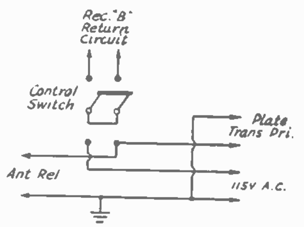


Fig. 340 — W8FAZ's single-switch control system.

For duplex work, the antenna relay must be discarded and a separate antenna introduced to the receiver but, otherwise, the operation remains the same, provided a separate send-receive switch is located on the receiver in parallel with the connections marked "Rec. B."

A double-pole double-throw mercury contact switch will serve the purpose best, especially in the case of a 'phone transmitter, where a silent change-over is desired. A single-pole double-throw antenna relay switch can be used where such arrangements are necessary. — *Joseph Zelle, W8FAZ.*

A VARIABLE-FREQUENCY CRYSTAL HOLDER

The experience of being told that some other station is transmitting on the same frequency you are, or near enough to heterodyne badly, is of course one of the commonest among amateurs. While the operator of a transmitter which is not crystal controlled may have a certain advantage in being able to shift his frequency at will, few of us wish to sacrifice the advantages of crystal control, especially on the higher frequencies. Having several crystals is of course a help, but quite often a number of them may be tried without finding a satisfactory spot. There is also the likelihood of some other station being unable to find the carrier again after a shift.

The variable-frequency crystal is obviously the answer to this problem, giving the stability of crystal control yet allowing a sufficient shift of frequency to clear other carriers. The frequency change may be made while operating the transmitter, thus allowing the other operator to follow along on the receiver. Any adjustment of the tuned circuits is usually unnecessary.

However, variable frequency crystal assemblies are relatively expensive, and it is the purpose of this discussion to describe how an ordinary holder may be converted into such a unit, or at least how one may be acquired at little more than half the price. The first requisite is an 3.5-Mc. crystal of the low-drift type. An X- or Y-cut will not do, and the crystal must be a "hot" one so that it will oscillate satisfactorily with an air gap, the variation in the gap determining the frequency — the more gap the higher the frequency. A normal variation of 6 kilocycles on the fundamental may be had with good stability, which will give 12 kilocycles on 7 Mc., 24 on 14 Mc., and 48 on 28 Mc.

A number of designs may be used in making over the holder. The top plate may be fastened to an adjusting screw which raises and lowers it above the crystal. One of the best and simplest however is the "hinge" type in which one edge of the top plate is always against the crystal, the opposite edge being raised and lowered to vary the gap. This holds the crystal firmly and allows operation in any position. As a typical case the conversion of a Bliley LD2 unit will be described in detail.

First disassemble the holder, removing the top plate, the two contact plates and crystal, and the coil tension spring. Solder a wire to the center of the bottom plate and insert the end of the wire through the terminal pin, soldering at the tip. This gives a solid bottom contact plate for the crystal. The top contact plate should be prepared by cutting two strips of thin spring brass about ⅛ inch wide and ⅛ inch longer than the width of the plate. These are soldered on to the plate parallel to each other at two corners, the free ends extending the ⅛ inch beyond the opposite edge of the plate. Two small bits are cut away in the inside corners of the bakelite frame so that when the plate is slipped in, the two overlapping strips will hold the one edge up and yet will be sufficiently recessed so as not to be clamped when the top disc is screwed down. There remains but to drill a hole through the circular top plate, thread it to take the adjusting screw and reassemble the unit. If a ¼-inch screw is used, a knob may be put on it. The original calibration of the crystal will of course be changed somewhat and if it is desired to know the exact frequency at various settings it will be necessary to recalibrate. The same frequency will always be found at the same setting of the adjustment.

The air gap will cause a noticeable decrease in crystal current, making for safer operation of the crystal as well. — *L. W. Sorensen, W6JWQ.*

4. *Hints and Kinks . . .*

for the 'Phone Rig

'PHONE MONITOR USING INFINITE-IMPEDANCE DETECTOR

George Montgomery, W8IKE, describes a simple 'phone monitor which enjoyed considerable popularity among the hams of Western Pennsylvania. The monitor, shown in Fig. 401, makes use of two triodes, one as an infinite-impedance detector and the other as an audio amplifier. In addition to the feature that the detector will handle high-percentage modulation without distortion, and therefore comes the nearest to telling the operator what his signal sounds like at a distant receiver, the following advantages are claimed:

Wide-range frequency response.
Can be used on any band from 3.9 to 60 Mc.
Single adjustment.
Suitable for use with crystal headphones.

The unit is designed to operate from the receiver power supply. Small by-pass condensers are used in the detector circuit for high fidelity. The resistor, R_3, in the "B" + lead provides additional filtering.

With the audio volume control, R_4, at maximum setting, the length of the pick-up antenna is adjusted to give satisfactory signal strength on the band on which the signal seems to be weakest. When this length has been determined, the volume control is adjusted for signals on the other bands to bring them down to the desired signal strength level.

The same arrangement has been used successfully with dual-triode tubes having separate cathodes, such as the 6C8 or 6F8.

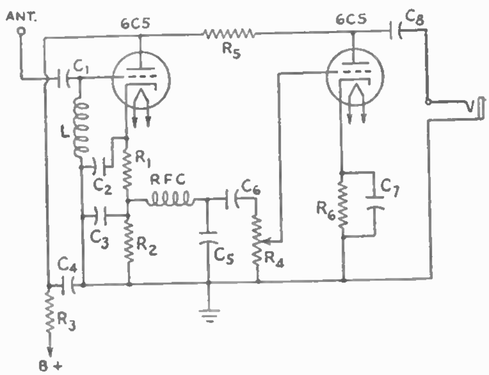


Fig. 401 — Circuit of the 'phone monitor using an infinite-impedance detector as described by W8IKE.

C_1, C_2, C_3 — 100-μμfd. mica.
C_4 — 8-μfd. electrolytic.
C_5 — 50-μμfd. mica.
C_6 — 0.05-μfd. mica.
C_7 — 10-μfd. electrolytic.
C_8 — 0.1-μfd. paper.
R_1 — 50,000 ohms.
R_2 — 0.1 megohm.
R_3 — 10,000 ohms.
R_4 — 0.5-megohm variable.
R_5 — 0.1 megohm.
R_6 — 2000 ohms.
L — 25 turns No. 24 d.c.c., close-wound, 1½-inch diameter.
RFC — 2.5-mh. r.f. choke.

'SCOPE COUPLING

Coupling a cathode-ray 'scope for r.f. energy from a 'phone rig employing link coupling from the final to antenna or antenna-tuning unit generally means the use of an extra coil. The diagram of Fig. 402 illustrates a simple but effective means of securing the voltage without the necessity of an extra coil, while the coupling may easily be varied to the correct value for any band.

In the diagram, C_1 may be any small condenser, such as a double-spaced 35-μμfd. variable. This condenser is connected to one side of the link coil, which may be any of the numerous types on the market. The other side of the condenser is connected to the *ungrounded* terminal of the vertical deflection plates. The r.f. input may be varied by increasing or decreasing the capacity of the condenser.

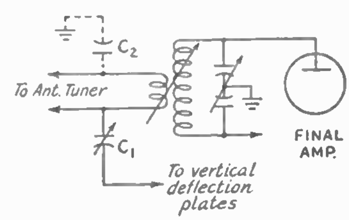


Fig. 402 — Coupling the oscilloscope to the output link. (See text for values of C_1 and C_2.)

With link coupling to an antenna tuner unit, the link may have to be grounded either directly or through a condenser, C_2. This might be of more importance at low power than at higher power. The idea of unbalance may be suggested as a possible disadvantage, but satisfactory operation doesn't require much capacity and any unbalance introduced will be slight. — *George W. Brooks, W1JNO.*

MODULATION MONITORING WITH AN OSCILLOSCOPE HAVING NO SWEEP CIRCUIT

FIG. 403 shows a simple way to monitor modulation with an oscilloscope which has no linear sweep or amplifier for horizontal displacement.

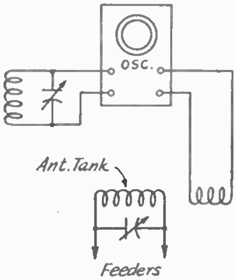


Fig. 403 — **Using an oscilloscope without linear sweep circuit for measuring modulation.**

A tuned pick-up coil is connected to one set of plates, while an untuned pick-up coil is connected to the other set. For the tuned unit a midget tuning condenser and tube socket may be placed at the oscilloscope terminals, where the proper coil may be plugged in. The untuned coil has two or three turns placed near the antenna tank so that it will pick up about the same voltage as is developed in the tuned circuit.

When the condenser in the tuned circuit is rotated through resonance, a point will be found where a circular outline will appear on the screen. When modulation occurs this circle will increase and decrease somewhat in size, giving the appearance of a disc with the unmodulated portion of the carrier appearing as a dark spot in the center. A bright spot in the center clearly indicates overmodulation. Distortion will be indicated by circular lines more or less brightly illuminated than the rest of the pattern. — *R. E. Patrie, W9CWD.*

'PHONE MONITORING KINK

FROM Caldwell Smith, W5FKW, comes a suggestion for making use of the grid current

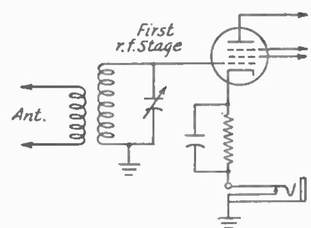


Fig. 404 — **Circuit connections for using the first r.f. tube in the receiver as a 'phone monitor.**

that usually flows in the first r.f. stage of a receiver during transmitting periods, even though the "B" supply is switched off. W5FKW simply inserts a headset in series with the grid return so that the quality of 'phone transmissions can be checked. One method of doing it is shown in Fig. 404. The 'phones should be removed from the jack or short-circuited by contacts on the "send-receive" switch during reception.

This arrangement is nothing more than the familiar diode detector, the grid of the first r.f. tube acting as the diode plate. It makes a satisfactory 'phone monitor, and requires nothing more than a jack.

SIMPLE MODULATION INDICATOR

THOSE 'phone amateurs using plate modulation and desiring a negative-peak overmodulation indicator will appreciate the gadget diagrammed in Fig. 405. This unit may be set to indicate modulation up to 100 per cent; in other words, to give a warning signal when a peak of a predetermined amplitude exceeding 100 per cent is reached in the modulation.

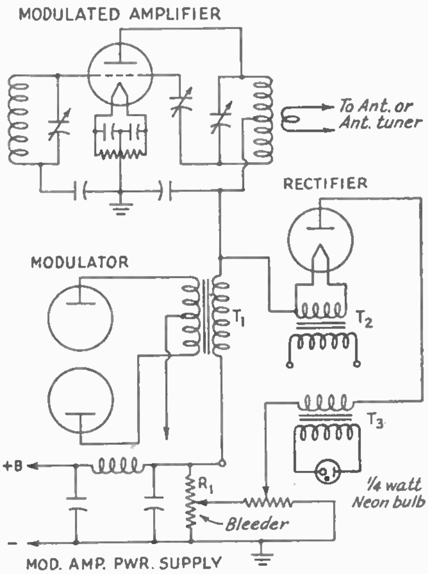


Fig. 405 — **A negative-peak modulation percentage and overmodulation indicator.**

In Fig. 405, R_1 is the bleeder across the modulated amplifier plate supply, while R_2 is a potentiometer in parallel with the portion of R_1 between ground and the adjustable tap. R_2 serves two purposes — that of a vernier control on the portion of R_1 in use, and that of a convenient method of adjusting from the front of panel the tap from the audio transformer primary for the proper voltage above ground on the modulated amplifier plate-supply. T_3 is an audio transformer with primary connected in series with a rectifier between the modulated amplifier "B" + connection and the adjustable tap on R_2. The polarity of the rectifier tube connections is such that the voltage at the "B" + connection of the amplifier must be negative with respect to the voltage of the R_2 tap to cause a warning flash of the modulation indicator. This indicator, a simple neon bulb with the resistor removed from the base, is shown connected across the secondary of the audio transformer, T_3.

The neon bulb is mounted in an old Readrite meter case with a frosted glass; this makes the small flashes more noticeable. The glass disc may be given a frosted appearance by grinding the surface with a fine abrasive just as crystals are ground to frequency.

If the tap on R_1 is set at a point one-fourth the distance from the ground end, R_2 may be used to set the modulation percentage to give indications at any value between 75 and 100 per cent. However, on many 'phone transmitters the plate voltage used for the modulated amplifier limits this range, for the voltage across R_2 may be as high as 500 volts if the tap on R_1 is set at one-fourth the voltage in a transmitter with 2000-volt supply. Unless a heavy-duty potentiometer or a slider-type resistor mounted on the front of the control panel is used, care must be taken to limit the range of the variable unit to a value safe for the control.

A suitable rectifier for use in this indicator is an 81 tube, with the filament supplied by a 7.5-volt transformer insulated to withstand more than double the plate supply voltage. Although the inverse peak voltage on the rectifier tube will be higher than the rated value, the current through the tube is limited sufficiently so that the overload is not serious.

If the potentiometer or slider resistor used for R_2 is linear (that is, if the resistance between tap and end terminal varies proportionately with angular movement of the tap or rotation of the knob), this control, once the tap on R_1 has been permanently set, may be readily and conveniently calibrated to show the modulation percentage at which flashes will occur. — *Ray Harland, W7FRA, Moscow, Idaho.*

ELIMINATION OF FILAMENT TRANSFORMER IN A NEGATIVE-PEAK OVERMODULATION INDICATOR

Use of the modulated-amplifier plate current to heat the filament of the rectifier tube used in an overmodulation indicator of the negative-peak type has been proposed by James Fulleylore, Port Washington, N. Y., and by George Woster, W9FHN. With this simplifying step, the apparatus required for the indicator is reduced to a single rectifier tube of low filament-current requirements and a neon-bulb or meter indicating device. The cost of an expensive filament transformer with high-voltage insulation is eliminated by the use of the amplifier plate current for filament heating.

The circuit shown in Fig. 406 is designed to operate with high-voltage amplifiers as well as with low-voltage high-current stages. Since the tubes suitable for use as rectifiers with the low filament heating current available are not capable of withstanding very high inverse peak voltages, W9FHN places the rectifier filament between series sections of the secondary winding of the modulation transformer. Because this connection of the rectifier makes only a fraction of the audio output voltage available for operation of the modulation indicator, the tap on the resistor across the power supply, R_1, must be placed a proportionate distance toward ground from the positive supply terminal to cause flashes at 100 per cent modulation.

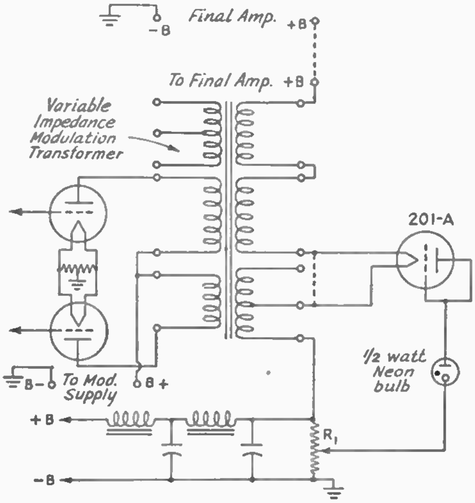


Fig. 406 — Negative-peak overmodulation indicator.

If a modulation transformer with two equal secondary windings designed for series or parallel connection is used, the rectifier filament may be connected in series with the two windings when used for high-voltage modulation. Where the more recent type of variable-match transformers are used, in which separate winding portions are connected in series to form a secondary suitable for matching a desired impedance, the secondary portions should be connected in such a way as to place the rectifier filament only a few turns from the positive power-supply connection.

The voltage divider, R_1, for the d.c. voltage to the indicator is made up of carbon or small wire-wound resistors, with a total resistance (ohms) equal to about 1000 times the power-supply voltage and a total power-dissipation capacity of approximately 5 watts. A simple refinement for this indicating system is the use of a potentiometer as as portion of the voltage divider. When properly calibrated with a borrowed oscilloscope, the potentiometer may be set to flash at any desired modulation percentage.

This system, with the rectifier tube connected at the center of the modulation transformer secondary, has been in use several months at W9FHN on a 1500-volt modulated amplifier, with entirely satisfactory results.

VOICE-CONTROLLED TRANSMITTER SWITCHING

Being a very lazy person, I want to eliminate as much work as possible in the operation of my postwar rig. Here is a system to eliminate all the drudgery of pushing a button or a toggle switch to turn on the transmitter! (There are some other advantages to be pointed out.)

The circuit is shown in Fig. 407. The controlling elements of the device are the two potentiometers, R_1 and R_2. Together with C_2, R_1 is the time-delay control. It can be set to hold the transmitter in operation from zero to a maximum of about 5 seconds after the operator stops talking into the mike.

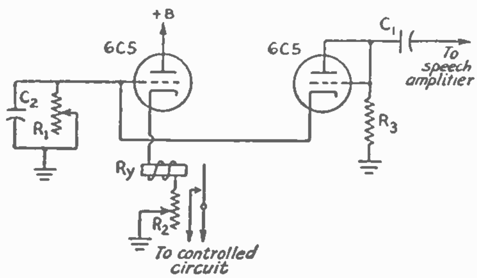


Fig. 407 — Diagram of circuit for voice control of transmitter switching.
C_1 — 0.01-μfd. 600-volt paper.
C_2 — 1-μfd. 200-volt paper.
R_1 — 5-megohm potentiometer.
R_2 — 25,000-ohm potentiometer.
R_3 — 1 megohm, ½-watt.
Ry — 2500-ohm s.p.s.t. relay.

R_2 is the threshold control which allows the operator to adjust the input level to suit his own particular requirements. Experience proves that this control can be set from a point where shouting into the microphone will not turn on the transmitter to another point where the sound of steps in another room will actuate the device. Somewhere between these points a setting will be found where normal speech at a distance of about one inch from the microphone will throw the transmitter into operation.

The original circuit employed two 6C5 triodes, as shown in the diagram. One is used as a rectifier, with grid and plate tied together. The other is used as the control tube. One of the new dual-triode tubes, such as the 6SN7 or the 6SL7, having separate cathode terminals for each section, may be used instead of two separate tubes.

Operation of the circuit is as follows. Audio voltage from the driver stage of the speech amplifier is fed through 0.01-μfd. condenser, C_1, to the plate and grid of the rectifier. Rectified voltage from the cathode of this tube is direct-coupled to the grid of the control tube. Thus the flow of current through this tube and through the relay connected in its cathode circuit is speech-controlled. There is no time lag between the time the first word is spoken and the time the relay closes to start the rig.

Two disadvantages appear in the use of this method of transmitter control. It requires that the speech amplifier as well as the control unit be in continuous operation. Further, if the threshold control is set too high, excessive volume from the loud speaker may operate the device during receiving stand-by periods. If headphones are used the latter disadvantage is removed.

Advantages would seem to equal or outweigh the disadvantages. It makes possible break-in operation comparable to the best c.w. practices. With the high-speed change from transmitting to receiving, operation is as natural and pleasant as with the outlawed "duplex" 'phone operation. The operator who has formed smooth speech habits will not be bothered by the clacking of the relay, but the "Ah — er" operators will be rebuked by interruptions by the relay — a possible aid to reformation!

Properly adjusted, this speech-control circuit will be found very helpful. It will be black magic, or at least a source of wonder, to uninitiated visitors to the shack. If used at both stations in communication it will produce a favorable impression of amateur radiotelephone operation in the minds of some who find it hard to understand why the party at the other end does not come right back in reply to questions and remarks, as in land-wire telephone conversations. — "*Lazee Bones.*"

SIMPLE MODULATOR FOR PORTABLE WORK

In Fig. 408 is shown the circuit of a simple audio amplifier that I have found very useful as a portable modulator and for general utility work. The idea is not new, since at least one manufacturer has used it in mobile police transmitters. Almost any power supply with an output of from 200 to 300 volts at 75 to 100 ma. may be used. The filtering is not critical and no mike supply is needed. I don't happen to have a picture of the complete unit, but it measures only 3½ inches by 6½ inches by 4 inches high. It was built on a homemade chassis 3½ inches by 6½ inches by ¾ inch deep. One side of each heater is grounded, so that only three connecting wires are needed.

Almost any single-button mike will do, depending on the quality desired. The bias tap may need

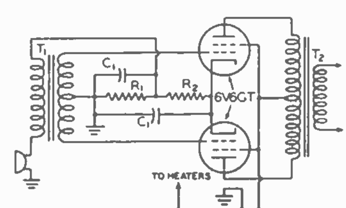


Fig. 408 — Simple modulator for portable and general-utility work used by W7FRA.
C_1 — 10-μfd. 25-volt electrolytic.
R_1 — 100 ohms, 1-watt.
R_2 — 150 ohms, 1-watt.
T_1 — Input transformer (Thordarson T-83A78).
T_2 — Output transformer (Thordarson T-19M13).

to be adjusted to suit the mike and output required. R_1 and R_2 could well be a single resistor with a variable tap. If only a speaker is to be used, the output transformer could be changed. This amplifier, with 275 volts on the plates, will modulate a 25-watt final (input) up to 100 per cent. — *Ray Harland, W7FRA.*

SELF-BIASING SYSTEM FOR CLASS-B MODULATORS

It is well known that biasing systems which introduce resistance in the d.c. grid circuit of a Class-B modulator should be avoided because the variable grid current of the Class-B stage will cause a change in bias over the audio cycle, resulting in nonlinearity. For this reason, a regulated supply or battery supply is universally recommended for Class-B applications.

It is possible, however, to filter out the variations in biasing voltage caused by the changing current through a biasing resistor. Fig. 409 shows a circuit which is used frequently in commercial practice. The biasing voltage for the modulator is obtained from a variable tap on a resistor connected between filament center tap and the negative high-voltage terminal. A low-pass filter is connected in series with the biasing lead to the Class-B stage.

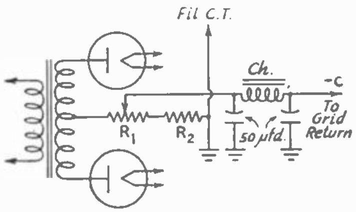


Fig. 409 — Self-biasing system for Class-B modulators. The low-pass filter in the grid lead holds the biasing voltage constant with change in cathode current. The filter is made up of an ordinary low-current choke and a pair of 50-µfd. electrolytic condensers.

The resistance required may be computed by Ohm's Law; it is necessary to know the total current flowing in the center tap and the desired biasing voltage. It is desirable to have a protective minimum bias, which can be provided by making part of the center-tap resistance fixed. By using a fixed resistance of 100 ohms in series with a 150-ohm variable resistor, the resulting bias (at a center-tap current of 225 ma.) would be variable between 22.5 and 56.25 volts.

This system permits panel control of the bias on the Class-B stage and allows adjustment to be made of the idling plate current of the modulator. — *Merle B. Parten, W8BWC.*

DIODE MODULATION INDICATOR

Fig. 410 shows the circuit diagram of a modulation indicator which was popular among the boys of the "Farmer's Net." With the switch thrown to the right, the carrier level is indicated on the meter. By means of the variable resistor, R_1, the reading may be varied to suit the operator; I set mine at 0.8 ma. Once set, the point will remain the same. By a flip of the switch the meter is returned to zero with carrier on, but if there is any noise or hum on the carrier the needle will lift off zero in proportion to the amount of noise. (Some of the net boys thought this the best feature.) With the meter at zero with carrier, modulation will show by a lift of the needle. Modulation at a level of 100 per cent will make the needle go to the point of the original setting (0.8 ma., in my case). If this reading is exceeded, overmodulation is indicated.

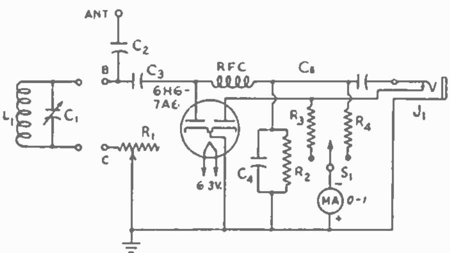


Fig. 410 — Circuit diagram of the dual-diode modulation indicator.
A — Antenna (about 2 feet long; see text).
C_1, L_1 — Tuned to band (see text).
C_2 — 100-µµfd. mica.
C_3 — 50-µµfd. mica.
C_4 — 0.001-µfd. mica.
C_5 — 0.1-µfd. paper.
R_1 — 10,000-ohm volume control.
R_2, R_3 — 50,000 ohms.
R_4 — 150,000 ohms.
RFC — 2.5-mh. r.f. choke.
J_1 — Closed-circuit jack.
S_1 — S.p.d.t. toggle switch.

With the meter in plain sight on the operating desk, any transmitter failure is instantly spotted by watching the indicator. By inserting headphones in the jack the gadget becomes a very excellent monitor.

The transmitter is not disturbed in any way when the monitor is used. It may be used without the tuned circuit by simply shorting the terminals intended for the tuned circuit and attaching the antenna lead directly to the transmitting-antenna feeder. I used mine that way on all bands without any tuned circuit and found that it did not bother the antenna circuit. An alternative would be to connect the input terminals to a line coupled closely to the final-amplifier tank. If the tuned circuit is used, the indicator may be placed anywhere in the operating room and will give fine results with the short pick-up antenna.

When used with the tuned circuit, the unit also makes a good field-strength or antenna adjustment indicator.

Coil and condenser combinations will be found in *The Radio Amateur's Handbook.* Plug-in coils with a small tuning condenser mounted inside the coil-form may be preset to the desired transmitter frequency, for quick band-change.

I mounted mine in a 6-inch-cube standard steel box, and arranged it so that the indicator is turned on with the transmitter filaments.

Credit for the circuit should go to W1BZR and W1HSV. — *George W. Bailey, W1KH.*

AUDIO PEAK LIMITER FOR SPEECH AMPLIFIERS

AUTOMATIC volume compression as a means of preventing overmodulation in 'phone transmitters has been advocated in a number of articles in recent issues of *QST*. A rather simple and easily installed system, involving operation only over a single stage, is shown in Fig. 411. It was worked out by M. C. Bartlett, W9JHY, and has proved to be quite satisfactory in practice, since overmodulation is practically impossible once the operating conditions are set. There is no perceptible effect on the speech quality.

A pair of 802s, operating as Class-AB amplifiers, is used to drive the Class-B grids. In W9JHY's case the driver is coupled to the Class-B input transformer through a 200-ohm line. The audio voltage appearing across the line is applied to the primary of the transformer, T_2, whose center-tapped secondary is connected to the plates of a 6H6 used as a full-wave rectifier. The rectified audio voltage is suitably filtered and applied as bias to the suppressors of the 802s. Thus the greater the output signal the greater the bias developed, and, in turn, the lower the amplification in the 802 stage. The 6H6 cathode is given some initial bias through R_6, so that the automatic control does not function until the signal reaches a predetermined level.

In describing the adjustment of the circuit, W9JHY writes:

"Adjust R_2 until the two tubes draw 60 ma. (no signal), which gives about Class-AB operating conditions.

"Now, with constant tone input, measure the voltage appearing from suppressor to ground. This should be about 1 volt, on a high resistance voltmeter, when the Class-C stage is being modulated from 75 to 80 per cent. Then, when the lag of the R_4C_5 circuit is taken into account, the transmitter will not go over 90 to 95 per cent modulation. The setting of R_6 controls the threshold bias on the 6H6, which, if being fed a high enough voltage by T_2, will nicely control the gain of the 802s.

"As an indicator of modulation percentage, or rather of the operation of the compression circuit, a voltmeter (0–100 volts d.c.) can be connected from suppressor to ground — although this will make the gain-change more rapid and tend to upset the C_5R_4 ratio, which must be right. Perhaps a variable resistor at R_4 might be a good idea. It is desirable to set the gain control at some point where the compression is *not* brought into play (since, after all, this system is only intended as a protective measure), and probably better quality will result if no compression voltage appears on the suppressor.

"If this plan is employed where the 802s are driving the Class-B stage grids directly, it stands to reason that the higher voltage which appears at the Class-B grids will necessitate a higher threshold voltage, obtainable with a potentiometer of a proportionately higher resistance at R_6. With voltages of this value, an 80 rectifier could be used to advantage in place of the 6H6.

"The coupling transformer, T_2, is the only part that proved troublesome. I finally picked on an old high-ratio General Radio transformer that had bumped around the junk box since the days of two-filament audions. I believe it is either 6:1 or 10:1 ratio, but almost any high-ratio transformer will work; it should develop about 150 volts of audio across the secondary terminals on external peaks."

In W9JHY's speech amplifier, the 802s replaced a pair of 2A3s formerly used in the driver stage.

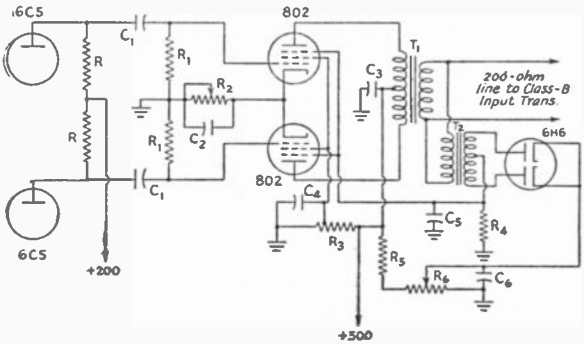


Fig. 411 — Amplitude limiting circuit for pentode speech amplifiers.

C_1 — 0.1-μfd. paper.
C_2 — 1.0-μfd. paper.
C_3 — 4-μfd. electrolytic.
C_4 — 1.0-μfd. electrolytic.
C_5, C_6 — 0.1-μfd. paper (C_6 optional).
R — 250,000 ohms, 1-watt.
R_1 — 500,000 ohms, 1-watt.
R_2 — 1000-ohm variable.
R_3 — 40,000 ohms, 25-watt semi-variable.
R_4 — 0.1 to 1.0 megohm (time-constant control).
R_5 — 150,000 ohms, 2-watt.
R_6 — 5000-ohm potentiometer.
T_1 — Class-AB to line transformer.
T_2 — Class-B input or push-pull interstage transformer, 3:1 ratio or higher.

SHIELDING THE MICROPHONE PLUG

A COMMON cause of r.f. feed-back in 'phone transmitters is inadequate shielding of the microphone circuit. If a manufactured shielded microphone plug is not available, an excellent substitute may be made from an ordinary bakelite-shell plug. These plugs may be shielded easily in the following manner:

For shielding material, use a small piece of tinfoil taken from an old paper condenser. Do not detach the tinfoil from the waxed paper; instead, cut both paper and foil to size so that, when formed in a cylindrical shape, a snug fit inside the bakelite shell of the plug will result. When forming the cylinder make sure that the paper will be turned to the inside, so that there will be no chance of the foil shorting the microphone connections. When the bakelite is screwed back on the plug the thread will bite into the foil, thus grounding it and making the shielding effective. — *W. B. Thompson, W8OKC.*

5. *Hints and Kinks . . .*

for the Power Supply

BIAS SUPPLY FOR R.F. AMPLIFIERS

A SIMPLE and effective scheme for obtaining fixed bias for r.f. amplifier stages is suggested by W8OAH, Edward Eggebrecht, Grand Rapids, Mich. One arrangement, shown in Fig. 501, makes use of a filament transformer with filament winding connected to the filament of one of the amplifier stages. The filament winding, or usual secondary winding, thus becomes the primary of a step-up transformer, giving approximately 115 volts at the terminals of the transformer usually used for primary connection. Thus, when the filament of the amplifier tube is heated, bias voltage is developed across the filter condenser, C_1, and the combination bleeder and grid leak resistor, R, by means of the reversed filament transformer and the rectifier.

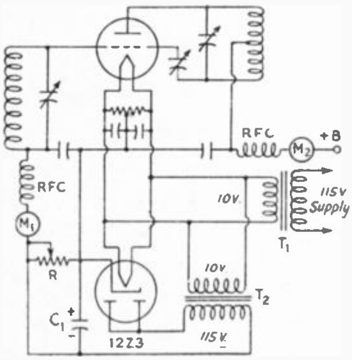


Fig. 501 — Circuit of the transmitter bias supply.

With plate voltage applied and key closed, the grid current flowing through R produces the greater part of the bias voltage for the amplifier; whereas, with no excitation applied, the rectifier-filament circuit maintains cut-off bias voltage on the amplifier grid.

It will be noted in the diagram that the cathode connection of the rectifier tube is placed at ground potential, thus preventing a possible voltage breakdown between cathode and heater of the rectifier.

The filter condenser, C_1, should have a capacity of from 8 to 16 μfd. (the latter value being preferable) and a voltage rating of from 450 to 600 volts, depending on the bias voltage which accompanies flow of grid current through the grid leak, R.

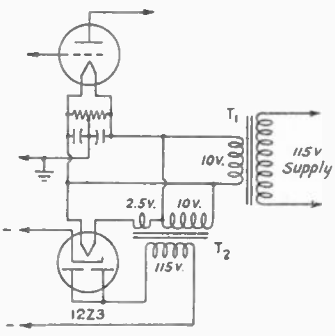


Fig. 502 — Alternative connections for the bias-supply rectifier system suggested by W8OAH.

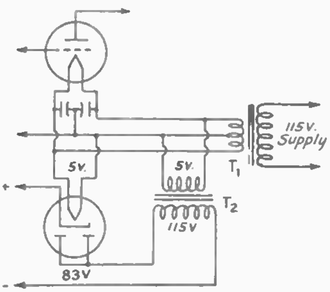


Fig. 503 — Second alternative connection, using a center-tapped transformer for the bias rectifier.

It is advisable to make use of a high-vacuum rectifier tube rather than one of the mercury-vapor type, since the latter is likely to cause a slight disturbance while the receiver is in operation, the filament of the transmitting tube being heated throughout stand-by periods.

Fig. 501 gives circuit connections for use of a 10- to 12-volt heater tube as the bias rectifier. An 83V may be used with dropping resistor of $1\frac{2}{3}$ ohms connected in series with the heater, or a 12Z3 may be used. (If the 12Z3 is used, a single plate connection is necessary, this being a half-wave rectifier). Although this latter provision does not place the rated voltage on the heater, 10 volts has been found sufficient for the very light duty imposed on the tube by a grid-leak resistor, *R*, of reasonable size.

Figs. 502 and 503 give alternative connections for rectifier tubes and filament transformers, the filter and bias connections with these arrangements being the same as those used in Fig. 501. The three diagrams given are for use with 10-volt tubes; however, similar simple arrangements for use with tubes of other filament-voltage ratings may be easily worked out.

Fig. 502 gives a circuit by means of which a 12-volt rectifier tube may be operated at its full heater voltage, if a spare transformer designed for 2.5- and 10-volt filaments is available.

Fig. 503 shows an arrangement using a center-tapped 10-volt transformer to supply bias voltage through a 5-volt transformer connected to half of the filament transformer secondary. The other half of the filament winding of T_1 is used to heat the 83V or similar rectifier tube.

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IMPROVED VOLTAGE REGULATION WITH VR-TYPE TUBES

During the course of making measurements of small intensities and variations in light with a photoelectric cell and vacuum-tube amplifier, Harry Dubofsky, W1IJP, encountered the necessity for a voltage supply of exceptionally good regulation for the amplifier. He reports some interesting observations in connection with the use of VR gaseous regulator tubes.

The original supply was of good design with a choke-input filter. A single VR150 was connected at the output of the supply in the conventional manner shown in Fig. 504-A. The use of the VR tube resulted in an improvement in voltage regulation of the order of seven to eight times.

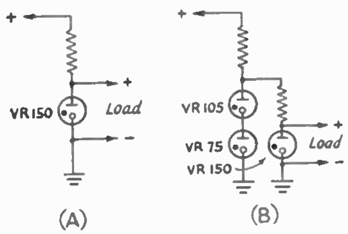

Fig. 504 — Voltage regulating circuits. (A) is the usual arrangement with a single VR tube. (B) is the cascaded form used by W1IJP to improve regulation.

Desiring still greater improvement, three VR tubes were arranged as shown in Fig. 504-B. This arrangement resulted in an improvement in regulation of three times, meaning a total improvement of more than twenty times over the regulation of the supply without the regulator tubes.

Such a combination should be of value in supplies for heterodyne frequency meters and other laboratory oscillators as well as in conjunction with variable-frequency oscillators for transmitters and other applications requiring a high degree of voltage regulation.

A POWER SUPPLY FOR BATTERY OR A.C. USE

From time to time, various experimenters have suggested the use of a b.c. type transformer in conjunction with Ford coils to secure 350 volts or so for the operation of a receiver or portable transmitter from a 6-volt storage battery. An arrangement which strikes us as being a highly practical one is suggested by James McBride,

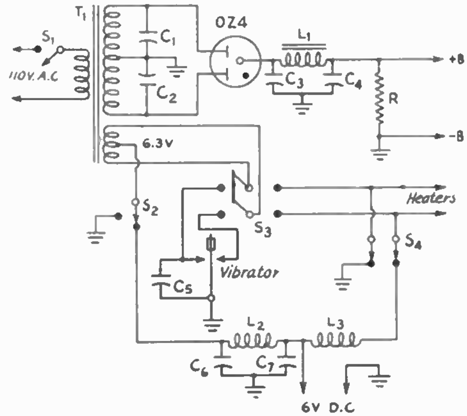

Fig. 505 — Power supply for a receiver or a low-power transmitter which will operate either from the 115-volt a.c. line or a 6-volt storage battery.

C_1, C_2 — 0.002-μfd. 1000-volt mica.
C_3, C_4 — 8-μfd. 450-volt electrolytic.
C_5 — 0.002-μfd. 1000-volt mica.
C_6, C_7 — 0.5-μfd. paper.
R — Bleeder resistor, 25,000 to 50,000 ohms.
L_1 — 30-henry filter choke.
L_2, L_3 — Hash-filter chokes (see text).
S_1 — S.p.s.t. switch.
S_2 — S.p.d.t. switch.
S_3 — D.p.d.t. switch.
S_4 — D.p.s.t. switch.
T — B.c.-type power transformer with 6.3-volt winding

W4BAF, whose supply can be used either on 6 volts d.c. or 115 volts a.c., whichever may be available. In the interests of reliability, W4BAF's rig uses a standard vibrator of the type universally incorporated in auto radio receivers.

The circuit diagram of the power supply is given in Fig. 505. The transformer is a standard b.c. job, with a 6.3-volt winding which is used as the primary with 6-volt battery supply. This winding should have fairly heavy current-carrying capacity, since the battery current runs as high as 12 amperes under load. The vibrator used by W4BAF is of the synchronous type with the contacts strapped together for non-synchronous use. The rectifier is an OZ4, a gas tube without a hot cathode. A conventional filter is used.

The diagram shows the various switches necessary to change from battery to a.c. supply. All switches are shown in the battery-supply position. When operating on a.c., the vibrator is cut out of the circuit and the 6.3-volt winding resumes its normal function of furnishing filament power for the tubes.

Coils L_2 and L_3 are part of a filter intended to cut out "hash" from the vibrator. They are probably subject to some experimenting to obtain best suppression of noise, but coils consisting of 20 or so turns of No. 12 wire, wound to 1-inch diameter, are suggested.

W4BAF's power supply delivers 90 milliamperes at 350 volts with either a.c. or battery source. It has proved to be highly effective in operating a 6C6-41 receiver and a 6L6 transmitter, both portable and at home.

A FILAMENT TRANSFORMER KINK

Here is a kink which may come in useful in an emergency. Sometimes a ham has a filament transformer delivering 5 volts or some other voltage and has need for one delivering 6.3 volts. A simple solution is to take a small core and wind an autotransformer on it, the autotransformer to operate from the 5-volt transformer (or whatever the available voltage happens to be).

The diagram of the autotransformer is shown in Fig. 506-A. Make the 5-volt section about 3 turns per volt and then add more turns, tapping off at about every two turns.

The idea has the merit of extreme simplicity, since few turns are required and no particular attention has to be paid to insulation. An autotransformer can be wound in a few minutes. The

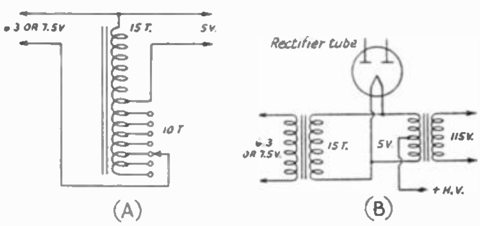

Fig. 506 — **Details of the simple transformers suggested by N8FU. At (A) is shown the autotransformer. (B) is the isolating transformer.**

wire should be of sufficient size to carry the required current and the amount of power drawn from the autotransformer should not exceed the output rating of the transformer from which it is operating.

Another variation of this idea is shown in Fig. 506-B in which a handwound transformer is designed to operate from the filament transformer supplying a rectifier. Isolation between rectifier and other filaments thus is obtained. Here the insulation must be sufficient to withstand the voltage at which the rectifier is operating and the rectifier transformer must have a rating capable of handling the extra power drawn from the homemade transformer. — *J. C. Nelson, N8FU.*

BOOSTING TRANSFORMER VOLTAGE

In the past few years, probably thousands of a certain make of transformer have been sold at a very reasonable price. The rating is 600 volts, 200 ma. and the transformer has 7.5-, 5- and 2.5-volt windings. Tubes such as the T20, 809, etc., need a bit higher voltage, so I have used a simple scheme to raise the voltage. It means using separate filament transformers for the tubes but these are cheap or easily made. The idea is to connect the 5- and 7.5-volt windings in series to give 12.5 volts which may be added to the primary voltage by connecting them in series with the line as shown in Fig. 507. The three windings must be polarized correctly to obtain this increase. Perhaps the easiest way to do this is to feed 5

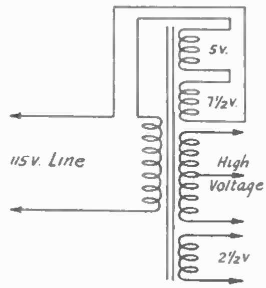

Fig. 507 — **Making use of unused filament-transformer windings to boost the plate-supply voltage.**

volts or so from a separate transformer into the primary winding. This will enable the secondary voltage to be read on an ordinary 150-volt a.c. meter. Then try different combinations of the 5-volt, 7.5-volt and primary windings until the highest secondary voltage is obtained. I am using my transformer in this manner with a pair of 866 jr. tubes and with condenser-input filter get 700 volts at 200 ma. with no heating of the transformer. The increase in output voltage obtained by also using the 2.5-volt winding is hardly worth while. — *Noble Smith, W9HCO.*

CONNECTING DISSIMILAR PLATE TRANSFORMERS IN SERIES

Roy Wheadon, W6KTY, suggests the circuit shown in Fig. 508 to solve the problem of connecting unlike transformers in series to obtain higher plate voltage. When identical transformers are connected in series, no problem is involved,

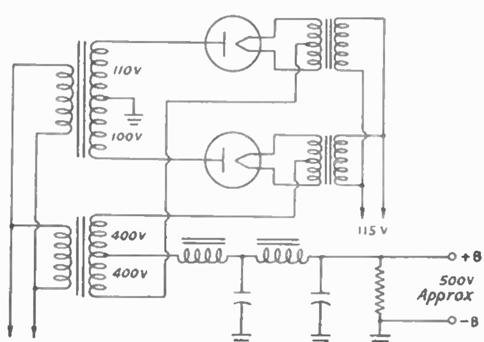

Fig. 508 — **Circuit for obtaining symmetrical output from a combination of dissimilar transformers connected in series to obtain higher voltage. Insulation of the transformer secondary connecting to the filter must be sufficient to withstand the total output voltage.**

since a center tap is obtained easily at the junction of the two identical secondaries. When dissimilar transformers are used, a center tap is impossible and the only means of using such a combination has been by use of the bridge-rectifier system which requires no center tap but does require four rectifier elements.

In the system suggested by W6KTY only two rectifier elements are required, but each filament must be insulated from the other. Double rectifiers, like the type 83, may be used by connecting plates in parallel and using a separate tube for each element shown in the circuit diagram. Balanced output is obtained by connecting one of the transformer secondaries in the rectifier return leads and using both center taps. As with any series arrangement, the transformer on the positive side must have sufficient insulation to take care of the additional voltage. Correct polarization of the primary windings will be required. This can be determined by trial. Incorrect polarization will result in bucking voltages.

6.3 VOLTS FROM 7.5-VOLT AND 2.5-VOLT WINDINGS

The use of a center-tapped 2.5-volt winding and a 7.5-volt winding to obtain 6.3 volts for heater-type tubes is suggested by Edwin Kirchhuber, W2KJY, Brooklyn, N. Y.

Fig. 509 shows the circuit suggested. The voltage between center-tap and one side of the 2.5-volt winding is connected in phase-opposition with the 7.5-volt winding, and the series combination is used to supply the heater voltage required.

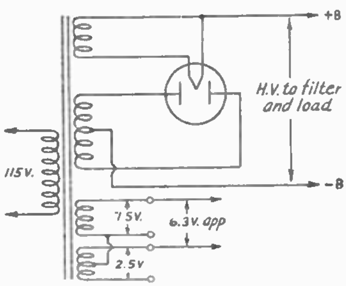

Fig. 509 — Method for obtaining 6.3 volts from old-type 7.5- and 2.5-volt transformers.

As the 7.5- and 2.5-volt filament windings were designed for these voltages at loads greater than that usually required for 6.3-volt tubes, the voltage to be expected should be quite close to the desired value.

AN AUTOTRANSFORMER FOR POWER CONTROL

We all know that we should reduce power for local QSOs, not only because FCC regulations require it but also as a courtesy to our fellow amateurs.

Reduction in power output should be accomplished without lowering the efficiency of the rig and without retuning, detuning, etc. The well-known, but little-used autotransformer, shown in Fig. 510, serves as a dandy gadget for this purpose and has many other uses around the shack, such as filament-voltage or soldering-iron heat control. Its use provides reduction of power during tuning-up, and may save a tube.

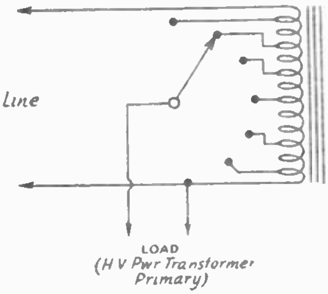

Fig. 510 — Circuit diagram of the autotransformer.

Don't become alarmed over the difficulty of winding a transformer. It is a simple job even without a coilwinder, as the wire is comparatively large and the number of turns relatively few.

Most junk boxes will provide a burned-out transformer having a suitable core. Usually the insulation next to the core will be found to be in good shape and can be used again if carefully removed. A wood core of the same size as the transformer core should be placed inside the core insulation during winding to serve as a handle and to retain the shape of the winding.

The following table will provide information concerning core area, wire size and number of turns required for transformers rated from 100 to 500 watts. Data found in *The Radio Amateur's Handbook* will enable the user to compute this information for higher ratings.

Watts	*Core (Square Inches)*	*Wire Size*	*No of Turns*
100	2	21	450
200	3	17	300
300	4	15	225
400	5	14	175
500	6	13	150

The job will be simplified if the taps are taken off at the end of each winding layer. In the absence of better insulation, ordinary wrapping paper, doubled, can be used between layers.

Care should be taken to prevent shorting of the windings by contact with the sides of the core. Most cores have room for several windings in the original transformer so that there is no need to crowd the layers close to the core sides.

When the winding is completed, the wooden block is removed and the core carefully fitted back in its place. After assembly and testing are finished, it is well to take the transformer to a shop where armatures are rewound, for dipping and baking. The charge is generally small (mine cost 25 cents). This treatment will waterproof the windings and take the noise out of the core.

The autotransformer may be built into a box with a panel for the switch and outlets. In addition to the switch, tip jacks may be connected to the taps, and jumpers used to connect them to outlets furnishing different simultaneous voltages.

The box should be well ventilated, or the autotransformer should be mounted in the open. However, a well-constructed job should not heat appreciably under rated loads. — *Victor I. Brock, W9TUJ.*

AN IMPROVED AUTOTRANSFORMER

A SUGGESTION is offered which may be considered an improvement on the design for a standard autotransformer.

It will be observed that the usual transformer must be designed to carry the total current consumption of the applied load whereas with the design shown in Fig. 511 the power-handling capacity required is only sufficient to withstand the desired difference in line voltage. As an example, assume a line voltage of 120 in which a reduction

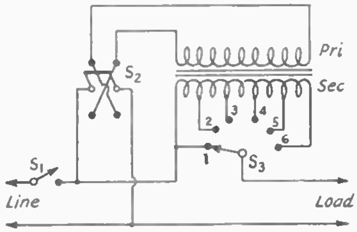

Fig. 511 — Circuit of improved autotransformer.
S_1 — S.p.s.t. toggle switch.
S_2 — D.p.d.t. toggle switch.
S_3 — Multipoint rotary selector switch, single gang.

to 110 volts is desired. In the usual transformer, the total core, diameter of winding, and number of turns must provide a total inductance and current-carrying capacity to satisfy the requirements of the 120-volt primary source, and it must be capable of delivering 110 volts at the current rating demanded by the load.

In the suggested design, the secondary, tapped for various voltages, must supply only the difference between the voltage requirements. In the case of a 120-volt line, reduction to 110 volts would require a transformer capable of supplying only 10 volts at the load-current rating.

By placing a switch in the primary of this autotransformer it is made equally useful for raising voltage as well as lowering it, by shifting the polarity of the primary connection of the transformer to the supply line.

The secondary must have a wire size capable of carrying the current demanded by the load, but in most cases a suitable transformer can be made by winding a tapped secondary of No. 12 soft-drawn copper wire over the windings of a large-size receiver power transformer. Such a transformer when wound with the proper number of turns will either increase or decrease the line voltage, depending on whether the secondary is bucking the line voltage or adding to it.

When the transformer is used in a voltage-bucking position it has a tendency to stabilize line-voltage variation inasmuch as a drop in line voltage will be reflected back to the primary of the transformer. This will, in turn, lower the voltage in the secondary, resulting in a lessening of the bucking effect on the load side. Yet the ratio of voltage correction will still depend upon the secondary output voltage of the transformer. With a line voltage of 120 and a secondary bucking voltage of 60, the load side of the transformer would have only one-half the voltage variation of the primary. In other words, the voltage regulating ability of the transformer is inversely proportional to the primary/secondary ratio of the transformer.

It should be noted that the effect just described is reversed when the transformer is used with the secondary voltage additive to the line voltage.

The writer's transformer is assembled within an old radio-analyzer case to give it portability. It is constructed with a selector switch on the panel. The points of the switch are given dual markings, i.e., the point marked 105–125 is the one at which, with a normal line voltage of 115 volts, the output of the transformer will be 105 volts on the low or bucking side, and 125 on the high or additive side, depending on the position of the primary-reversing switch. — *Jack R. Zeckman, W7DVK.*

USING TRANSFORMERS WITH 2.5-VOLT WINDINGS FOR 6.3-VOLT TUBES

NOW that there is a trend toward using any old parts that can be salvaged, I would like to pass on an idea for using obsolete b.c. power transformers with 2.5-volt filament windings for tubes with 6-volt heaters.

By replacing the usual 80 rectifier with a tube using an indirectly heated cathode, such as an 84 or 6X5, the 5-volt winding can be connected to one half of the 2.5-volt winding, giving a total of 6.3 volts as shown in Fig. 512.

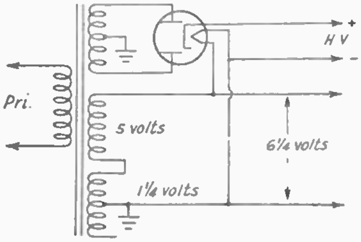

Fig. 512 — Scheme for using 5-volt winding and half of the 2.5-volt winding on old transformers to obtain 6.3 volts when desired. The substitution of a rectifier with an indirectly heated cathode is required.

When using the windings in series, they must be connected in phase. If the first connection gives less than 5 volts, reverse the leads to *one* of the windings. The total current drain should be limited to about 2 amperes, which is usually the rating of the rectifier-filament winding. As the current drain of 6-volt tubes is small, this will be sufficient for the average equipment to be powered by such a supply. — *R. R. Robinson, W8MGV.*

A SAFE AND ECONOMICAL POWER-SUPPLY CONTROL UNIT

As THE trend today in transmitter design is toward safe and foolproof operation rather than watts per dollar, we believe that the control unit to be described will be of interest to many hams.

This unit, which is a combination of the ideas of several other hams and the result of studying the cause of the misfortunes of still others, has been incorporated in the rig here at W1KSJ and has been used with very good results. Its features are as follows:

1) Provides protection against some causes of accidents, since the high voltage cannot go on unless the transmitter is grounded to earth.
2) Prevents overload of high-voltage supply.
3) Provides high-voltage time-delay.
4) Provides a stable source of bias voltage.
5) Protects tubes against bias failure.

Referring to the diagram of Fig. 513, the operation is as follows: When the main transmitter switch, S_1, is closed, all the filament transformers are on and the "hot" side of the 115-volt line is applied to the cathode of the 83V tube. When the tube reaches operating temperature (about 20 seconds), the current flows through the bias voltage divider, the Ry_2 winding and the normally closed contacts of Ry_1 to the transmitter frame, and thence back through the ground lead to the a.c. line. This energizes the Ry_2 and applies a.c. to the high-voltage transformer primary.

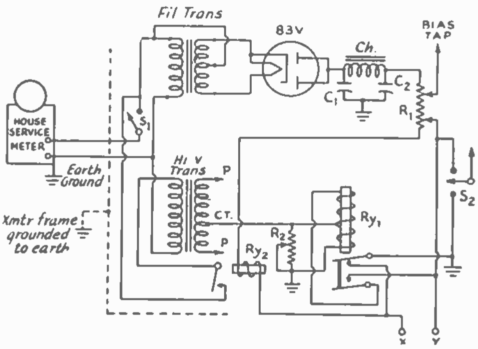

Fig. 513 — Circuit of the transmitter control system. All switches are shown in the non-operating position.

C_1, C_2 — 16-μfd. 250-v. filter condensers.
R_1 — 400 ohms, 25-watt.
R_2 — 20-ohm wire-wound rheostat.
S_1 — Main transmitter switch.
S_2 — Push-button bell switch.
Ry_1 — See text.
Ry_2 — 200- to 500-ohm d.c. relay (heavy duty contacts).
Ch — 300-ohm 30-henry choke.

In the event of overload on the high-voltage transformer, the current flowing through the selected portion of the winding of Ry_1 pulls open the pair of contacts in the bias circuit between Ry_2 and ground and, immediately afterward, closes the bias circuit again through the whole coil of Ry_1 and holds it in that position. To reset the circuit it is only necessary to push the push-button switch, S_2, which shorts out Ry_1 and Ry_2 and allows them to return to their normal position. The reset control switch, S_2, may be located on the operating table.

The only part requiring special treatment is Ry_1 which is an old "AB" power-pack relay rewound with approximately 600 turns of No. 24 enameled wire. This is tapped at about every 100 turns, accuracy not being essential. This provides a range of adjustment for wide differences in current values. The 20-ohm rheostat, R_2, provides fine adjustment.

And now for a few precautions — the relay Ry_2 should have as stiff a spring action as possible, and its contacts should be kept clean, so that they will not stick at the time its protection is most needed. In case the time-delay is not sufficient for the rectifier tubes (866s at high voltages, for instance), the push-button switch, S_2, may be held down for an additional 15 seconds, although this was not found necessary here with a 1000-volt supply. The slider on the bias divider which controls the voltage to the entire coil of Ry_1 should be set as near as possible to the ground end so too much current will not be drawn by the 83V when S_2 is closed.

The values accompanying the diagram will vary somewhat, depending on the resistance of Ry_2 and of the choke, *Ch*, and are not intended to be followed exactly. They are shown rather as an indication of what to expect. The second tap on Ry_1, to which the center-tap of the high-voltage transformer is connected, was found to give best operation with approximately 250 ma. current.

If complete break-in operation is not desired or for any reason it is felt desirable to be able to shut off the high voltage and leave the filaments and bias supply on, a switch similar to S_2 may be installed across points *X* and *Y* on the diagram. Then, if the switch is pressed, the additional magnetism in the coil of Ry_1 will cause an effect similar to that of an overload and, of course, the relay would hold shunt until the push-button, S_2, is used to reset the circuit. Should this additional control be used, it will be found necessary, however, to adjust the overload action within closer limits by means of R_2 than would otherwise be necessary.

The bias supply was found to be very steady and showed only about a 12 per cent change in voltage from zero to 50 mils of grid current to the final stage. Since the buffer stage here is also supplied from the same source and its grid current also must be added in, we believe that the regulation is quite adequate. — *Roger F. Hamilton, W1KSJ.*

A CHEAP FILAMENT RHEOSTAT

AFTER searching for a small-size rheostat to use in series with a 7½-volt filament winding for 6.3-volt tubes, I found that the rheostats ordinarily used on car heaters work very well. The kind without an indicating light sells for about 21 cents at most auto stores and it will dissipate the heat without trouble. It is small enough to mount in a number of ways, or may be mounted in a hole like other rheostats. — *W8TLW.*

WATCH YOUR CHASSIS CONNECTIONS FOR SAFETY

Here is a safety-first idea which seems to have received meager attention in radio publications, despite its obvious importance. It concerns power supplies where the power section is made as a separate unit from the other gear.

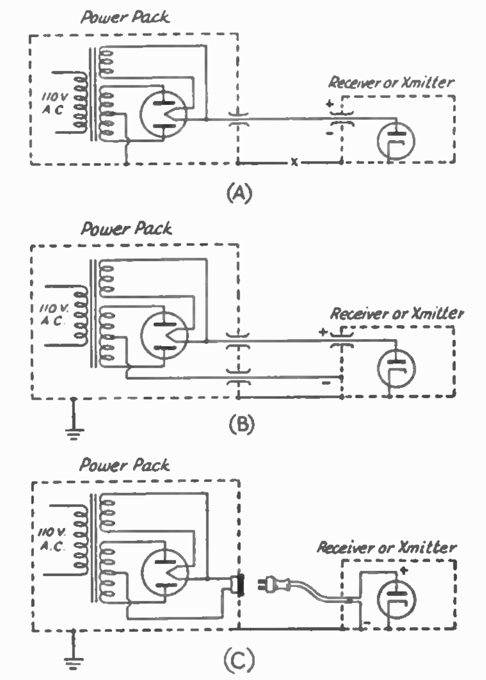

Fig. 514 — (A) The wrong way to make connections between chassis units. (B) The right way. (C) A safe plug and receptacle system for separate units.

Fig. 514-A shows that if the negative of the power supply is grounded to its own chassis and a negative return wire is connected between the two chassis, a highly dangerous situation can exist. If, accidentally or otherwise, the negative-return wire is broken or removed as at *X*, the full high voltage appears between the two chassis. If anyone were to place his hands on the two chassis simultaneously, he would receive the full shock of the supply. It is very easy to overlook the fact that the chassis may at any moment carry high voltage, whereas if the "B"– is carried to the receiver (or transmitter) by a separate wire, as in Fig. 514-B, all high potentials are confined to the leads which, if broken or disconnected, would be recognized as potential dangers anyway. Of course, an unsound connection of this kind is likely to be made only by the inexperienced, to whom this lecture mainly is addressed. Never under any circumstances should the "B"– be connected directly to the power-supply chassis. The golden rule for the "B" – should be, "First stop: receiver chassis."

If it is desired to have "B"– run to an external ground, this must be effected *through* the receiver frame, back via a ground wire and through the power supply chassis to ground, as at (B). Connected in this manner, no shock can result from the mere fact of a disconnected lead. My own practice, in the case of separate power packs, is to terminate the positive and negative high voltage right on the power-pack chassis in the form of a flush receptacle and connect the receiver thereto by means of a corresponding plug. Fig. 514-C shows the idea.

This is at least one sound solution of the problem, since pulling out the plug renders the power supply quite harmless. Ordinary house fittings are quite suitable electrically up to voltages of about 500 and maybe higher. — *Wm. H. H. Massy, Devon, Conn.*

SHIELD FOR EXPOSED HIGH-VOLTAGE CHASSIS TERMINALS

There always is danger inherent in the use of porcelain feed-through bushings as high-voltage chassis terminals.

The makers of Amphenol products have on the market a stamped metal shell which covers one of their standard plugs (Type C-CAB). This shell is threaded to fit a male shell of identical size. My idea is to cut one part of the shell as shown in

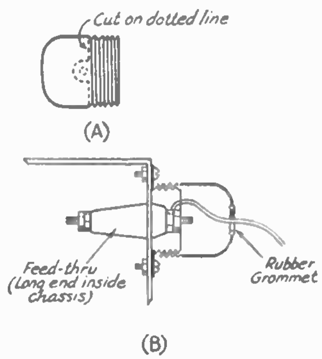

Fig. 515 — How a shield for exposed high-voltage chassis terminals may be made from an Amphenol cable-connector shell. The insulation on the connecting wire should be adequate for the voltage employed.

Fig. 515-A so that it may be fastened to the chassis over the feed-through insulator. The other section then will thread onto the first, making a complete protective covering over the exposed terminal. — *George H. Goldstone, W8MGQ.*

POLARIZED PLUG FOR A.C.-D.C. GEAR

In several issues of *QST* I have noticed articles suggesting just what to do when using a power supply the chassis of which is grounded to one side of the power line, especially in the use of the 117L7 and other tubes where one section of the tube is used for power and the other for oscillator, etc. Probably someone has written something about this, but I have not seen it in print.

If you will look carefully, you will find that in most of the outlets used in house wiring and passed by underwriters, the opening for the neutral prong is longer than the opening for the prong connected to the hot side of the line, as shown in Fig. 516. It looks as though they had made it for

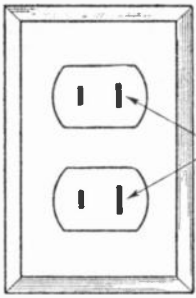

Fig. 516 — **Most types of approved power outlets have prong openings of two different sizes. Plugs may therefore be polarized by flattening one of the prongs.**

the special purpose of polarizing one side of the line. If anyone will check the sockets, he will usually find that the neutral or grounded white wire of the 115-volt system goes to the prong with the longer opening.

Now just take a hammer, flatten the prong of the plug which goes to the case or chassis, so that it will fit only the larger of the two outlet openings and there you have it. I have found this type of outlet in several homes and dime stores sell the same type, so they must be readily available in stores in many parts of the country.

Before inserting the plug, it is a good idea to make sure that the grounded side of the line *is* connected to the outlet prong with the larger opening. — *R. B. Murphy, W4IP.*

DISCHARGING TOOL FOR SAFETY

THE bleeder on the power supply for the final r.f. stage at W1EH recently opened up. Thus, even with the main switch pulled, I was due for trouble the next time I shut down the rig to change bands and put my elbows on the chassis while I took hold of the final coil to pry it out of its socket. Fortunately for me, I was suspicious of the thing at the time, so I didn't get bitten.

My safety item for this hazard is a discharging tool, consisting simply of a dry 2-ft. dowel bearing at one end a U of No. 12 soft tinned bus wire.

Fig. 517 — **A simple safety gadget for discharging "hot" power-supply filter condensers.**

As shown in Fig. 517, the wire goes through a pair of holes in the end of the dowel so it won't pull off. The wire can be readily formed to any desired shape to form a short circuit across filter output terminals, etc. When I have to change bands or otherwise touch the rig, I not only pull the main switch, but I apply the tongs across the filter terminals. When nothing happens, I know it is safe and that the bleeder is still doing its stuff. If I get a report like a pistol shot I'll know the bleeder was open, and I'll be glad I tried it.

Don't get to worrying about the surge current from the condensers and be tempted into putting a resistor in series with the shorting wire. The resistor might open up the same as it sometimes does in the bleeder. Ordinarily there will not be any current. The first time there is, it's time to fix something. — *K. B. Warner, W1EH.*

INSULATED HOLDER FOR SMALL CARTRIDGE-TYPE FUSES

IN SERVICING radio sets one will occasionally blow a fuse. Here at the hospital this involves most undesirable consequences.

I desired to install a local fuse that would be inconspicuous. The small cartridge fuses available were undesirable because of their lack of insulation. A couple of Christmas-tree miniature bulb sockets were adapted to make an insulated fuse holder as shown in Fig. 518.

Fig. 518 — **A miniature lamp socket may be used as an insulated cartridge-type fuse holder.**

The brass shell in each socket was pushed out with long-nosed pliers, and its center contact was punched out. In place of the center contact a small grid cap connector was soldered, making a clip of the proper diameter to receive a small cartridge fuse. The shells were replaced in their original sockets, the result being an insulated fuse holder which reveals about a half-inch of the middle of the fuse barrel.

If insulation is not required, two grid caps alone make a useful holder. — *Harold Ramsey, Bethesda Hospital, Zanesville, Ohio.*

NOTES ON SAFER CONSTRUCTION

Power-Supply Cable Plugs

NO ONE who has had the most casual acquaintance with power switchboards knows that there is one commandment: "Thou shalt keep all male plugs cold." We see frequent applications in multiconductor power-supply cables where the male plugs are "live." This can be dangerous to the operator if the plug is pulled apart with the power on and also can cause damage to apparatus by accidental short-circuit when a "live" prong comes in contact with ground. When power-supply and transmitter units are connected by a multiconductor cable fitted with plug connectors, the female receptacles should be mounted on the power-supply and on the transmitter end of the cable, while the male plugs should be used on the transmitter chassis and the power-supply end of the cable.

Receiver "B" Switches

A receiver "B" switch should have good insulation and the place for it is in the positive side.

Otherwise, the chassis of either the power supply or the receiver will be "hot" with the switch open, depending upon which is grounded.

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Parallel Feed for Headphones

Parallel feed or output transformers always should be used in stages feeding headphones. Aside from the great advantage of safety, there are numerous other benefits which make it well worth the slight extra cost even in the most compact portable equipment. High plate currents which often damage headphones are diverted, switching between receiver or monitor is easier because one terminal is grounded, insulation is easier to carry out, and two or more receivers can be connected simultaneously. — *Yardley Beers, W3AWH.*

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REPLACING AN 83 WITH 866 JR.S FOR HIGHER VOLTAGES

Every once in a while, we hear from hams who have been a little too optimistic in judging the voltage which an 83 rectifier will take. As a result they find that frequent replacement is necessary. However, it's a lot cheaper to get rid of the trouble permanently by replacing the 83 with a pair of 866 jr.s. This can be done quite simply, in most cases, since the filaments of the 866 jr.s operate at 2.5 volts, 2.5 amperes, while the 83 operates at 5 volts, 3 amperes. Therefore,

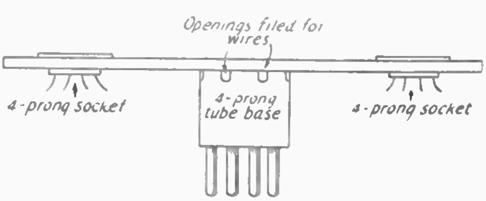

Fig. 519 — Adapter for replacing a type 83 rectifier with type 866 jr.s for higher voltages. If the rectifier filament transformer has no center-tap, make positive high-voltage connection at center of series-connected filaments. The strip is fastened to the tube base by a 6-32 screw running through the center of the tube base.

it is necessary only to wire the filaments of the 866 jr.s in series to operate from the same filament transformer.

If a 4-prong tube base is available, an adapter may be made up in a few minutes as shown in Fig. 519. The shape of the mounting strip and the location of the adapter plug may be varied to suit the available space.

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PLATE-VOLTAGE CONTROL WITH A COMBINATION TRANSFORMER

Many amateurs are not blessed with an abundance of funds, and a nickel saved is that much more towards improving their sets. Most power-supply diagrams show a plate transformer with two or three separate filament transformers. At the same time, most of the low-voltage plate transformers already have two or three filament windings which are not used because the boys want separate filament transformers to heat their tubes before plate current is applied.

My plate transformer has several filament windings — enough to heat my two 866 jr. tubes, as well as the filaments of the tubes in the transmitter.

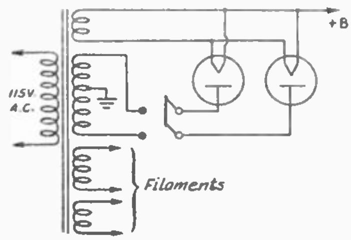

Fig. 520 — Switching the plate winding on a combination transformer so that transmitter tubes can be heated before application of plate power.

For 25 cents I purchased a heavy-duty porcelain double-pole single-throw switch, which I mounted on the inside of the power pack near the transformer. I brought the two plate leads from the transformer to one end of this switch and from the other end ran two leads to the rectifiers, as shown in Fig. 520. An 8-inch length of one-inch wide bakelite strip is fastened to the handle of the switch, with the loose end extending through a hole cut in the panel. When I shove the bakelite strip in about an inch the plate switch is open. All I have to do is give the tubes a few seconds to heat up when I first start up the rig and then pull the strip out, which closes the switch and applies plate voltage. This saves the price of an extra toggle switch for the plate transformer, as well as the cost of an extra filament transformer. — *W. F. Worrell, W5AQD.*

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INCREASING SEMI-VARIABLE RESISTOR POWER RATINGS

The handy kink shown in Fig. 521 is very simple in principle, but for this very reason it might not have occurred to some. The power rating given a vitreous-enameled resistor of the slider-type applies to the entire resistance. Thus, when only a portion of the resistor is in use, its power rating is reduced. In other words, the current-handling ability of the wire with which the resistor is wound is the principal limiting factor. By putting the slider at the center and connecting

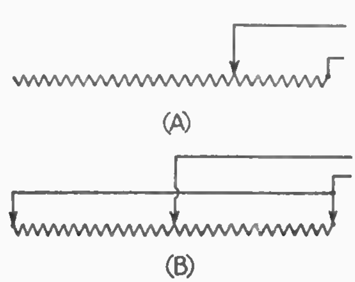

Fig. 521 — A simple method for increasing the power rating of adjustable resistors at low resistance values.

the ends of the resistor together, as shown at (B), Fig. 521, the two halves of the resistor are connected in parallel, the total resistance is reduced to one quarter of the original value, and the current-carrying capacity is doubled. If less than one quarter of the resistance is required, additional sliders may be placed at an equal distance from each end. This idea should be useful particularly in experimental adjustment of a series voltage-dropping resistor where the current through the resistance increases with a decrease in resistance. — *Elmer F. Blanchard, W1CHB.*

CABLE CONNECTORS FROM OLD METAL-TYPE TUBES

WHAT with priorities, shortages and materials being generally unobtainable, I found one remedy for the trouble of getting an occasional connecting plug for equipment. As shown in the drawings of Fig. 522, use is made of old metal tubes salvaged from the junk pile. These are taken apart and all of the elements removed, leaving the bakelite base and the metal jacket. Holes may be drilled in the end or side of the

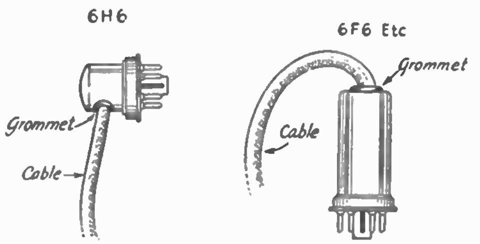

Fig. 522 — Homemade cable-plug connectors constructed from old metal tube envelopes.

jacket and a rubber grommet inserted to provide an opening for the cable. After the wires are soldered in the pins the jacket is slipped up and clamped on the base. The jacket may be grounded for better shielding, if desired. I have found this a good substitute for regular parts which often cannot be obtained and hope that someone else will benefit from this "brain storm." — *G. Pennington Schleicher, W9NLT.*

ELIMINATING GAS-DRIVEN-PLANT INTERFERENCE

FREQUENT reference to receiver noise from gas-engine-driven power installations indicate that many others may be having the same difficulty. It happens that I have had the job of eliminating noise generated by several plants, so perhaps I can suggest some effective relief.

The most important point is that of grounding the frame of the generator *and* one side of the output line. The ground lead should be short to be effective, otherwise grounding may actually increase the noise. A water pipe may be used if a short connection can be made near the point where the pipe enters the ground, otherwise a good separate ground should be provided.

The next step is to loosen the brush-holder locks and slowly shift the position of the brushes while checking for noise with the receiver. Usually a point will be found (almost always different from the factory setting) where there is a marked decrease in noise.

From this point on, if necessary, by-pass condensers from various brush holders to the frame, as shown in Fig. 523, will bring the hash down to

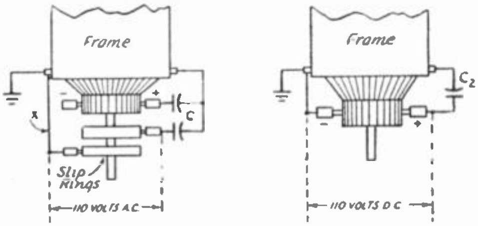

Fig. 523 — W8BQ shows the connections used for eliminating interference from gas-driven generator plants. C_1 should be 1 μfd., 300 volts, paper, while C_2 may be 1 μfd. with a voltage rating of twice the d.c. output voltage delivered by the generator. "X" indicates an added connection between the slip ring on the grounded side of the line and the generator frame.

within 10 to 15 per cent of its original intensity, if not entirely eliminate it. Most of the remaining noise will be reduced still further if the high-power audio stages which manufacturers insist on hanging in their receivers are cut out and a pair of cans tied right into the second detector! — *Herb Walleze, W8BQ.*

SIMPLE CHECKS ON GAS-DRIVEN A.C. GENERATORS

BEING in doubt about the frequency and voltage of the a.c. power output generated by a particular 3-kw, separately excited generator with 5-horsepower single-cylinder gasoline engine, I arrived at a simple and economical method of solving these problems.

A 60-cycle electric clock was attached to the output of the generator. Frequency checks of fair accuracy were made by comparing the speed of the second hand of the clock with that of a pocket watch. By adjustment of the engine speed to give correct rate of the second hand, the clock may be made to keep fairly accurate time.

Operating the transmitter while varying the speed of the engine, it was found that the transformers operated best in the frequencies between 50 and 60 cycles, the efficiency dropping off with operation outside of this range.

It was further found that a light bulb connected across the output of the generator was far from a reliable check, since the voltage required to produce what seemed normal brilliancy of the bulb on bright sunlight days was in the neighborhood of 150 volts. Accordingly, the light bulb was replaced by a Readrite a.c. voltmeter. This instrument has been found satisfactory for the adjustments required to maintain correct output voltage of the generator.

It should be noted that, if a 50-cycle clock is used to check the frequency of a generator, delivering 60-cycle a.c., one revolution of the second hand should be made in 50 seconds, and therefore the clock should gain a total of 4.8 hours in each 24-hour day.

With the employment of this inexpensive equipment for checking the operation of the generator, stable operation with both regenerative and superheterodyne receivers is maintained. — *Dan Nightingale, W5EGV.*

FILTERING GENEMOTORS USED TO SUPPLY RECEIVERS

It is possible to install a genemotor and filter for use as a receiver power supply with a minimum of commutator ripple appearing in the receiver output, even though no method has been devised, thus far, to eliminate the "whine" from the background.

Methods employed in present-day aircraft receivers in mounting the genemotor should be the amateur's guide. The support should be in the form of rubber mounting blocks, or their equivalent, to prevent the transmission of vibration mechanically. The frame of the genemotor should be grounded through the use of a heavy flexible braid connector.

The brushes on the high-voltage end of the shaft should be by-passed with 0.002-μfd. mica condensers to a common point on the genemotor frame, preferably to a point inside the end cover, close to the brush holders. Short leads are absolutely essential.

Sometimes it is necessary to shield the entire unit, or even to remove the unit to a distance of three or four feet from the receiver. Shielded leads seem to be of little or no help.

A filter for the genemotor should be designed in very much the same manner as those used for vibrator supplies. Such filters are shown in *The Radio Amateur's Handbook.*

A 0.01-μfd. 600-volt (d.c.) condenser should be shunted across the output of the genemotor, followed by a 2.5-mh. r.f. choke in the positive high-voltage lead. From this point the output should be run through a "brute force" smoothing filter which uses, say, an 8-μfd. electrolytic condenser on each end of a 15- or 30-henry filter choke having low d.c. resistance. — *Harris C. Haines, W8IBQ.*

BREAK-IN OPERATION WITH DYNAMOTOR SUPPLY

For those fortunate enough to have a.c. available, break-in is so simple there is no excuse, it seems, for not using it. But for the ham who must depend on a dynamotor or a motor-generator set it may not be such a simple matter. The dynamotor formerly used at this station made so much QRN that even an S9 signal was copied with difficulty.

After making a number of inquiries as to possible remedies, I was none the wiser and about to give up. R.f. chokes and condensers up to 20 μfd. across the brushes did not improve matters much, if at all. The machine was enclosed in an iron casting, so that shielding it further did not seem to hold much promise.

However, I decided to try something. With the aid of the soldering iron, a box with a tight-fitting cover was made from galvanized-iron sheet. It was made with two compartments. In one, the dynamotor was mounted on heavy felt padding to absorb vibration and thus eliminate much of the QRN coming through the air, and also to insulate the machine completely from the sheet-iron box. That may be of importance. Two 2-μfd. condensers were connected in series across the primary, or motor, brushes. The center-tap, or the connection between the condensers, was grounded to the dynamotor frame. Lead-covered cable was used to connect the primary to the storage battery. The sheath of this cable makes contact with nothing except the metal box.

In the other compartment was placed the starting relay, a Ford generator cut-out, and three chokes, one in series with the lead to the starting relay, and one in each secondary or high-voltage lead. The chokes are "shuttle" type, and are wound with about 325 turns of No. 28 d.c.c. They are separated as far as possible in the box and the center one is wound in the opposite direction from the others.

The particular dynamotor in use is a General Electric 24/750-volt machine, which has a 1-μfd. condenser in the base to filter the high voltage. Using crystal control, T9 reports are received on all bands even without the filter, but it helps to minimize sparking at the brushes. With the load off, the h.v. QRN is of little consequence. The entire output is keyed with another generator cut-out relay so there is no load on the machine when the key is up. The advantages of the idea are break-in on any frequency, less current drain on the storage battery, and greater output resulting from the greater speed of the armature because of the "fly-wheel" effect. This procedure would, perhaps, not be advisable unless the transmitter in use is crystal-controlled, although dynamotors in general have very good regulation unless they are greatly overloaded.

After the cover was put on the box, it was a pleasant surprise to find the generator hash had cleared up enough so that all signals except the very weakest could be copied with the machine running, making c.w. break-in and 'phone push-to-talk operation possible.

All of the precautions I took may not be necessary in all cases, but a few additional suggestions may help in curing more stubborn ones. A large choke in each primary lead, wound with No. 10 to No. 14 enameled wire, may be useful. Shuttle-type chokes are very compact but effective. By habit I connect the inside terminal to the output or cold side of the circuit. Sometimes chokes are more effective if individually shielded in small tin boxes such as Kester solder boxes. Different-sized chokes may be tried. Grounding the metal box may help, but in my experience "floating" shields are more effective as a rule. — *Robert E. Valgren, W9ALO.*

BIAS SUPPLY FOR "ZERO-BIAS" MODULATORS

BATTERIES proved to be noisy nuisances when used for grid bias on my Class-B 805s which require about 15 volts. The solution to the problem turned up a novel use for a mercury-vapor rectifier as a regulator in conjunction with my regular a.c.-operated bias pack furnishing voltage to the grids of the r.f. amplifiers. Except for supplying the mercury tube with filament power, the action is the same as that of the well-known 874, or its more modern version, the VR105/30. In this case, however, the output voltage is about 15 volts because of the mercury-vapor tube's constant voltage drop of that value.

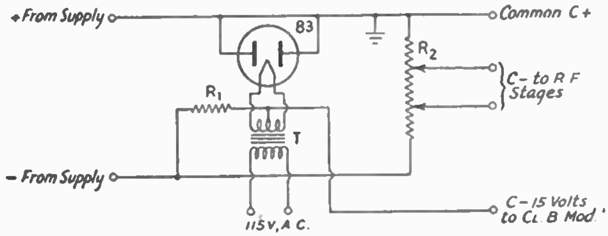

Fig. 524 — Circuit diagram of the combination bias supply described by W8HLM. The branch with the 83 rectifier-regulator supplies a constant regulated voltage of 15 for the Class-B modulator tubes.

The circuit diagram of the combination bias supply is shown in Fig. 524. Resistor R_1 should be of a value such that the mercury vapor tube draws only enough current to glow dimly (but reliably) with the biased stage not drawing grid current (about 20 ma. in the case of an 83 tube). The rectifier tube which should be used will depend on this resting current plus the peak grid current of the biased stage. The sum of these currents should not exceed the maximum d.c. output current rating of the tube.

Using an 83 tube to regulate a circuit in which the grid current varies from 0 to 40 ma. the voltage is held steady to within 0.1 volt or so, which is better than dry batteries used to do. Substitution of an 866 brought the variation to an even lower value, but this refinement is not needed.

Bias for the r.f. tubes is taken in the usual manner from the output voltage divider. — *Charles Affelder, W8HLM.*

IMPROVED VOLTAGE REGULATION FOR THE OSCILLATOR

IN attempting to operate a self-excited oscillator and power amplifier from the same power supply, I encountered considerable difficulty with poor voltage regulation. A standard single-section choke-input filter system was used with an 83 rectifier and a transformer delivering 600 volts each side of center with a 200-ma. rating. The choke was a double 30-henry unit with the two sections connected in parallel. Each unit has a 125-ma. rating.

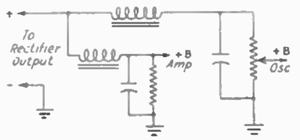

Fig. 525 — Improving voltage regulation at the oscillator tap by the use of a separate filter choke.

Investigation showed that most of the drop in voltage was occurring across the filter choke. Upon arranging the circuit as shown in Fig. 525, so that the amplifier current was drawn through a separate choke section, I found that the voltage at the oscillator voltage-divider tap remained practically constant when the amplifier was keyed. A 4-μfd. condenser in each branch provided sufficient smoothing. — *John H. Stone, W8MYQ.*

POWER-TUBE PROTECTIVE CIRCUIT

THE writer has used the method shown in Fig. 526 to protect the power tubes and eliminate complete breakdown of a p.a. amplifier in case of failure of the fixed-bias system normally used. In this case, the tubes were a pair of 2A3s drawing a normal plate current of about 80 ma.

Across the usual self-bias resistor was shunted a Little-Fuse, rated at 125 ma. If the fixed-bias system failed, the plate current on the power tubes would exceed the rated carrying capacity of the fuse and it would blow, thereby removing the shunt across the self-biasing resistor and automatically putting the tubes in normal operation with self bias. The grid return would be through

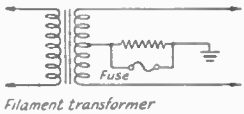

Fig. 526 — Power-tube protective circuit for use on fixed-bias stages. It employs an auxiliary self-biasing resistor which is normally shorted by a fuse.

the bias-supply voltage divider to ground. As an added protection, a fuse of the same rating was used in series with the bias resistor.

This idea probably can be applied in other ways. In a transmitter, it might be adapted to an overload relay circuit which would remove a short across a self-bias resistor calculated to reduce plate current to a safe value when off resonance, instead of opening the plate circuit and killing the transmitter. — *Henry C. Kuhn, W8IRU.*

A METHOD OF REJUVENATING ELECTROLYTICS

I WOULD like to pass on a method which I have found to be effective in rejuvenating 90 per cent of wet electrolytics. The reason for the failure of these condensers seems to be a thin dielectric film which forms at the junction of the aluminum anode and the supporting rod.

The unwanted film can be removed by connecting the condenser in series with a 40- or 60-watt lamp across the 240-volt a.c. mains. Usually nothing happens for several minutes. Then the film suddenly breaks down, causing the electrolytic to sizzle and the lamp to light. The power should then be switched off and the condenser reformed by connecting it to a d.c. supply of several hundred volts for about ten minutes. After this it will generally be found that the condenser has acquired a new lease on life.

Obviously, if there is no electrolyte in the condenser to start with, this method will not work. — *VK2ABS, in* Amateur Radio (*Australia*).

GASEOUS TUBES AS BIAS REGULATOR

Arrangements using gas tubes (such as VR or 0Z4) for bias work out nicely if properly handled and provided the current through the tubes is fairly high, that is, near the current limit for the tubes. At low currents, the tubes are inclined to oscillate and if this occurs, modulation of the transmitter is bound to result. — *R. M. Purinton, W2ICU.*

WHY NOT PROVIDE OVERLOAD PROTECTION FOR YOUR EQUIPMENT?

The radio amateur and experimenter often has need for a device that will limit the amount of current that can be supplied to a changing load. This load may be a grid-leak-biased transmitter stage which tends to draw excessive current when out of tune or overcoupled to an antenna, or one of those ultrahigh-frequency, high-power oscillators which tend to run away when loaded too much. The conventional fuse, while giving satisfactory protection, is inconvenient. A fuse with a rating sufficiently low to provide adequate protection may be blown during the normal adjustment procedure. Replacing fuses also becomes costly if done very often. A circuit-breaker eliminates the necessity for replacement of fuses, but it has the disadvantage that if it is set to provide the maximum protection, it will often open and need resetting even when the equipment is very near to its proper adjustment. Reducing the plate voltage supplied to the transmitter while adjustments are being made and selecting a fuse or overload relay of suitable value is a possibility, but this procedure is somewhat inconvenient. A series resistor often is used to supply voltage to such variable loads, but this is rather wasteful because, even under operating conditions, there is a certain amount of power lost in the protective device. A handier protective device would allow normal operation up to a predetermined current level and then function to prevent this value being exceeded, regardless of output load or applied voltage.

Such a device may be conveniently constructed from a normally closed d.c. relay. The exciting coil of the relay is shunted so that the relay will open when the desired limit current passes through the winding-resistor combination. This coil is then connected in series with the relay contacts as shown in Fig. 527-A. The relay is placed in series with the lead supplying current to the device to be protected. While the current drawn by the equipment is lower than the desired limit, the protective device will have no effect on this current or voltage. Above the overload point, the relay will open, causing the current to be shut off from the equipment. Shutting off the current will then de-energize the relay coil so that the contacts will again close. This process will be repeated at a rate determined by the amount of excess current that the protected device tried to draw.

A typical operating characteristic is shown in Fig. 527-B. In this case, the relay was placed in series with a resistor and the voltage across the combination varied. The current through the resistor was plotted against this voltage variation. It will be noted that the current to the resistor was directly proportional to the applied voltage until the predetermined current value was reached. The current then dropped slightly as the supply voltage was increased. For a two-to-one increase in supply voltage, the current through the resistor stayed within 15 per cent of maximum, never exceeding this value. This characteristic will vary slightly with the particular relay chosen. The opening and closing of the relay will cause a modulation on the current supplied to the load. In most cases this will not be objectionable, since the device will operate only when the protected equipment is overloaded. If desired, a part or all of this modulation (and interference with other equipment) can be removed by use of resistor-capacitor filters, or inductor-capacitor filters, such as are commonly used for the elimination of keying interference in c.w. transmitters.

In choosing a relay, care should be taken to pick one that has sufficient spacing between the contacts so that the high voltage present across them when the relay is open will not start an arc. If an arc forms, the circuit will not open and the protective device will be of no value. For experimental purposes, it is often convenient to place a variable resistor across the relay coil so that the operating current may be set at will.

A small d.c. relay shunted with a 250-ohm wire-wound rheostat makes a suitable protective device for small transmitters drawing not more than 150 ma. at 400 volts. These relays usually open with a coil current of 10 to 20 ma.

The system has been used in the laboratory in the development of several pieces of equipment in which it had previously been necessary continuously to replace fuses or run the risk of destroying expensive tubes. — *H. C. Lawrence, W3IXL.*

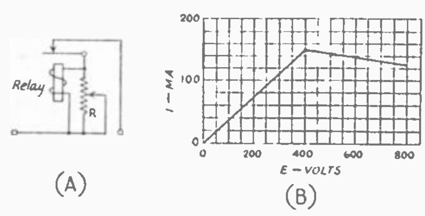

Fig. 527 — Overload protection system suggested by W3IXL. (A) shows the relay circuit, while the curve at (B) shows the output current *vs.* input voltage when used in series with a resistor as mentioned in the text.

A SAFETY SWITCH FOR THE POWER SUPPLY

An inexpensive idea for power-supply switching which, if properly used, may save the operator from painful shocks is shown in Fig. 528. A double-pole double-throw switch is used in the position normally occupied by a single-throw

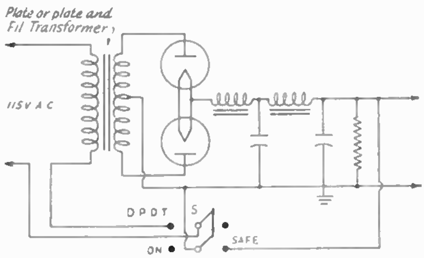

Fig. 528 — Power-supply filter discharging switch.

single-pole switch. One pole performs the function of opening the plate transformer primary circuit, while the other pole, on the opposite throw, shorts the output terminals of the plate supply. This removes the chance of shock by condenser discharge if the bleeder circuit should be opened and, in addition, it reduces the danger of having high voltage appear in the power supply because of accidental primary circuit closing through a path external of the switch.

Two precautions should be carefully observed in the use of this switch, however, without which it may prove a hazard rather than a safety device. First, the moving part of the section used for output shorting should be connected to the ground power supply terminal, with the stationary pole connected to the other high-voltage terminal. Second, if an open knife switch is used, the stationary pole of the shorting section should be made inaccessible to accidental contact with the operator's hand or body. The switch should be enclosed completely or of a type which may be mounted with the "works" behind a panel or in a control box. — *Everett G. Taylor, W8NAF.*

GROUNDING THE POSITIVE HIGH VOLTAGE FOR SAFETY

The desire to "switch to safety" and to build an inexpensive r.f. amplifier led me to adopt the circuit shown in Fig. 529. Although the idea is not new, I think it deserves much more consideration than has been given. Comparison with the orthodox circuit at (B) will show that the *positive* terminal of the high-voltage plate supply is grounded instead of the negative terminal. While this involves certain problems, they are not insurmountable and are brought about chiefly because the design of commercially produced components have been based upon the grounded-negative circuit. When the two circuits are compared, the advantages of the grounded-positive version are quite apparent. Almost without exception, those parts of the circuit which normally are exposed sources of danger in the grounded-negative circuit are grounded and, therefore, are harmless in the grounded-positive circuit. The tank coils, tank condensers, plate-circuit milliammeter, tube plate terminal and filter chokes are at ground potential and the adjusting shaft of the neutralizing condenser also is grounded. Another advantage is that no difference of d.c. potential exists between the rotors and stators of the split-stator condenser, and therefore the tank condenser must withstand only the peak r.f. voltages.

On the other hand, the filament and d.c. grid circuits are at high d.c. potential in respect to the chassis or ground, and these circuits must be suitably insulated. Fortunately, these portions are the ones which usually are hardly accessible to accidental contact. The filament by-pass condensers must have a voltage rating somewhat greater than the plate voltage used. The same sort of insulation is required between the primary and secondary windings of the filament transformer. All components of the bias supply also must be well insulated from ground, including the rectifier filament and plate-transformer secondaries. Batteries might be used for low-voltage, high-μ tubes but they must be placed at an inaccessible point on well-insulated mountings. The grid coupling condenser must withstand the sum of grid and plate voltages. Some of these difficulties may be avoided by obtaining bias from a voltage-divider across the plate-voltage supply, connecting the grid return to the negative high-voltage and filament center-tap at an appropriate point on the divider. With high-μ tubes, the sacrifice in plate voltage will not be appreciable. — *Arpard A. Fazakas, W2FLT.*

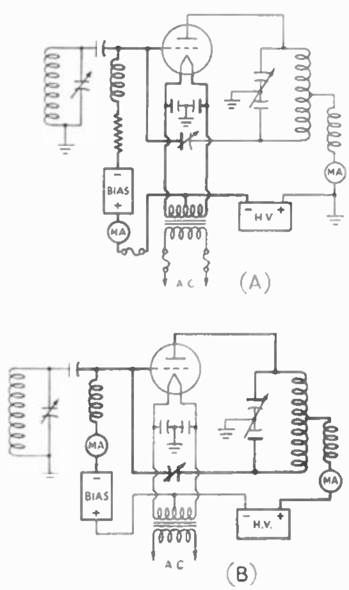

Fig. 529 — Heavy lines indicate the high potential points in the usual arrangement, shown at (B), and those in the grounded-positive arrangement at (A).

OPERATING STAGES IN SERIES FROM A HIGH-VOLTAGE POWER SUPPLY

THE problem of using a single power-supply unit for a transmitter of several stages, some of which may operate at different voltages, is always a difficult one. It usually is solved by the use of inefficient dropping resistors. In contrast to this, Jim Blitch, W4IS, describes a rather novel way in which an entire c.w. transmitter is operated from a single 1500-volt supply.

The essentials of the circuit are shown in Fig. 530. The transmitter in this case consists of four stages: 6F6 Pierce oscillator, 6L6 buffer, 809 driver and push-pull 808 final, all operating at different voltages. Since the oscillator is designed to operate with very-low plate current, plate voltage may be obtained without great loss in power through the series dropping resistance, R_4. The voltage is prevented from soaring by the VR-105 tube.

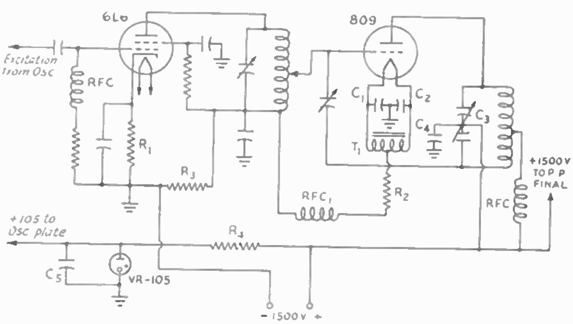

Fig. 530 — Two stages operating in series from a single high-voltage supply. All circuit values differing from those which would be normally employed are discussed in the text.

The innovation in the system is in the manner in which the two intermediate stages are supplied. As the circuit diagram of Fig 530 shows, these two stages are connected in series across the supply, the series circuit from the positive high-voltage terminal being through the plate circuit of the 809 to its filament center tap, thence to the plate circuit of the 6L6 whose cathode forms the return connection to negative high voltage. Since the 809 normally operates with a higher plate current than the 6L6, and since the current throughout the series circuit must be the same, the 6L6 is shunted by the resistance R_3 which is proportioned to carry the difference between the plate current of the 809 and that of the 6L6. This point may be made clearer by comparing the circuit with that of series connected heaters, commonly found in a.c.-d.c. receivers. In cases where heaters of unlike current ratings are connected in series, those of lower current rating are shunted by resistors which limit the voltage across the heater terminals to the proper value when rated current is flowing through the heater of highest current rating.

Bias for the 809 is obtained by the drop across the cathode or center-tap resistance, R_2, by-passed by C_1 and C_2. To obtain this bias, the grid is returned through L_1 and RFC_1. Since no coupling may be used, excitation is adjusted by a variable tap on L_1.

The idling plate current may be adjusted by varying the value of cathode resistance, while the input to the 6L6 can be controlled by adjusting the size of R_3.

All values not indicated are normal. The filament by-pass condensers, C_1 and C_2, and the filament transformer, T_1, should have voltage ratings of not less than 1000 volts. If a d.c. connection is made to the rotors of C_3, as shown in the diagram, a tank condenser with normal plate spacing may be used. However, if the rotor is grounded, the spacing must be increased to take care of the full supply voltage (1500 in this case) plus the peak r.f. voltage. C_4 should be rated to withstand full supply voltage. For the particular arrangement shown, 900 ohms, 25 watts and 25,000 ohms, 25 watts are appropriate values for R_2 and R_3, respectively. Also in this particular instance, the dropping resistor, R_4, is 37,500 ohms. C_4 should have a voltage rating proportional to the full supply voltage. A resistance of 100 ohms for R_1 should be suitable.

This circuit has proved entirely practicable here. However, such an arrangement is not suitable for 'phone work.

FILTER-DISCHARGING RELAY OR SWITCH

I BELIEVE the arrangement shown in Fig. 531 is an improvement over the usual filter-shorting relay circuit. It is a scheme which has been used by the Italian Marconi people in certain types of their short-wave transmitters, in which changes in tank-circuit values are made by operating bare switches in a 3500-volt series-fed circuit.

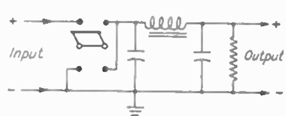

Fig. 531 — Safety switch which opens the high-voltage circuit as well as discharging filter condensers. Switching is done by a protected knife switch or relay.

A double-pole double-throw relay or switch is connected so that the filter is disconnected from the rectifier before the filter is short-circuited. This automatically prevents the possibility of damage to the transformer and rectifier as well as injury to the operator should he fail to switch the supply off before shorting the output or by failure of the shorting relay to operate properly.

As used by the Marconi Co., the switch is manually operated by an insulated control from the panel. Of course, if a relay is used, the stationary contacts must be well insulated from one another. — *Keith Olson, W7FS.*

AN INEXPENSIVE-TIME DELAY RELAY

Time-delay relays, though almost a necessity in the up-to-date transmitter, are often avoided because of the cost. However, an ordinary power-remote control relay can be made to do the trick by the addition of a flasher and lamp bulb. The flasher may be of the small disc variety which may be obtained at any electrical store.

Fig. 532 shows one circuit arrangement using a double-pole double-throw relay. Initially the lamp and flasher are in series across the 115-volt line and the relay coil is across the flasher. When the flasher heats up sufficiently to open, the relay coil is energized, whereupon the lamp and flasher are disconnected, and the relay coil together with the load are connected directly across the line. It should be noted that this relay should be of the quick-acting type, with a fairly heavy armature, otherwise it will not hold in properly when the flasher opens.

Should the relay at hand not prove suitable for use as in Fig. 532, the circuit shown in Fig. 533 may be used. Here the relay is always connected

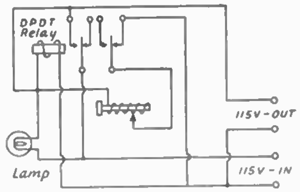

Fig. 532 — **A simple time-delay relay circuit using a d.p.d.t. power relay and flasher.**

in series with the lamp, but is shorted out by the flasher until the latter warms up sufficiently to open. Having the relay in series with the lamp is not a material disadvantage, providing it receives sufficient energy for correct operation. If the relay draws considerable current, a larger bulb and flasher may be used.

For most purposes, a flasher suitable for use with a 60-watt lamp will give good results, the

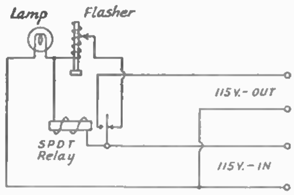

Fig. 533 — **This time-delay circuit may be used with a s.p.d.t. relay operating on low current.**

time lag, of course, depending on the bulb used and any possible adjustment on the flasher itself. Time lags longer than about 20 seconds are inclined to be rather unstable; hence this type of relay is not altogether suitable for such service.

A suggested arrangement is to mount the lamp bulb and the flasher in a twin plug fuse receptacle, with a plug fuse to complete the circuit through the flasher. A refinement would be to substitute a resistor for the lamp bulb and a special mount for the flasher. — *Wilbert B. Smith.*

A SIMPLE LINE-VOLTAGE CONTROL

The dodge of using a spare filament transformer as an auto-transformer for compensating for variations in line voltage often has been suggested but apparently has never gained the

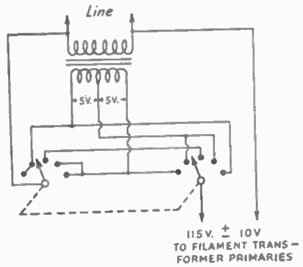

Fig. 534 — **Circuit for line-voltage control by means of a center-tapped filament transformer.**

popularity it deserves. While a primary rheostat gives a smooth control if the line voltage is always sufficiently high, the autotransformer has the advantage of being able to take care of wide variations above and below the normal line voltage. For example, a 10-volt filament transformer used as an autotransformer will take care of a 10-volt variation either side of the normal line-voltage value.

In order to facilitate adjustment, a simple switching system can be used, as is shown in Fig. 534. The switch can be any double-pole five-position job that isn't too flimsy. Any of the better switches should do the trick nicely. The transformer can be any spare filament transformer — we use an old 7½-volt one but plan to scare up a 10-volt one for slightly more range of control. The voltage is controlled in steps equal to half of the secondary voltage of the transformer used. — *W1JPE.*

POLARITY OF SUPPLY LINE IN REGARD TO SAFETY

To make certain that the switch or other device is always placed in the ungrounded side of the line, the use of polarized outlet plugs, which cannot be reversed, is suggested by many, while others provide a signal lamp connected with the series outlet as shown in Fig. 535. If the polarization is correct, the lamp will light when the short-circuiting *plus* is inserted but will not light if the polarization is incorrect. If the lamp does not light, the power plug should be reversed to make certain that the light has not burned out. The lamp serves as a warning light when power is on.

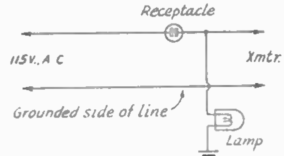

Fig. 535 — **A series plug fitted with a lamp is useful for indicating when the protective pol plug is in the ungrounded side of the line as it should be.**

6. *Hints and Kinks . . .*

for the Antenna System

THREE-BAND "AUTOMATIC" ANTENNA

FIG. 601 is a sketch of a novel antenna system which has been working out satisfactorily for Frederick Weyerhaeuser, W9YPQ. As most amateurs know, a center-fed antenna with twisted feeders is good for operation only in the band for which the antenna is cut. W9YPQ gets around this situation by using three antennas, one for each band, but all fed through a common low-impedance feeder. Only the desired antenna will take power because the others are the wrong length for resonance. The shorter antennas are suspended from the longer by means of glass-rod spreaders so that the spacing between wires is 4½ inches.

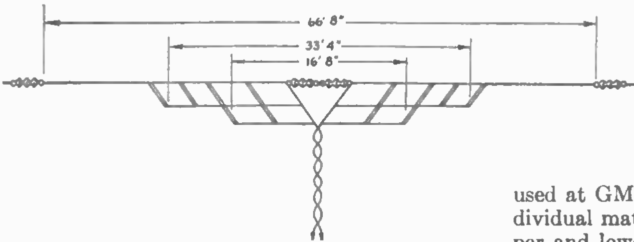

Fig. 601 — A three-band antenna with twisted-pair feeders. Three separate antennas are used with the same feed line. The feeder is fanned at the upper end so that the spacing on the 40-meter antenna is 12 inches.

W9YPQ writes: "The fact that different center spacings are required for proper impedance matching of a twisted pair to a 7-, 14- or 28-Mc. antenna suggested combining all three of them to a single feeder. Local field-strength measurements and DX results are comparable to separate half-waves of the same type. The feeders at present are No. 18 stranded rubber-covered wire, and it is hoped that even better results will be had with more efficient feeders. The theoretical value for center spacing was used only on 7 Mc.

"The tuning characteristics on each band are identical with those of separate antennas, and a neon bulb indicates the presence of r.f. in the desired section only."

One point about such an antenna system is that it does *not* possess the ordinary twisted-pair feeder's harmonic-discrimination. Therefore harmonics must be eliminated before they get to the feeder.

A FLAT LINE FOR THE "LAZY H" ANTENNA

THE difficulty of adjusting a matching stub for a perfectly flat line is well known. The principal reason for this lies in the fact that the stub shows pure resistance only at its ends and not at the point at which the flat line is attached unless the stub is detuned slightly.

To eliminate this, the arrangement shown in Fig. 602 has been used at GM6RG with a "lazy H" antenna. Individual matching sections are connected to upper and lower sections of the antenna. The one for the upper section is transposed and is three-quarters of a wavelength long to bring its lower end down to meet the one-quarter wavelength section attached to the lower antenna section.

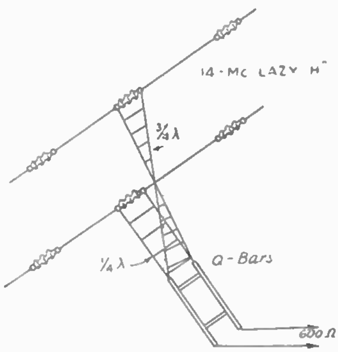

Fig. 602 — The arrangement by which GM6RG obtains a flat 600-ohm line with "lazy H" antenna.

A "Q" matching section is then used between the two open-wire matching sections and the 600-ohm line. When the "Q" section is correctly adjusted, the line will be terminated in a pure resistance. The impedance at the antenna end of the "Q" section will be about 15 ohms. — *Bryan Groom, GM6RG.*

The construction and adjustment of "Q"-section transformers are discussed fully in the Radio Amateur's Handbook (p. 209 of the 1945 edition) and in *The ARRL Antenna Book* (p. 48).

A MULTIBAND END-FED ANTENNA

When multiband operation of an end-fed antenna is desired, the annoying problem of how properly to feed it always presents itself. It is often necessary, and sometimes desirable, to erect a transmitting antenna in such a way that an end is near the transmitter. Then one has the choice of either running a transmission-line out to the center of the system, or of using any of the conventional forms of end-feed with the attendant feeling that all will not be well when operating in a band other than that for which the antenna and feeder-system is designed.

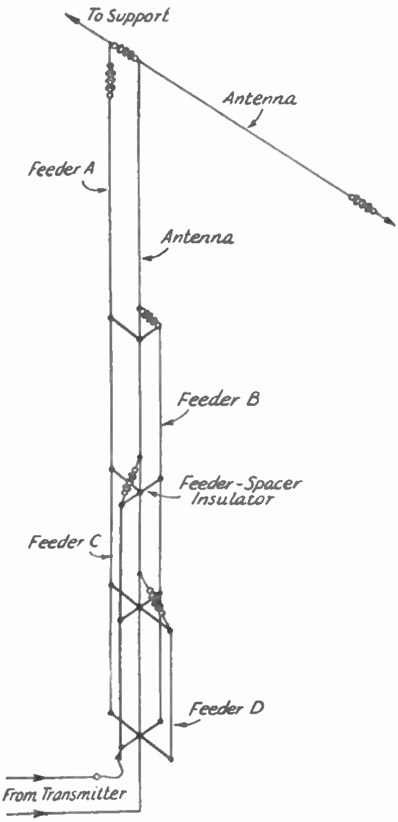

Fig. 603 — Multiple feeders for maintaining feeder balance when using a Zepp for multiband work.

One convenient solution to the problem of multiband operation of a Zepp antenna has been found. Take, for example, an antenna with a natural period of 1.75 Mc., together with the usual feeder-system consisting of a ¼-wave transmission line. This is a typical antenna-feeder system which we may wish to operate on 3.5, 7 and 14 Mc., as well as the wavelength for which it is designed. To this system there can now be added another feeder, equally spaced from both the original feeder wire and the antenna, but of length ¼-wave at 3.5 Mc. Two more feeders also can be added of lengths ¼-wave at 7 Mc. and ¼-wave at 14 Mc.; all equally spaced with respect to the other feeder wires and to the antenna as shown in Fig. 603. This results in a four-band Zepp system which performs equally well on any of the four bands and which maintains a current-loop at or near the transmitter.

One may, with justification, ask about the length of the antenna itself, since it cannot be of exactly the right length for all of the bands. Experiment has shown that any random length is satisfactory and that almost complete compensation may be made in the transmitter matching network. Somewhat better results are evident when the antenna-length is great (of the order of 300 feet or more) than when the length is small, although both long and short wires operate successfully. Two such systems were in operation for over two years, while perfect contact was maintained over a 12,000-mile path on two different bands. — *S. L. Seaton, VK6MO, Dept. of Terrestrial Magnetism, Carnegie Institution of Washington, D. C.*

A MATCHING SYSTEM FOR LOW-IMPEDANCE RADIATORS

Fig. 604 is a sketch of a feed system I used on my rig here which might be of interest to the gang. I have never seen it in print before, although the underlying ideas are very simple.

Having erected a four-element close-spaced beam here at W6DSZ, we finally came down to the troublesome question of feeding it. The radiator's center impedance of only 5 ohms or so presented a problem, since we wished to use open-wire lines, if possible, and yet be able to rotate the beam without having to resort to slip rings or similar means. We finally hit upon the idea shown, which seems to work very well.

Beginning at the antenna end, the piece of EO-1 cable is delta-matched to the antenna at the center. This cable is just long enough to pass through the center supporting shaft with enough

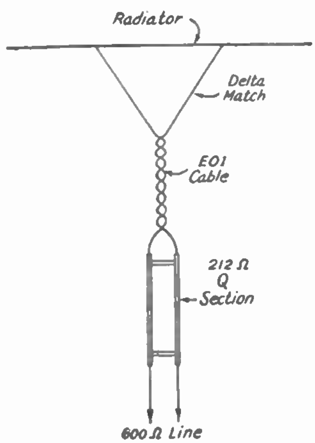

Fig. 604 — Feeding low-impedance beam radiator. In the specific case described by W6DSZ, the delta is attached 30 inches from each side of the center of the 14-Mc. radiator element of a four-element beam. The distance from the center of the radiator to the junction with the EO-1 cable measures 60 inches.

slack to turn the beam around. The bottom end of the EO-1 cable is matched to a 600-ohm line with a standard 20-meter Johnson "Q" section. Of course, a home-built quarter-wave section of 212 ohms surge impedance will do as well.

The advantages of this system are obvious. First, since only enough EO-1 cable is used to reach through the supporting shaft, losses due to long lengths of this cable are reduced. Second, since the section that is used is operated as a flat 72-ohm line, rather than as a "Q" section as some systems use it, losses are further reduced to the absolute minimum possible with this type of line. In our case where only 6 feet or so is used, losses are considered negligible.

In operation, the 600-ohm part of the line shows substantially the same r.f. voltage and current along its length; the voltage falls off gradually as we progress up the "Q" section toward the antenna. The voltage is very low all the way up the EO-1 cable to the antenna — scarcely enough to light a ½-watt neon lamp even with a full kilowatt input in the transmitter.

We might also mention that the antenna can be rotated four times in either direction without any difficulty from the feeders twisting up.

With suitable change of the "Q" section length and spacing of the delta match, this system could be used on any type of beam having radiation resistance less than 72 ohms and at any frequency. — *Fred Clapp, W6DSZ.*

ADJUSTING THE DELTA-MATCH SYSTEM FROM THE GROUND

THE problem of impedance matching between an antenna which is part of an array, and its feed line is often a hard one, because of the difficulty of computing or measuring the impedance at the points of connection to the antenna.

Since cut and try methods must be employed, it is advantageous to use a matching system which is continuously variable over a considerable range. The matching stub with its feed line tapped on at the proper point, and the "Y"-match seem to be the most flexible systems. Using either system, the approximate spot is chosen for tapping on and the taps are then varied until standing waves are eliminated from the feed line. Adjustment of the taps often is a tedious and physically difficult task, because adjustments must be made while the antenna is in the position in which it is to be operated.

The "Y"-match antenna can be adjusted in another manner which greatly simplifies the whole procedure and which should prove very valuable in making adjustments on beam antennas where the whole array is mounted so as to be accessible only with difficulty. The "Y" antenna, as shown in Fig. 605, can be thought of as a grounded quarter-wave antenna with a single-wire feed line. The portion to the left of the dotted line represents the image in the earth. The feed line is correctly terminated when the resistance presented to the feed line at point P_2 (assume a resonant wire) is equal to the characteristic impedance of the feed line. This resistance is a function of the length of the wire, L_1, its characteristic impedance, and the impedance presented to it at P_1. It has been customary to secure the correct resistance at P_2 by changing the position of P_1, thus changing the load pre-

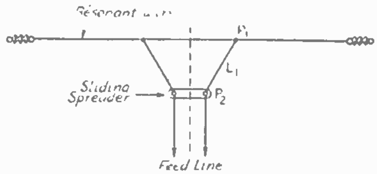

Fig. 605 — Scheme suggested by W9RQG for making final adjustments of a delta match from the ground.

sented to P_1, the length of L_1, and the characteristic impedance of L_1 (by changing its average height above ground).

This same result can be achieved by moving the sliding spreader at P_2, thus changing the length and impedance of L_1. It is not possible to get as great a variation by this method as by moving the taps, but if the points of tapping are roughly correct it should be possible to secure a match with reasonable movements of the spreader from its original position, as determined from tables in *The ARRL Antenna Book*, or in *The Radio Amateur's Handbook*.

The system can be raised to its operating position and the spreader moved up or down by means of a long fish pole with a hook or clamp attached to its end. When the proper position is found, the spreader can be wired in place. — *Victor H. Voss, W9RQG.*

INCORRECT USE OF 115-VOLT LAMPS TO TERMINATE RHOMBICS

IN A number of contacts with amateurs using rhombic antennas, dissatisfaction with them in many cases was found to arise from termination in 115-volt lamps. A Mazda lamp calculated by Ohm's law at 330 ohms was used for a series of resistance measurements at different power dissipations, and it was found that the resistance of the unheated filament is approximately 60 ohms, less than one-fifth of the heated value.

Thus, many of the installations making use of lamps have actually presented terminating impedances far from the expected values, and have resulted in improper operation of the systems, probably more often than not dissipating disproportionately large parts of the transmitter output, and leading to standing waves on the rhombic and feeders.

Even though lamps are carefully chosen for proper resistance at the working load, keying the carrier results in rapid change of the terminating resistance, and thus in the radiation of the system. This means that satisfactory use of lamps for termination is almost entirely limited to 'phone operation with output power confined to narrow limits. — *L. F. Sherwood, HH4AS.*

A FIXED-POSITION THREE-ELEMENT DIRECTIVE ANTENNA

Expensive three-element rotatable beams are enjoying widespread use on the 14- and 28-Mc. bands, but it doesn't seem to be generally realized that a three-element *fixed* beam can be built for little more than an ordinary half-wave antenna. As a matter of fact, the one that was used at W5CXII for more than six months cost only $2.00 complete, including the 50-foot feed line. Since, by checking back in the log, it was found that about 80 per cent of the contacts with the old half-wave antenna were in one general direction, the logical thing to do was to replace the half-wave with a unidirectional beam of definite gain for that direction.

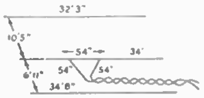

Fig. 606 — The fixed-position three-element directional antenna used by W5CXII.

The elements were made of regular No. 12 antenna wire, and fishpoles were used to separate the elements. A twisted pair made of No. 12 house wire was used to feed the radiator, and a delta match was used between the radiator and the line. The dimensions of the system are shown in Fig. 606. An open line, delta-matched to the radiator, might have had less loss, but would have increased the cost.

Tilting this three-element fixed antenna brought several interesting facts to light. First, with the antenna at a height of ¾-wavelength, tilting the antenna system about 35 degrees above the horizontal seemed to give maximum field strength at distances less than 1200 miles, on 14 Mc. At this distance, tilting usually increased the signal about two S points. The signal seemed to be little affected at a distance of about 1600 miles, but tilting resulted in a decrease in strength at greater distances. Several stations have reported increased signal strength at distant points (greater than 5000 miles) by dipping the beam below the horizontal about five degrees or so, but the writer has been unable to notice this effect with the present set-up.

A duplicate of the beam was used at VP1WB in British Honduras, and he also had excellent results with it. — *Dawkins Espey, W5CXII.*

OPERATING A HALF-WAVE DOUBLET AT THE SECOND HARMONIC

Fig. 607 shows an effective arrangement which we used at W4GNQ for operating a half-wave doublet with low-impedance feed line at the second harmonic. All it requires is the addition of a single-wire feeder, insulated from the antenna and spaced from the low-impedance line by means of standard spacers. At the fundamental, the additional feeder is idle and the system performs in the usual manner as shown at (A). To operate the system at the second harmonic, the two conductors of the low-impedance line are connected together to form one side of an open-wire line as shown at (B). If the line and the added feeder are one-quarter wavelength long, no tuning apparatus will be required. With longer lengths, series or parallel tuning should be used, depending upon the length of the line. — *Eugene Black, W2ESO–ex-W4GNQ.*

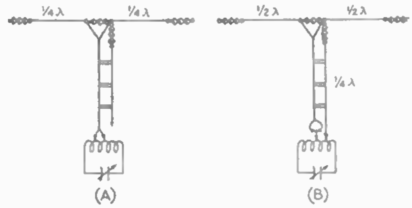

Fig. 607 — Scheme used by W2ESO for working a doublet antenna at the second harmonic. (A) shows the conventional arrangement for use on the fundamental while (B) shows the added feeder for harmonic operation.

TUNING INDICATOR

Those who have low-range d.c. milliammeters but lack r.f. ammeters will find this idea, contributed by Norman Bush, VE3KW, of interest. It uses the aforesaid d.c. meter in combination with a tube and a few spare parts to provide comparative indications of r.f. flowing in the feeders.

The circuit diagram is given in Fig. 608. Note that the filament of the tube (any type which will work on fairly low filament current) is clipped across a short length of feeder. The rectified current, therefore, depends to a considerable extent on the filament temperature as well as upon the difference in r.f. potential between one end of the filament and the diode element consisting of grid and plate tied together. The chokes and by-pass are for the purpose of keeping r.f. out of the meter; VE3KW also found the resistors indicated to be necessary to prevent overheating of the chokes. The arrangement has worked out to be quite a sensitive indicating instrument for tuning purposes.

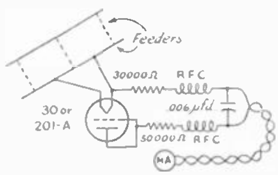

Fig. 608 — An r.f. current indicator using a vacuum-tube rectifier and a d.c. milliammeter. A 0-1 ma. meter will be most sensitive, although larger sizes may be used. With instruments of greater range, a "B" battery may be needed to increase the sensitivity.

The most pronounced change in meter reading for a small change in feeder current will occur when the filament is somewhat below normal operating temperature. The spread between the clips attaching to the feeder preferably should be such that the maximum current will cause the filament to come up to approximately normal temperature. Naturally, the spread will depend upon the type of tube used and the magnitude of the feeder current, and must be determined by experiment.

KINKS IN FEEDING ROTATABLE ANTENNAS FOR CONTINUOUS ROTATION

Many amateurs are in search of some new ideas in feeding rotatable antennas which would permit continuous rotation. These little details usually cause the most head-scratching and brain-racking.

Robert Murray of Long Island City, N. Y., and Winfred Lowe of New Brunswick, N. J., say that it's often hard to avoid wobble in a rotating shaft carrying sliding contacts for feeder connections between the stationary and moving portions of the antenna structure, particularly if the entire mast rotates. The slip-rings and brushes commonly used do not always give satisfactory contact. To overcome this, Mr. Lowe suggests the use of relatively wide disks as the movable contacts which are pinched between pairs of sliding spring contacts as shown in Fig. 609-A. Good contact is provided in spite of reasonable wobble in any direction. The stationary contacts may be made up in the form of laminations of phosphor-bronze strips. Mr. Murray's idea, shown at (B), is essentially the same except that his movable contacts are in the form of wide metal bands with the edges in a vertical plane. He claims that vertical surfaces are less susceptible to accumulations of ice or dirt. Mr. Murray suggests that spring battery clips would make good contacts if the points of the teeth are filed down.

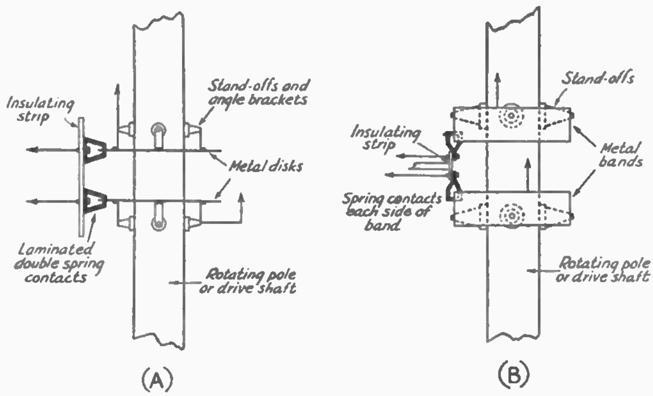

Fig. 609 — New ideas in sliding contacts for rotatable antenna feeder connection to permit continuous rotation. The broad bearing surfaces take care of any wobble in the rotating mast or driving shaft.

W3GHW of Philadelphia avoids the use of any form of sliding contact by mounting a feeder tuning unit on the rotating pole and link-coupling the antenna tank circuit to the transmission line as shown in Fig. 610. Series or parallel tuning will be used depending upon the length of the feeders between the antenna tuning unit and the antenna. The link winding is held in place by supports extended from the ground or a stationary platform. It would seem that the practicability of winding the coils about the pole would be limited to wooden poles of small diameter. The sheltering hood is fastened to the pole so that it rotates with the pole. Feed-through insulators are fitted in the top of the hood and any space between the hood and the pole should be plugged to make the hood water-tight on top.

W9AYH of Louisville has another idea, the chief disadvantage of which is that the idea is applicable to vertical antenna elements only. The antenna-system arrangement is quite similar to that described by W2BSF and W2AJF in *QST* for March, 1938, and is shown in Fig. 611. The antenna remains stationary while the reflector and director rotate about it. Thus the problem of making contact between a stationary line and a rotating antenna does not exist.

The novel feature of the W9AYH design is that the pole itself is of metal pipe and a portion of it is made to serve as the antenna. A one-quarter wavelength "J" matching section is fastened to the pipe three-quarters of a wavelength down from the top; the first half wavelength from the top forms the antenna. Since the bottom of the "J" section is at ground potential, the fact that the pipe mast is set in the ground makes no difference. In fact, good lightning protection is automatically provided. The top end of the "J" section is fastened to the mast with a stand-off insulator to provide rigidity.

The "J" section may be fed with a 600-ohm open line or a low-impedance cable and its length adjusted until standing waves disappear from the line.

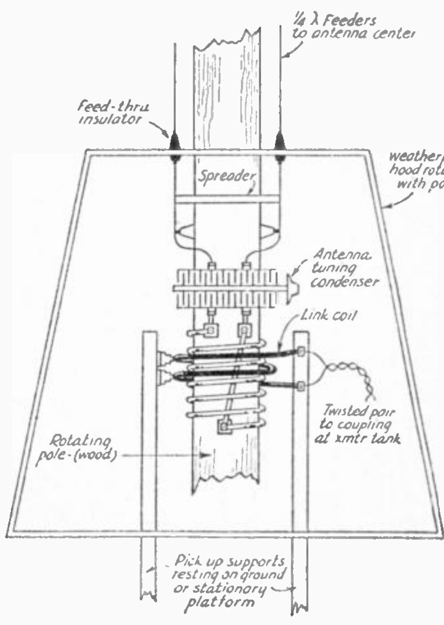

Fig. 610 — One method of transmission line-antenna system coupling which eliminates sliding contacts. The low-impedance line is link-coupled to a tuned line.

The rotating director and reflector are supported by arms fastened to a section of larger-diameter pipe which slides over the mast and is set in bearings at top and bottom.

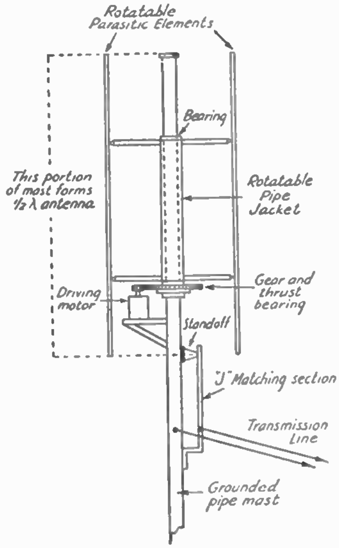

Fig. 611 — **A vertical system in which a portion of the grounded pipe mast forms the stationary antenna, eliminating the necessity for feeding a movable element. The director and reflector rotate about the antenna.**

Henry Riesmeyer of New Kensington, Pa., had an idea which, while it doesn't solve the problem of contact between stationary and rotating members, has interesting possibilities in feeding a low-impedance antenna. A section (or more than one section) of pipe serves as the rotating mast and also as the outer conductor of a concentric transmission line or matching section. A rough idea of the construction is shown in Fig. 612. A second pipe or section of tubing inside the first completes the concentric line. Any type of sliding contact could be used at the base.

If the section is used as a 72-ohm line it may be of any length, but the ratio of *inside* diameter of outer conductor to *outside* diameter of inner conductor should be 3.32:1. A diameter ratio of 3:1 will produce a 66-ohm line. In either case, some matching arrangement will be required between the line and the antenna system. This may consist, for example, of a tuned tank circuit with two links, one going to the line and the other to the center of the antenna.

A similar arrangement may be used as a matching section, provided that the pipes are cut to one-quarter wavelength or some odd multiple of one-quarter wavelength. In this case, the top end of the matching section may be connected directly at the center of the antenna. Assuming an antenna impedance of 15 ohms for a two-element system and a 72-ohm transmission line between transmitter and the lower end of the matching section, the ratio of diameters should be 1.72 to 1. If the impedance at the center of a three-element antenna system is 7 ohms and a 72-ohm transmission line is used, the ratio should be 1.46 to 1. If a 600-ohm line is used instead of the 72-ohm line, the ratios should be 4.87 and 2.95 to 1, respectively, for antenna impedances of 15 and 7 ohms. The problem of support and insulation of the central conductor should not be insurmountable. In all probability, a short tower support fitted with a bearing, would be necessary.

LOW-FREQUENCY ANTENNA FOR EMERGENCIES

A LONG bamboo fishing pole wound with wire makes a very good portable antenna for emergency purposes. It is light in weight, offers little resistance to strong winds and is easily installed in almost any location.

One which works well at 3.5 Mc. has a winding consisting of about 60 feet of No. 18 enameled wire, space-wound over the top 14 feet of the bamboo pole and then close-wound for three feet. The remaining length at the bottom is left free of wire so that the pole may be lashed to a tree or other convenient upright or simply stuck in the ground when no support is available.

The bottom end of the wire is connected through an antenna tuner to ground. Such a radiator seems to be much more effective than one would suppose. One of our stations in Southern California has worked the East Coast on 4-Mc. 'phone with only 40 watts input, while using an antenna of this type. — *Vernon C. Edgar, W6CRF.*

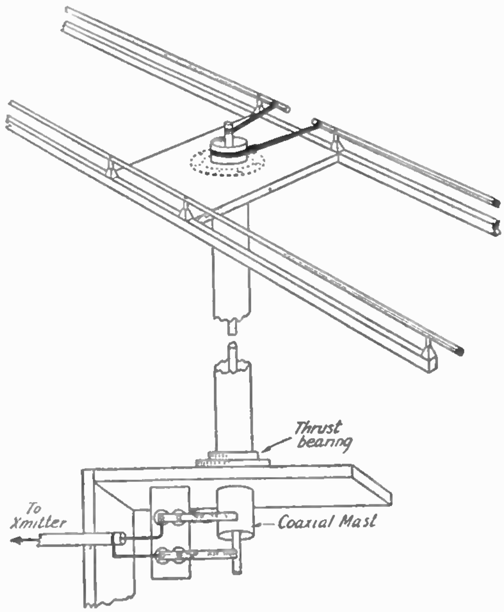

Fig. 612 — **In this mounting scheme the rotating pipe mast serves also as the outer conductor of a concentric transmission line used as a matching section.**

AN INEXPENSIVE 50-FOOT MAST

Back in 1937 I built a 50-foot mast which has withstood weather so well that I feel that constructional details would be of interest to others. The type of construction shown in Fig. 613 has the advantage that the mast is extremely strong, although light enough in weight to make erection easy. Material for the mast should be obtainable for about $10, plus or minus, depending upon where you happen to live in respect to lumber country.

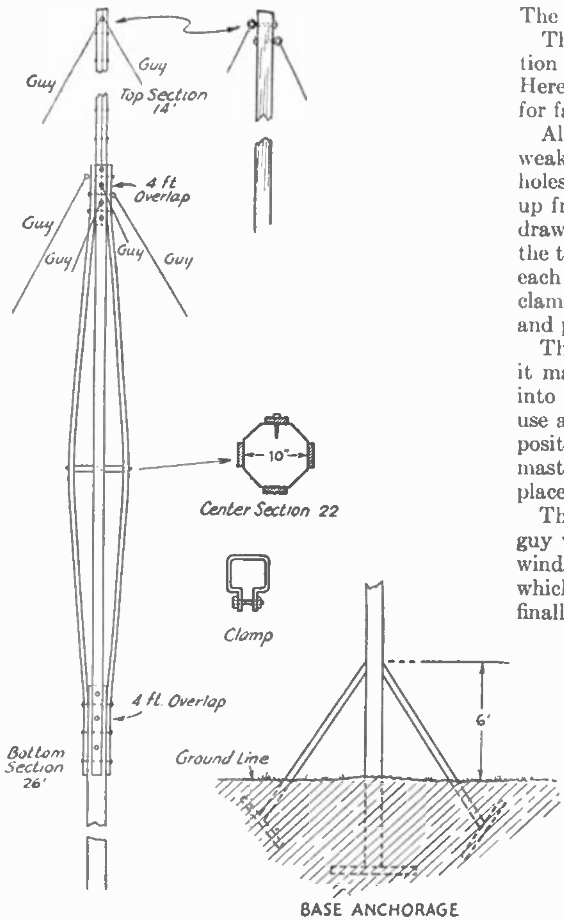

Fig. 613 — W6PGB's 50-foot mast which may be built for about $10. The martingale section at the center combines strength and light weight.

The bottom section is a 26-foot "six by six" of selected Douglas fir. The center section is the part which differs from the usual types of construction. Four 22-foot strips of 1¼ × 3-inch spruce stock are used to form a martingale structure. The four strips are spread at the center by an octagonal piece (or square piece if you don't want to bother to cut off the corners) 2 inches thick and measuring 10 inches across. The strips are fastened to this piece with lag screws.

The top section is made up of two pieces of 1¼ × 3-inch spruce bolted together with ¼-inch bolts. Eye bolts should be used at the top for fastening guy wires and pulleys.

Before assembling, each of the pieces should be given three or four coats of good lead and oil paint. The center section is bolted to the bottom section with ⅜-inch carriage bolts 9 inches long with large malleable iron washers at each end. The sections should overlap 4 feet.

The top section is fastened to the center section in a similar manner with an overlap of 4 feet. Here, also, some of the bolts should be eye bolts for fastening guy wires.

Although it has not been found necessary, weakening of the joints by the drilling of bolt holes could be avoided by the use of clamps made up from heavy iron strap as shown in the detail drawing. Two of these clamps could be used at the top and bottom of each joint, the open end of each clamp facing in a different direction. Similar clamps could be used for fastening the guy wires and pulley.

The mast is sufficiently rigid and light so that it may be assembled on the ground and raised into position in one piece. The easiest way is to use a 20-foot gin pole and pull the mast up into position with block and tackle. After raising, the mast is plumbed up and the bottom braces set in place.

The mast was used for over two years with no guy wires at all and stood up well under severe winds which blew down two "A"-frame towers which had three sets of guy wires. Guys were finally used on this mast to prevent the top from swaying in heavy winds.

I believe it would be practical to extend the height of the mast to 70 feet by the addition of a second martingale section, if desired. The added length would, however, increase the raising difficulties and require an additional set of guys. — *Rex Reinhart, W6PGB.*

A LIGHTWEIGHT HOLLOW MAST

The writer believes that the following description fits the ham's wish for an ideal antenna mast. The pole was erected in 1921 when the writer was ADM of Illinois and is located in Hoopeston, Ill., where up to a few years ago it was still standing, straight and true, though somewhat in need of paint. The cost of materials for the mast, white lead and guy wire was about $10. It was sold for $5 when I left Hoopeston in 1924 and was still standing in 1937, in the yard of the ham who purchased it. Its appearance and life have been so remarkable that I believe I built better than I realized, so I feel that I am really passing along a good and worth-while suggestion.

The principle of the thing is to create a square hollow pole, held together in the fashion of bamboo growth; that is, with a bracing and strengthening section spaced about every 2 feet. The essential details are shown in Fig. 614.

The lower section of the mast is naturally the larger. Its foundation is a good and solid 6 × 6 timber about 6 feet long. The next step is to make a section about 14 to 16 or 18 feet long, depending upon the availability of the lumber which should be good, smooth finish, hard pine, cypress or spruce, depending upon the locality. Needless to say, good grain, free from knots, is desirable. Three pieces (assuming that 18-foot stock is available) are laid out. There will be two sides 6 inches by 18 feet long of ¾-inch or ⅞-inch stock, and the third will overlap on the edges so that it will be 8 inches × 18 feet × ¾ inch or ⅞ inch. Insert the "six by six" about two feet into the U formed by the three pieces above mentioned. After lining up so that all edges are flush, commence to fasten together with nails, or preferably iron screws with flat heads, not forgetting to paint thoroughly every edge with a nice thick mixture of white lead and linseed oil.

Having completed this step we should have a U section of mast 8 × 6 inches, 18 feet long with a 4-foot section of "six by six" as a base, which later will be embedded in concrete when we are finally erecting the mast. The next operation is to put in the braces every two feet. These are 6 × 6 × 1 inch thick. These should be put in with white lead between wood surfaces and thoroughly fastened with screws or finishing nails. At the open end of the U we leave 18 inches for insertion of the next section of the mast, which telescopes into the base section. Give the inside a thorough coat of white lead and linseed oil about the consistency of glue and let dry for a week or so. The cover for this section of the U is another piece ¾ × 8 inches, 18 feet long which is screwed down after the second coat of white lead and linseed oil is dry. Any irregularities in the lumber and joints should be smoothed down with a plane.

The second and third sections of the mast are constructed in a fashion similar to that of the base, except that they are progressively smaller and that there is no need for a solid inner base section in the upper sections of the mast. We can see that the second section should have outside dimensions of 6 × 6 inches to telescope inside the base section and that the third section will be 4 × 4 inches to telescope into the second and that the top section is a solid piece 2 × 2 inches of say 12 to 20 feet length. Our sky hook will be in the vicinity of 50 to 60 feet high, depending upon the length of lumber available.

If a 50-footer is all that is desired, an attempt should be made to obtain 18-foot lumber for all sections. The third section should be capped or plugged, instead of being filled, with a section of timber 2 × 2 inches, 20 feet long (hardwood imperative). For three sections, which just about approach 50 feet altitude, the mast will be solid as a telephone pole and can be climbed with safety even if you are a 200-pounder. With the top section made of 2 × 2 inch lumber, it can be climbed by lighter men, but it is slightly "whippy" because only four guys are used, one in each of the points of the compass to take the strain off the antenna.

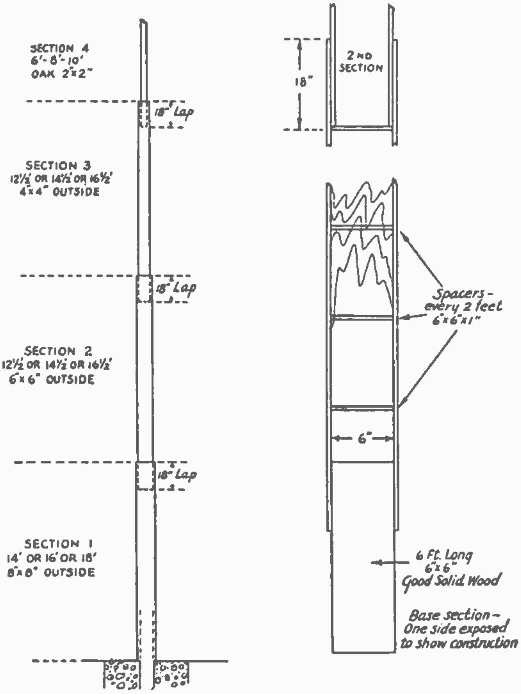

Fig. 614 — **Light in weight but strong is this novel mast of hollow construction.**

Let me add that the care in making the joints and keeping everything square and shipshape will pay when the sections are bolted together. Also it is very important to put white lead between the surfaces wherever wood joins wood. On top of this caution one should give it at least two coats of white lead and linseed oil. It will take a good deal of white lead but it will be money well spent.

It was found that the availability of two or more sturdy wooden saw-horses greatly aided in the mast construction. Also, these same horses were used in the painting of the mast, following its assembly. A level area was cleared and the mast laid out with three horses supporting its length. It then was easy to paint the mast without danger of smearing the job before it was dry.

Following the painting but during the long period of waiting for the paint and lead to dry, the guy wires were rigged and the pulley and halyard installed.

Erection of this mast is child's play for a fellow who can "tote" a man's share. About three huskies are all that are needed for pure "pusha-pusha" under a pair of "two by fours" bolted together like a pair of scissors. A hole is first dug for the base of the mast about 4 feet deep and with enough space around it to pour some good "grout" concrete. In the direction in which the mast lies, a slanting runway about the width of the mast and as deep as the bottom of the pit where it is finally to rest should be dug. The 6 × 6 inch butt is eased down this runway to the bottom of the pit which throws the top of the mast to about a 15 to 20 degree angle. Then the three huskies put the "two by four" scissors-like piece under the second section of the mast and "Heave ho! my hearties." The hardest part about building this mast is waiting for the white lead and linseed to dry. After two coats inside and out and roundabout, you will find it in your coffee and your pajamas and other unexpected places, but fifteen years later it will have been about forgotten.

The complete list of material required is given below:

1st Section

1 — 6″ × 6″ × 6′
2 — 6″ × 18′ × ⅞″
2 — 8″ × 18′ × ⅞″
7 — Spacers 6″ × 6″ × 1″

2nd Section

2 — 4″ × 18′ × ⅞″
2 — 6″ × 18′ × ⅞″
8 — Spacers 4″ × 4″ × 1″

3rd Section

2 — 2″ × 18′ × ⅞″
2 — 4″ × 18′ × ⅞″
8 — Spacers 2″ × 2″ × 1″

Top Section

1 — 2″ × 2″ × 20′ — oak
1 — Pulley (Brass or bronze) (See p. 78)
1 — (Necessary length) Manila rope
4 — Guys (necessary length) No. 8 galvanized iron wire
Strain insulators. — *Nathaniel C. Smith, W2GZU-W9UJ.*

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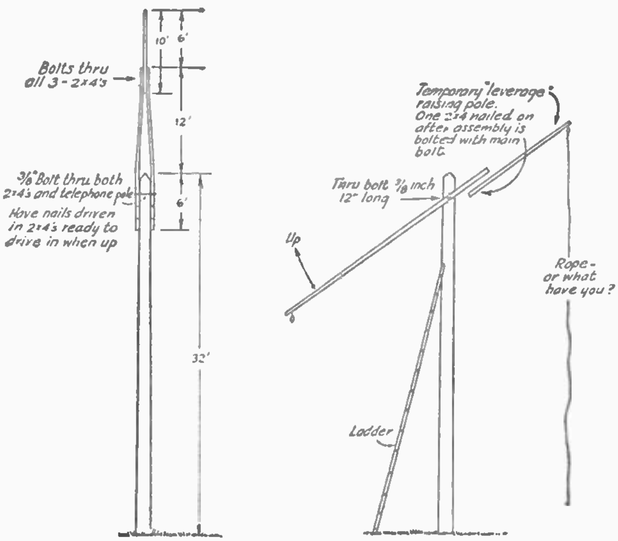

Fig. 615 — This type may be carried to a height of fifty feet or more. No guy wires are required.

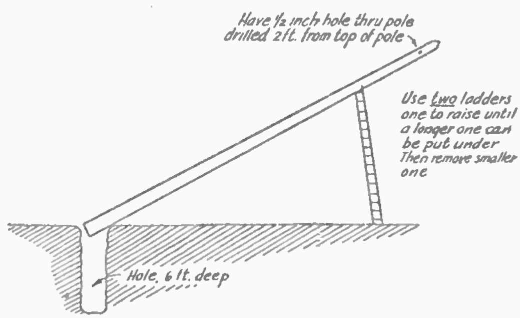

Fig. 616 — The telephone pole is raised by means of one or more ladders, as shown. A trench or slot, dug outward from the hole towards the direction of the ladder, will aid in handling the pole in the early stages of its upward progress.

A FIFTY-FOOTER USING NO GUY WIRES

THE mast here at W9LM was put up at a cost of no more than $8.

Only four persons were needed to put it up and no guy wires were used. It has stood four years through some strong winds, too. The drawings of Figs. 615 and 616 will help to make the details clear.

A used telephone pole was purchased and delivered for $5. That wasn't a special discount either. It was 38 feet long. A hole 6 feet deep was dug for it. This left about 32 feet above ground. About 2 feet from the top of the pole a half-inch hole was bored. The raising was done by hand until a ladder could be placed under it. Two ladders were used. After the pole was raised with a short ladder (about 12 feet long), another one about 20 feet was used to raise it up all the way.

The top section was assembled on the ground. Three "two by fours" were needed, two 18 feet long and one 10 feet long. The 10-foot section was placed between the two others and bolted in place so that the total length was 24 feet. The assembly also required a half-inch hole to receive the main bolt which is ⅜-inch diameter, about 12 to 14 inches long. This half-inch hole was drilled about 5 feet from the ends of the two long pieces. The long pieces were spread so that the "two by fours" would go on each side of the telephone pole, and the long bolt inserted. Three or four nails were driven in one side of one long length to nail it on the telephone pole when it is up straight.

In order to obtain leverage to swing this top part into an upright position, a temporary piece of "two by four" was nailed to the other long piece on one side. A rope was fastened on the end so that someone on the ground could swing the whole top section up in the air. This temporary raising apparatus should be in good condition to prevent the thing from coming back down with a bang. — *C. Falstrom, W9LM.*

AN EASY WAY TO RAISE A MAST

SINCE assistance in mast raising is often lacking, others might like to know how a 60-foot pole was raised at W6QXK by one person, *unassisted*. The general method, discovered by accident, is so simple that it has probably been used in many instances, but perhaps some may not have thought of it.

It was discovered when an attempt was being made to raise a 37-foot pole by sliding it up a 10-foot stepladder, top first, so that the pole would be in such a position that it could be pulled upright with a guy. The center of gravity had already passed the top of the ladder, creating the problem of keeping the base down while continuing to slide the pole over the top of the ladder without too much friction. The eventual result of this was that the pole got away and the bottom shot up as the pole pivoted on the top of the ladder. When the pole finally hit the ground, the top was on the ground and the bottom was sticking up in the air. The halyard had tangled around the bottom of the pole and the end was hanging down far enough to be reached. By merely pulling the base down with this rope, the pole was pivoted into the desired position using the ladder as a fulcrum, making it an easy matter to pull the pole erect with a guy. This pole was made of sections of "two by three" and, though it creaked some and bent considerably, it did not break from its own weight.

This job was so easy that it was thought that, with a fulcrum twice as high, a pole twice as tall could be raised in the same manner. Of course the strain on the mast at the fulcrum would be much greater for a taller pole. In order to see if a 60-foot pole made of the same material could be raised without breaking, the strain was calculated using the density of wood as 40 pounds per cubic foot (actually about 35, but it is best to have lots of safety). This strain for the 40-foot length, which would project beyond the 20-foot fulcrum came out to be about 1500 lb.-wt.-feet. This

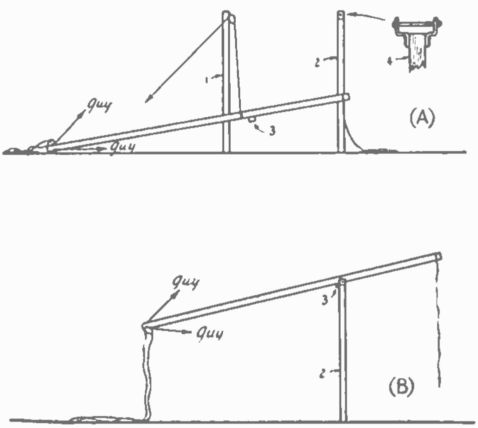

Fig. 617 — W6QXK raised a 60-foot mast without assistance by a leverage arrangement. A shows how the butt end of the mast is hoisted to the top of the fulcrum. B shows the mast partially hoisted into place.

was applied to a small section of "two by three" (150-lb. boy 10 feet from fulcrum). The result showed that some sort of bracing was necessary. Since there were many odd pieces of lumber available, it was decided that the pole should be made strong enough around the point of support so that it would not break of its own weight. This was accomplished by adding lengths of "two by three" and "two by two" as bracing until the pole was strong enough. The strength was tested with each additional bracing by hanging the pole on a short stepladder at the desired point of support. To be strong enough to support its own weight the pole had to have the thickness of three sticks around the point of support and two sticks halfway up and one stick at the top.

After painting the pole and bracing the joints with bands of No. 12 galvanized wire, the guy wires were put on. Three guy posts were used, each with three wires. One set of wires was 25 feet from the ground, the next 40 feet, and the top set was fastened at the end of the pole. The guys were No. 12 galvanized wire, broken every 12 feet with insulators. The guy posts were each 30 feet from the base of the pole. The length of the wires was calculated fairly closely so that there would not be too much slack while the pole was being raised. The fulcrum was a 20-foot "four by five." The top of this fulcrum was fitted with an arrangement something like that shown at (4) Fig. 617-A. In this particular case, a double roller-skate wheel with a guide made of "one by two" was nailed to the top of the fulcrum, to allow the pole to slide as easily as possible. To prevent the pole from sliding too far when being raised, a chock was nailed to the pole at the desired pivot point, 21 feet from the base (see (3) Fig. 617-B.) The fulcrum was raised 6 feet from the peg which marked the desired position of the base. This peg was sunk about 3 feet into the ground and protruded above the ground another foot. It was essential to the raising of the pole.

Now came the biggest problem of all — that of how to get the base of the pole onto the top of the fulcrum. The pole was quite heavy and, in spite of the thickness around the fulcrum, quite limber. Another factor was that the pole was very apt to break near the top, where there was only a single "two by three," if it were supported only at its two ends. These problems were solved by erecting another 20-foot "four by five," about 12 feet from the fulcrum in line with the fulcrum, peg and guy post. This "crane" had a pulley arrangement with the pole as shown at (1), Fig. 617-A. To raise the pole to the fulcrum, it was hoisted slowly by the pulley arrangement. As it was being raised, the top end was braced with a 4-foot stepladder which was constantly moved back to keep the pole fairly straight. When the end was brought near the top of the fulcrum, it was guided with a 20-foot piece of "two by two."

After the end was securely on top, the pole was pushed from the far end until the hoisting pulley on the pole was even with the fulcrum. The hoisting rope was pulled through the pulley with the aid of a long stick. When this operation was completed, the pole was pushed the rest of the way until the chock hit the skate wheel. The lifting crane was now taken out of the way, and two sets of guy wires were tied off. Then the base of the pole was pulled down toward the base peg. Because of uneven ground, the base hit about 2 feet from where it was intended, but it was lashed firmly in place with a rope around the peg. All that was left was to pull the pole into place with the unfastened set of guys. By fastening a long rope to the top guy and another to the middle one and getting off about 50 feet or so, the pole was pulled up with very little difficulty. After the pole was straightened a bit, the base was moved over to the peg by merely lifting and pushing.

The only equipment needed to raise poles up to about 40 feet by this scheme is a 10-foot stepladder. — *Bill Snyder, W6QXK.*

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MAST-RAISING KINK

In the various mast-raising schemes suggested from time to time, we often see a ladder put to use, usually as a sort of gin pole. In erecting a mast of moderate height made of light material, such as the popular "A"-type mast made of "two by two," the ladder often can be used to advantage in the manner shown in Fig. 618. Here the

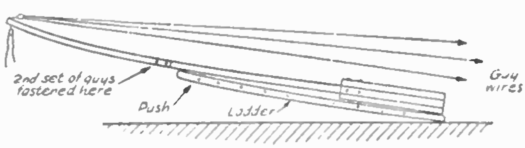

Fig. 618 — **This is how W2JAW uses a ladder to brace a light mast while it is being erected.**

ladder is used to prop up the mast to keep it from bending to the breaking point when it is pulled up with the guy wires. The ladder, rather than the mast itself is "ginned" up. Of course, careful timing between those handling the gin pole and those pulling on the guy wires is required, but I have put up a 50-foot stick in half an hour without any trouble. It is essential that the part extending beyond the ladder be kept bent up by proper tension of the guys. — *Robert Hidley, W2JAW.*

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FEEDER TUNING

Fig. 619 shows a rearrangement of the usual series-parallel feeder-tuning system which will often help when it is found that the parallel condenser doesn't have quite enough spacing and arcs over.

With the antenna coil plugged in at *A*, we have the usual circuit which is still used for series tuning. When the antenna coil is plugged in at *B*, however, the series condensers are now connected in series with the parallel condenser to decrease the voltage across the latter. The extent of the reduction in voltage across the parallel condenser will depend upon the setting of the series condensers. When each of their capacities is the same as that of the parallal condenser, the total voltage across the coil will divide equally, so that only one third of the voltage will appear across the parallel condenser.

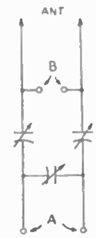

Fig. 619 — **W3FEG's arrangement for feeder tuning. Series tuning is obtained with the antenna coil plugged in at *A*, and parallel tuning with the coil plugged in at *B*.**

Of course, it may not be possible to reduce the voltage to this extent, because the series condensers usually have smaller spacing than the parallel condenser and, therefore, will arc over more readily. Nevertheless, many cases will be found where the reduction is sufficient to make operation possible without buying a higher-voltage condenser.

In practice, it is usually possible to find a fixed setting for the series condensers for each band, so that all tuning may be done with the parallel condenser once the series condensers have been set. — *Edward R. Hill, W3FEG.*

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DRIP WIRES FOR ANTENNA FEEDERS

When antenna feeders approach the window at a fairly low angle, rain has a tendency to follow the wires to the lead-through insulators before dripping off. Unless the joints are waterproofed, the rain may even penetrate the feed-through. In winter this results in a pile of ice on the window sill and around the lead-through insulators. The feeders of my station enter the top of the window through insulators at such an angle that the wires carry a lot of water to the window where it drips down onto the window sill and splashes badly against the glass.

To remedy this, I made drip wires as shown in Fig. 620. They consist of short pieces of copper wire

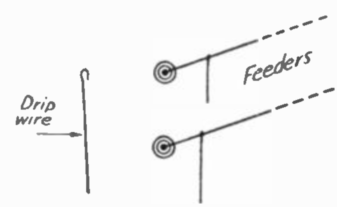

Fig. 620 — **A method for preventing rain from dripping off feed-through insulators.**

pinched on the feeders a short distance out from the window. These "drip wires" drain off all the water that runs down along the feeders, eliminating the nuisance of water dripping on the window sill as well as ice formation in the winter. — *Robert E. Foltz, W9GBT.*

INFORMATION ON PULLEYS

Nearly every person interested in radio is confronted, at some time, with the problem of the type of pulley best suited to antenna erection. In most antenna installations the pulley is so situated that it remains for weeks exposed to all weather conditions. In many cases the halyard remains in one position and failure to exercise the pulley results in "freezing." The results of tests with five common types should prove valuable to many readers. We are indebted to D. Reginald Tibbets, W6ITH, for this data compiled before World War II.

The five pulleys, all placed in use under the same conditions, were:

1) Ordinary cheap galvanized iron awning pulley; cost, 10¢.
2) Better grade galvanized iron with bronze shaft; cost, 25¢.
3) Bronze awning pulley, boat supply; cost, 65¢.
4) Hardwood block with steel shaft; cost, 90¢.
5) Hardwood block with bronze roller bearing shaft; cost, $1.50.

(Note. — All prices prewar.)

After several months of use, winter and spring, the test yielded the following comparison of the different types:

1) This pulley was completely out of operation. It had "frozen" within two months.
2) This pulley could be turned, but corrosion which had taken place on the inside face of the pulley caused binding.
3) The bronze awning pulley could be turned, but it showed some stiffness as a result of corrosion. This type was considered to be a satisfactory one for the purpose, if cleaned periodically; however, the usual inaccessible position of the antenna pulley makes this impractical.
4) The hardwood block pulley with steel shaft was inoperative, owing to rusting of the steel shaft which caused the latter to "freeze" in the block bearings.
5) The fifth type, hardwood block with bronze roller-bearing shaft, was found best suited to this use. Operation of the pulley under test compared favorably with that of a new one of the same type.

REPLACING THE ANTENNA HALYARD

Several suggestions have been made from time to time on replacing the pulley on the antenna mast when the halyard breaks. One of the most popular schemes is to rig up a new pulley and halyard and fasten the pulley to a loop of wire or a band of strap iron which may be slipped over the top of the mast or, if no obstructions exist, may be bent around the mast and slipped up to the top.

Quite frequently, however, when the loop is made large enough to slide up or down the pole readily, there is nothing to hold it in position when the desired point is reached. The sketch of Fig. 621 shows a scheme which VE4KN has used successfully to overcome this difficulty. The loop is fitted with a triangular steel spur which pierces the mast and prevents the pulley from sliding down. If it becomes necessary to replace the halyard again, the spur may be released by an upward push with a stick.

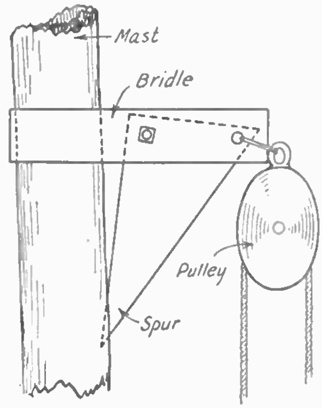

Fig. 621 — Spur suggested by VE4KN to prevent the replacement pulley from sliding down the mast.

SUBSTITUTE FOR ANTENNA PULLEYS

We recently ran across a suggestion made by the late Fred Sutter which was typical of his desire to simplify ham radio.

Knowing the difficulty with which broken antenna halyards are replaced in the usual pulley at the top of the mast, he asked, "Why use a pulley?" A rope rides about as easily over the gadget shown in Fig. 622 as it does through a pulley with the usual antenna load. If the rope breaks, there is a fair chance that a fellow with a good arm can succeed in throwing a weighted line up over the top of the mast, after a little practice. The line can be used to haul the new halyards into place.

If a strong arm is lacking, a kite or balloon with a light line may be flown near the top of the mast and maneuvered into a position which will permit dropping the line into the yoke.

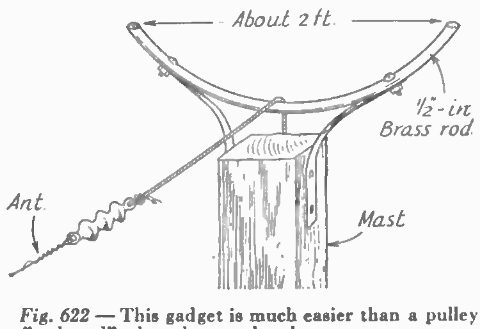

Fig. 622 — This gadget is much easier than a pulley to "rethread" when the rope breaks.

SCHEMES FOR REPLACING BROKEN ANTENNA HALYARDS ON MASTS

This problem is almost as old as amateur radio itself. If you have been wondering how to replace that broken halyard on your 60-footer without risking your neck, at least one of these solutions should make it easy. If you don't have such a problem at the present time, it would be a good idea to save this dope for a rainy day. The scheme which will best fit your particular problem will depend upon location and construction of the mast, surrounding objects and the material to which you may have access.

In most cases, it will be a much simpler job to replace the old pulley rather than to attempt to thread new rope through the old pulley, although this may often be done without great difficulty. Several schemes make use of the top guy wires in coaxing a new pulley, fitted with a new halyard, to the top of the mast. If you have a second mast or can make use of a tree or housetop or temporarily erected support, the scheme shown in Fig. 623-A is probably one of the easiest to execute. One of the top guys is set free. The new pulley with halyard is fitted with a heavy metal ring or a loop of several turns of heavy wire and the loose end of the guy wire is passed through this loop. The loop should be large enough to pass easily over the guy-wire insulators. A light cord is tied to the loop and the free end of the guy wire is tied to the halyard from the second support, hoisted up and pulled tight. It should then be possible to make the loop slide along the guy wire towards the top of the mast by shaking the new halyard and pulling on the assister cord from a distance. In some cases, it may be possible to coax the loop up over the top of the mast if one has sufficient patience and the top guys are not fastened too far from the top of the mast, although this isn't necessary. When the loop has been worked up close to the mast, it may be held there by the assister cord while the guy wire is lowered. While holding the free end of the guy wire, several turns about the mast should be made by walking around the mast outside all other guys. This will bind the loop securely to the mast. A sharp yank will break the assister cord after the job is finished.

Another scheme which may be tried is shown in Fig. 623-B. A loop of wire, as previously described, is passed around the rear top guy wire. If the loop is covered with tape or a section of old bicycle tire or garden hose, it may slide more readily on the guy wire. The new halyard and the halyard from the second support are tied together and a large slip-knot is tied in the other side of the new halyard to prevent the new halyard from running through the pulley when it is pulled up the guy. Alternatively, the two ends of the new halyard may be tied together and then tied to the halyard from the second support. An assister cord tied to the wire loop might be helpful in getting the loop over insulators; shaking the guy wire should also help. When the pulley reaches the top of the mast, the guy wire is wrapped around the top of the mast as previously described. A sharp yank on the free end of the new halyard will take the slip-knot out. It might be a good idea to tie some sort of weight between the two halyards to make sure that they will fall to the ground when released.

If you can't make use of a second support, there are other ways of doing the job. Take, for example, the idea shown in Fig. 623-C. Pass a heavy rope around the outside of all top guy wires.

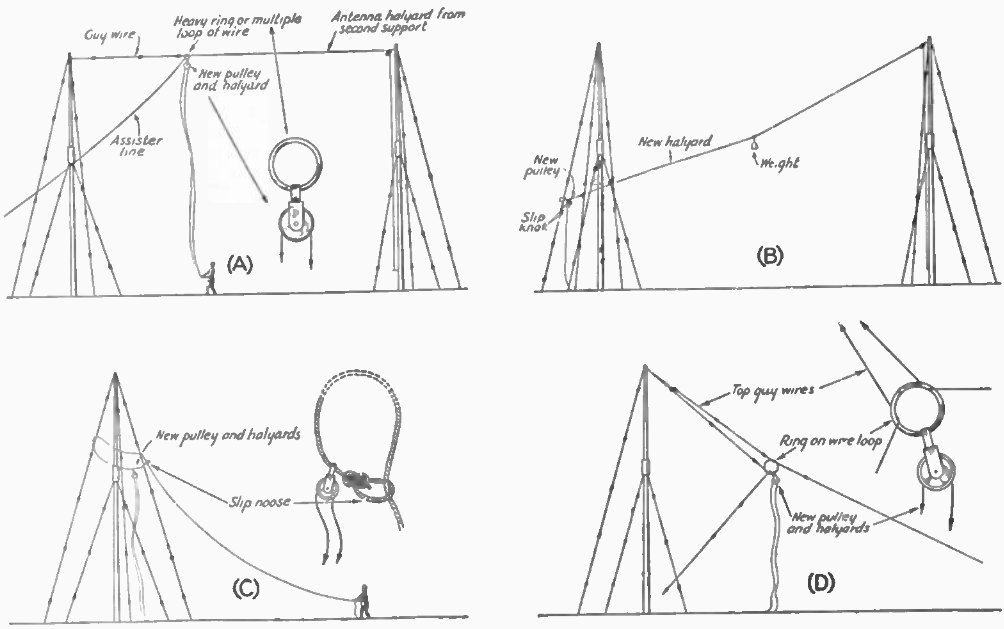

Fig. 623 — Various schemes for replacing broken antenna halyards.

Then pass the rope through the eye of the new pulley fitted with the new halyard and form a slip noose. By shaking and pulling the rope, it should be possible to work the loop up the guy wires to the top. Best results will be obtained by working the rope at a fairly good distance. If the loop becomes caught on an insulator, a friend can assist by sliding the pulley along the loop to a point near the insulator and whipping the halyard. When the noose reaches the top of the mast, its rope should be made fast to the base of the antenna.

In the scheme shown in Fig. 623-D, the ring to which the new pulley is attached should be as smooth as possible and fairly heavy. Two top guys are loosened and the ends are passed through the ring. By pulling the guy wires in as nearly opposite directions as possible, the ring will be forced towards the top of the mast. Temporary extension of each guy wire will make the job easier and some whipping or shaking may be required to get the ring over the insulators. The ring is fastened to the top of the mast by making a few turns with each guy about the top of the mast as previously described.

If you don't wish to disturb the guy wires, one of the schemes shown in Fig. 624 may be used. At (A), a series of light sticks is used to push a loop wire insulators. These loops should be spaced about every 3 or 4 feet. Lines or cords about 3 feet long carrying weights are attached near the top end of each section. These are to hold the stick steady on the top side of the guy wire. As the assembly is pushed up along the guy wire, additional sections are added, splicing them together with wire so that there is very little play between sections. When the loop has been maneuvered into a proper position, a sharp pull on the halyard will break the holding cord and bring the loop down over the top of the mast. Another pull on the sticks should pull out the staples holding the loop to the sticks and the pusher may then be removed and disassembled.

Sometimes the top guy wires are fastened some distance down on the mast so that it would be impossible to pass the loop over the top of the mast by this scheme. In this case, another idea may be used. It is shown in Fig. 624-B. The loop carrying the pulley is stapled to the top of a light stick. A guide loop is passed around one of the top guy wires and fastened to the stick a few feet from the top end. As the stick is raised, additional sections are spliced on rigidly. Providing sufficient distance has been left between the pulley loop and the guide loop, the pulley loop may eventually be lifted above the top of the mast and lowered over

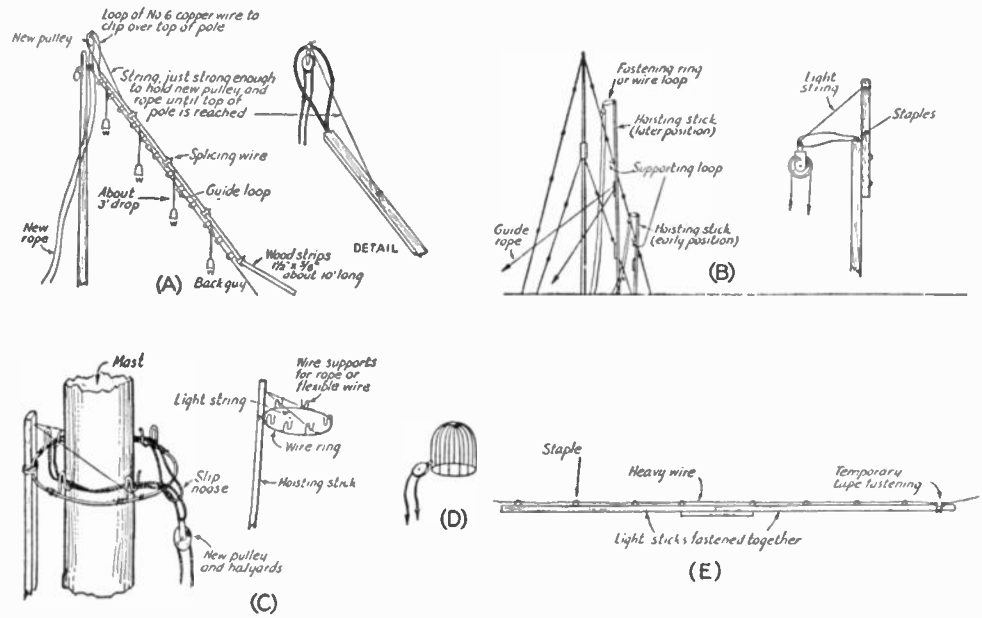

Fig. 624 — Additional ideas for replacing broken antenna halyards.

carrying the new pulley up along one of the top guy wires. The loop should be large enough to pass easily over the top of the pole. The side of the loop opposite the pulley is stapled to the end of the first stick and the loop is held in an approximately vertical position by means of a piece of light string. Each section of stick is fitted with loops of wire passing around the guy wire, the loops of sufficient size to pass easily over the guy-

it. If the weight of the halyard is too great for the strength of the hoisting stick, light cord may be substituted temporarily during the hoisting process and replaced with the halyard when the pulley is in place. Guide cords attached at points along the stick and operated by a friend may help to keep the stick from buckling and to maneuver the loop over the end of the pole. It may help some in getting over the insulators to release the guy wire and bring it into a more nearly vertical position near the mast. If the diameter of the pole does not vary too greatly between top and bottom, a similar series of sticks might be fitted with larger guide loops encircling the mast itself instead of the guy wire.

The details of a scheme which may be used where no guy wires or only a set of guys at the top of the mast interfere are shown in Fig. 624-C. A stiff ring which encircles the mast is fitted with a series of wire hooks bent as shown in the drawing. This ring is attached to a section of light stick by means of staples or light cord. A slip-noose of heavy rope or flexible wire to which the pulley is fastened rests above the ring supported by the wire hooks. Braces made of string keep the loop or ring at right angles to the hoisting stick. The ring with the noose is then pushed up the pole, adding sections of stick as required. If the stick starts to bend, it may be supported by attaching additional loops of wire at points along the stick. When the loop has been pushed to the top of the mast, a jerk on the halyard will tighten the noose about the pole and then the hoisting stick may be lowered. Should the noose have a tendency to loosen up and slide down the pole, this may be prevented by soaking the noose in varnish or some other adhesive which will bind the noose to the mast when it dries.

We think you'll agree that the risk of climbing to the top of a 50- or 60-foot pole is not only unnecessary but extremely hazardous. If you don't agree you might read the following letter on the subject, written by Douglas A. Parsonage of Grimsby, Ont.

"Don't climb the mast. I had a 65-footer with three sets of guys and I had the same difficulty with the halyards. I climbed my mast but came down a lot faster than I went up. When I reached the top, one of the top guys broke and I and the mast came down. It gave me a nice vacation of three weeks in the hospital with a spinal fracture. So, as the 'Voice of Experience,' I say, '*Don't climb it. Do anything else, but don't climb it.*'"

PUTTING THE ANTENNA BACK ON THE POLE

If an antenna halyard breaks, or if the pulley fastening breaks, the unfortunate ham is usually confronted with a big problem. At VE5DG, with the ground frozen and all the rigging fallen to the ground, prospects looked none too pleasant to the operator upon his return after a long absence. The poles were too tall and slender to be climbed, and the condition of the ground was added to the usual obstacles against taking down the poles. Suggestions from sympathetic friends ranged from kites to monkeys trained for such jobs, but none of these was considered practical.

After much searching a method for replacement of the rigging was found. With the necessary materials gathered together at a pole, less than twenty minutes were required for the complete operation.

A few 1 × 2 inch pieces of wood are used to carry rigging to the top of the pole. A hole is bored through the upper end of the first piece, and through it is passed a short length of stiff wire which is then bent to form a loose circle about the

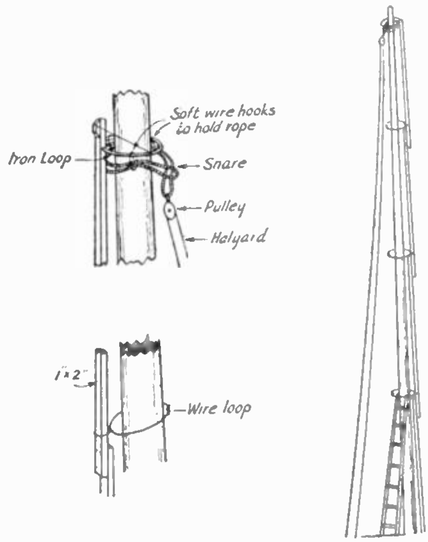

Fig. 625 — Details of the method used by VE5DG for replacing antenna pulley and halyard.

lower portion of the pole. Three hooks bent from soft copper wire and suspended from this hoop support a slip rope snare in which is placed the new pulley. Short pieces of wire are tied between the stiff wire hoop and a point on the stick a few inches above it, to carry the weight of the slip noose and insure that the hoop remains horizontal throughout the climb to the top of the antenna pole.

This assembly is then pushed up the pole by a member of the crew on a long ladder leaned against the pole, and the top of a second piece is then nailed to the bottom of the first. At this joint is fastened a second loop of wire around the pole, and the operation is repeated.

A sketch of the arrangement of the rigging at the top of the first stick is shown in Fig. 625. The completed assembly raised to the top of the pole also is diagrammed.

The tackle is sent up the pole "one by two" length, ladder high, at each step in the process. Particular care is exercised to prevent enthusiasm from allowing the loop to be pushed past the top of the pole. As insurance against such a calamity, it is desirable that someone view the closing operations from a point some distance from the bottom of the pole, since it is possible to be deceived by viewing the top of the pole from directly beneath.

When the top loop has reached the proper point near the top of the pole, a pull simultaneously applied to the two ends of the rope through the pulley is used to straighten out the soft wire hooks supporting the noose, and to tighten the noose on the top of the pole.

When the pulley is in place at the top of the pole, the sticks are lowered in steps and taken apart, and are then ready for similar use elsewhere by another unlucky ham.

Although the pole on which this method was used is unguyed, it may readily be applied to guyed systems as well. The top guys provide insurance against overrunning the top of the pole. On a calm day the intermediate guys may be unfastened from the stakes (if the pole is reasonably rigid) and pulled tight down to the base of the pole while the new rigging is run up. — *William Lowry, VE5DG.*

PREVENTING TANGLING OF OPEN-WIRE FEEDERS UNDER ROTATION

Harold Ulmer, W6EPM, describes a device he worked out to prevent tangling of the feeder wires as the antenna is rotated. A sketch is shown in Fig. 626. An iron bracket made from a piece of ¼ × 2 inch strip is fastened to the pole with lag screws. This bracket is about 9 inches long on each side. A U-shaped piece of the same material is loosely bolted to the outer end of the bracket to form a joint permitting

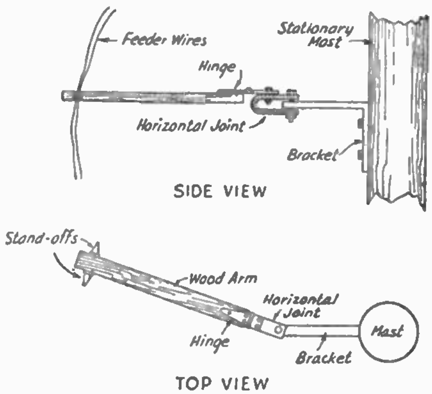

Fig. 626 — Sketch of the arrangement used by W6EPM to prevent tangling of open-wire feeders when used with a rotatable antenna.

horizontal motion. One side of a large hinge is bolted to the U-shaped piece, and to the other end a 3½-foot length of "one by four" is fastened. This arm is fitted with a pair of stand-off insulators to which the feeders are attached. The bracket is fastened about halfway up the antenna mast.

Now, as the antenna is rotated, the arm will swing around the mast to the point where the arm is stopped by the mast. When the antenna is turned the last few degrees to complete the rotation the hinge comes into play. The arm rises in an upward direction, which serves to release any strain which may be imposed on the antenna feeders.

INSULATED MOUNTING FOR ROTATABLE ANTENNA ELEMENTS

For those fellows making rotary beams and using ¾-inch or 1-inch diameter tubing for elements, here is a suggestion for providing support that is stronger than the use of stand-off insulators. This idea is shown in Fig. 627.

The hose clamp (stainless steel strap that fits around tubing) can be obtained from the Wittek

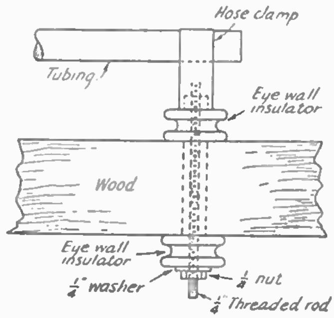

Fig. 627 — A substitute for stand-off insulators in supporting rotatable antenna elements which provides a mounting of greater mechanical strength.

Manufacturing Co. in Chicago at a cost of five cents each. Order them without the wing bolt, style No. 3. [Note. — Prewar price and type number.]

The porcelain-eye wall insulators sell for about two cents each at most radio supply houses. Remove the galvanized screw with a heavy screwdriver.

The porcelain tubes cost about 2½ cents for 6-inch lengths. Nick each of them with a file and insert in the wood framework (5⁄16-inch diameter hole) then break. You will get a clean square break this way and it's a lot easier than sawing. It is a good plan to boil the porcelain tubes in paraffin unless they are of the glazed type.

A threaded rod ¼ inch in diameter completes the assembly with a standard ¼-inch washer and ¼-inch square nut which may be obtained at any hardware store. The length of threaded rod depends on the thickness of the wood.

This procedure results in a good substantial mounting, well insulated and a lot stronger than stand-offs. — *Edward E. Schultz, Jr., W9UHA.*

TENSION FOR BUILDING SPACED FEEDERS

It is always a headache to pull up a pair of long wires and to hold them even in length and in tension when building spaced feeders. I have hitched one end of the wires to a solid support and the other end to the front bumper of the family car. By backing the car slowly, the wires can be pulled tight and even. When they look about right, the brake is set. The line is then ready for attaching the spreaders. If you're inclined to have a heavy toe on the gas pedal, however, take it easy. — *Owen Shepherd, Jr., W1IJ.*

PROTECTION AGAINST DAMAGE BY LIGHTNING

This hint deals with practical systems providing protection to the ham station and adjacent property against damage by lightning. We haven't much of an idea as to how many amateur installations are struck by lightning in the course of a year, but if the number is small, it is probably due to good luck more than anything else since protection is one of the last things the average ham considers. It is a rather absurd situation since a few simple precautions will render the installation impervious to almost anything except a direct stroke of the antenna and will also reduce the probability of even this.

The usual radio antenna will not survive a direct stroke. The current in some cases may be as high as 200,000 amperes which usually results in melting of the antenna wire and the creation of some other path to ground. Fortunately, however, direct strokes are comparatively rare except in unusually exposed locations. Indirect strokes are more frequent and are capable of doing serious damage unless precautions are taken. If an antenna is connected to a good ground, the danger of a stroke in the immediate vicinity of the antenna is considerably reduced. The charge between a cloud and the antenna is drawn off as rapidly as it is developed and only when the charge develops more rapidly than it can be discharged through the resistance of the antenna and ground system will there be great danger of a direct stroke.

Several methods of antenna grounding are suggested. The use of a grounding switch is obvious, but is not automatic and the operator often forgets or neglects to close the switch upon closing the station down. A direct ground connection also will take care of snow-static discharges which are often bothersome in northern latitudes. An arrangement which permits permanent grounding of the antenna system is shown in Fig. 628. The feeders are connected directly to ground through r.f. chokes. Balanced antenna systems

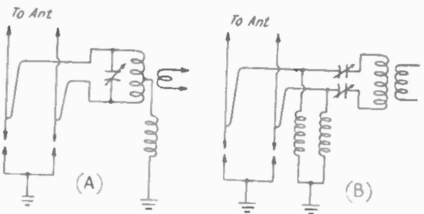

Fig. 628 — **Two methods for grounding antennas to reduce the danger from lightning.**

fed at the center should not require the r.f. chokes unless series tuning is necessary; the center point of the antenna tank coil or coupling coil may be grounded directly.

In the case of an unbalanced system such as the familiar Zepp-type antenna, however, it is probable that the r.f. choke at the center of the coil will be required in most cases, since a voltage node seldom occurs at the center of the feeder system unless the antenna is carefully cut for and used at one frequency.

To take care of rapidly rising charges which might not be dissipated sufficiently fast through the chokes, ground gaps are provided for each feeder wire. These gaps should be made as small as possible without breaking down under normal operation of the transmitter. In connecting to the gaps, the feeders should be bent at a rather sharp angle. Such a bend, or a turn or two of heavy conductor between the gap and the antenna tuning equipment, will provide an impedance for a steep wave-front surge, thus encouraging a discharge through the gap rather than through the transmitter. Once the gap breaks down, its resistance becomes very low. Several gap designs are shown in Figs. 629 and 630.

A very simple type of electrode and mounting is shown in Fig. 629-A. This is suggested by W8OSL. Rubber cones, cut from an old inner tube and slipped over the upper electrodes, protect the

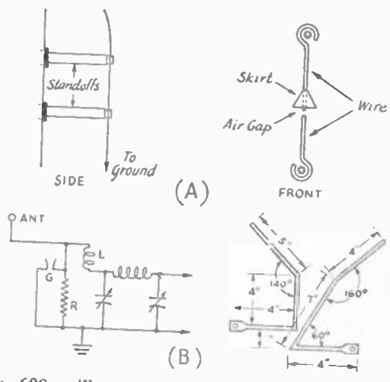

Fig. 629 — **Two gap suggestions. (A) shows the arrangement for mounting the gap suggested by W8OSL, while (B) shows the details of W4AAQ's gap.**

gap against short-circuit by snow or rain. In this case the electrodes are made of pieces of heavy wire.

W4AAQ recommends the arrangement shown in Fig. 629-B for Marconi-type antennas frequently used in 160-meter work.

"*L* is a two-turn coil of copper tubing or heavy wire, self-supporting, four inches in diameter. This coil has sufficient inductance to offer a high impedance to the steep wave-front of lightning surges and causes them to take the path of least resistance through the gap to ground. The resistance *R* is of the order of 200,000 ohms and is effective in draining small static charges to ground before they have an opportunity to build up a potential sufficient to break down the gap." (Unless a noninductive resistance is obtainable, an r.f. choke should be connected above the resistor. — Editor.)

Although a pi-section filter is shown in the diagram, the system may be used with other forms of coupling.

The construction of the gap is shown in the detail drawing. It may be made from one-quarter-inch copper tubing or No. 2 or No. 4 wire.

The one at Fig. 630-A is suggested by W1ALJ. The gap is made from three pieces of copper tubing, bent as shown and mounted on stand-off insulators. The side of the building upon which the gap is mounted is protected against possible danger of fire, when the gap operates, by an asbestos-board mounting. (Insulation of the ground wire is not required by fire underwriters. — EDITOR)

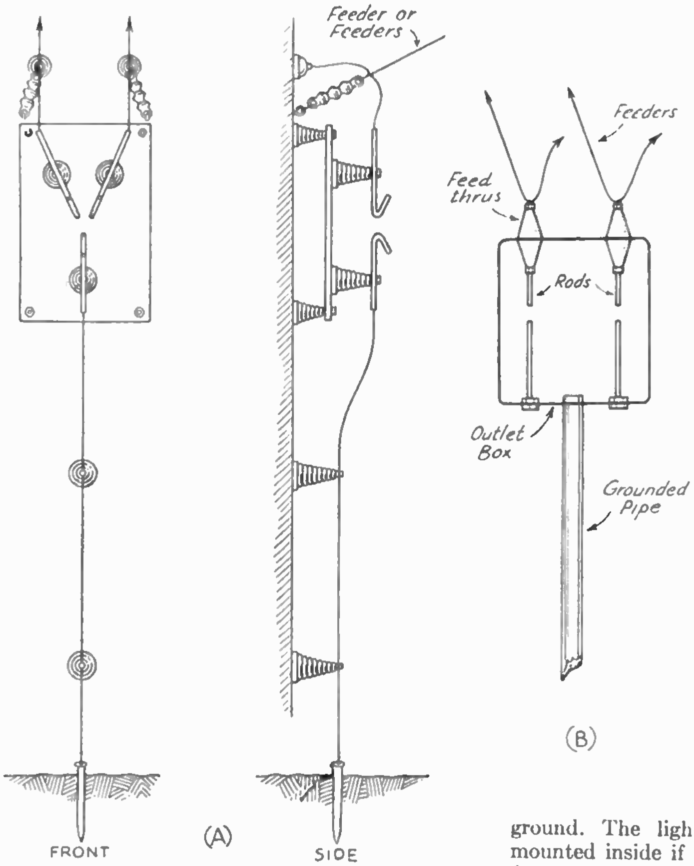

Fig. 630 — An enclosed weather-proof lightning gap mounted in an outlet box.

An enclosed gap is suggested by Robert Murray of Long Island City, N. Y. It is shown in Fig. 630-B and consists of a pair of gaps mounted in a steel outlet box. The box is mounted on a section of galvanized iron pipe driven well into the ground or bonded to a good ground. The contacts between the pipe and box and between the lower electrodes of the gap and the box should be as firm and of as low resistance as possible. The upper gap electrodes are mounted on feed-through insulators to provide good transmission-line insulation. The electrodes may be made from ¼-inch diameter rod.

Grounds and Ground Wires

In considering protective measures against lightning, it might be well to review the subject of grounds and ground wires. Any protective system is only as good as its ground connection. The National Board of Fire Underwriters recommends the use of a connection to a water-pipe system wherever such is available at not too great a distance from the antenna lead-in point. Other permissible grounds are grounded steel frames of buildings or other grounded metal work in the building.

Where a water pipe or other suitable ground connection is not available, an artificial ground may be made with driven pipes, buried plates, etc. If the soil is dry, several rods or pipes spaced three or four feet should be used. These should be driven as deep as practicable into the ground and connected together below the surface of the ground. A coil of wire, or metal plate submerged in a well, makes a good ground connection. If the well is some distance from the lead-in point, connection should be made to a driven-pipe ground immediately under the lead-in point before continuing to the well ground. In very dry locations, it would be advisable to create an area of permanent moisture around the ground rods or pipes by frequent application of salt water.

The ground wire need not be insulated from the building, but it should be protected against possible mechanical injury. It is permissible to run the wire to ground inside the building if this will shorten the path to ground. The lightning arrester also may be mounted inside if suitably protected to prevent fire when the gap operates. In most installations it probably will be most convenient to locate the gap on the outside of the building and run its grounding wire down on the outside to a suitable opening to a water-pipe connection while running the ground to the antenna coupling system on the inside of the building. The ground wire to the gap should be at least as large as the transmission-line wires combined and in no case should it be less than No. 14 wire.

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The most positive protection is to *ground* the antenna system when it is not in use. Grounded flexible wires provided with clips for connection may be used, or the old reliable "lightning-switch" may be installed. In any case, the ground lead should be short and should run as directly as possible to a good ground. Avoid sharp bends in any lightning protection system for best results.

7. *Hints and Kinks . . .*

for V.H.F. Gear

A SIMPLE BATTERY-POWERED 112-MC. TRANSCEIVER

Almost every ham has his pet circuit. Being experimentally inclined, I spent considerable time recently in trying one transceiver arrangement after another. Perhaps some of the other fellows might be interested in the one that has worked out best for me against all others I have tried. The circuit is shown in Fig. 701. It does not stray far from the conventional, but it has been found possible to simplify somewhat the usual change-over system.

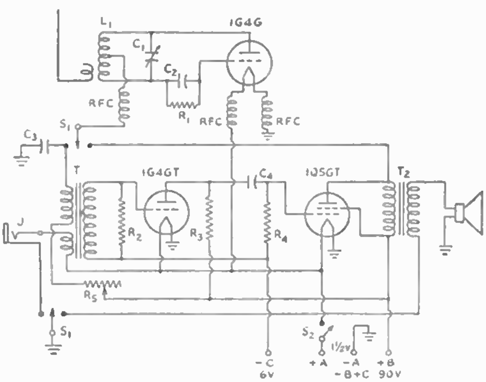

Fig. 701 — **Circuit diagram of W9EMQ's simplified 112-Mc. battery-powered transceiver.**

- C_1 — Two-plate variable condenser (Hammarlund MC-type with all but one rotor and one stator removed).
- C_2 — 100-μμfd. mica.
- C_3 — 0.002-μfd. paper.
- C_4 — 0.01-μfd. paper.
- J — Microphone jack.
- L — 6 turns No. 14, center-tapped, 3/16-inch diameter, 1¼ inch long.
- R_1 — 1 megohm, ½-watt.
- R_2, R_3 — 50,000 ohms.
- R_4 — 0.25 megohm, ½-watt.
- R_5 — 50,000-ohm potentiometer with on-off switch (S_2).
- S_1 — Sections of d.p.d.t. toggle switch.
- S_2 — See R_5 above.
- T_1 — Transceiver transformer.
- T_2 — Speaker transformer.

A 1G4GT first audio feeds a 1Q5GT power output tube. The primary of the speaker transformer is used as a modulation choke when the plate-supply lead is switched to the plate of the 1Q5GT. Battery bias is applied to both audio stages, holding the "B"-battery drain to a low value. The three tubes draw only 10 ma. when receiving and 13 ma. when transmitting. Numerous arrangements were tried to eliminate the microphone battery, the one shown finally being adopted.

The 1G4G oscillator tube is changed over from a superregenerative detector to a power oscillator simply by disconnecting the low-frequency plate by-pass condenser, C_3. No change is made in the value or method of connection of the grid leak. Smaller values of grid leak connected from grid to ground on "transmit" gave no appreciable increase either in input or output, and the necessity for an additional set of contacts on the switch and some trouble in making the receiver "super" because of the extra leads were entirely avoided. This is a little different from the usual transceiver, but it really works fine business — as a test will soon prove.

The important points of construction are shown in the sketch of Fig. 702. The unit, together with batteries, is housed in a standard steel case, 15 × 7¾ × 7 inches, with a handle attached at the top. Only the upper portion of the panel is shown in the sketch. The batteries occupy the lower portion of the case. A hole is cut for the 3-

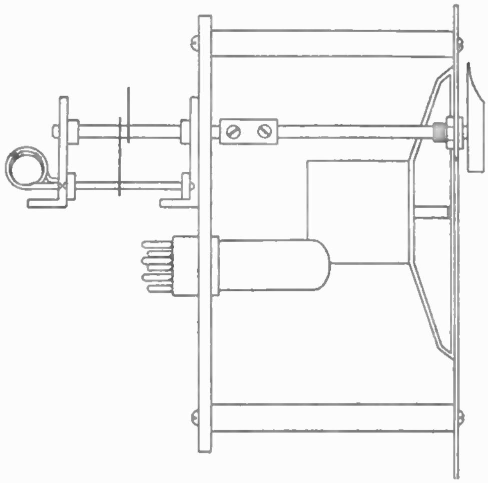

Fig. 702 — **Sketch showing layout and essential constructional points of W9EMQ's transceiver.**

inch permanent-magnet speaker which is mounted directly behind the panel.

The r.f. circuit components are mounted on a small Presdwood subpanel, approximately 3 × 5 inches, spaced from the front panel by sections of wood dowel. This subpanel is mounted on the left side of the front panel. To avoid socket losses, a hole to fit the base of the tube is cut in the subpanel and the tube is cemented in place. After all, it shouldn't be necessary to change the tube every five minutes! Before mounting, the base of the tube is scored between pins with a hacksaw. All tube connections are made by soldering directly to the tube pins. The tube should be placed so that the plate terminal is in the upper left-hand corner, directly below one stator terminal of the two-plate variable condenser. This should permit a plate lead one-half inch long. The grid lead is only the length of the grid condenser. An insulated shaft is used between the condenser rotor and the control on the front panel.

The audio-circuit components are wired together in a compact harness before they are mounted along the right-hand edge of the front panel. The change-over switch is a d.p.d.t. toggle switch mounted in the center of the panel below the speaker. — *H. Gordon Gwinn, W9EMQ.*

A V.H.F. AND U.H.F. CONVERTER USING A CRYSTAL DETECTOR

An experimental converter for reception on the very-high and ultrahigh frequencies is shown in Fig. 703.

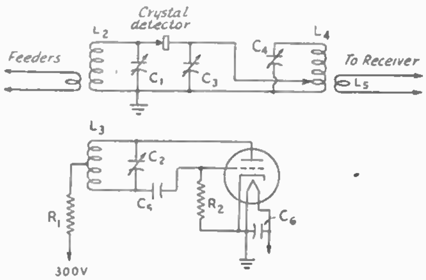

Fig. 703 — Circuit of a converter for v.h.f. and u.h.f. using a crystal detector as a diode mixer.

C_1 — 3-plate midget variable (approximately 5 μμfd.).
C_2 — 15-μμfd. midget variable.
C_3, C_4 — 3–30-μμfd. mica trimmer.
C_5 — 100-μμfd. mica.
C_6 — 500-μμfd. mica.
R_1 — 20,000 ohms, 1-watt.
R_2 — 0.25 megohm, ½-watt.
L_1 — 1 turn No. 14, ½-inch diameter.
L_2 — 5 turns No. 14, ½-inch diameter, turns spaced slightly more than diameter of wire.
L_3 — 4 turns No. 12, ½-inch diameter, ½-inch winding length.
L_4, L_5 — I.f. transformer for chosen input frequency on the receiver to be used.

A crystal rectifier is employed as a diode mixer. Crystal detectors are commonly used in ultrahigh-frequency work, since they will function at frequencies where the transit-time effect present in an ordinary diode or other vacuum-tube detector would result in impaired operation.

The oscillator tube may be a 7A4 if the converter is to be used only for reception in the 112-Mc. band. However, since interest in the experimental development of higher frequencies is a prime consideration in the design of the converter, a 955 acorn triode should be used as the h.f. oscillator if one is available.

Coupling between the oscillator and detector coils should be very loose. A spacing of about 2 inches gave ample injection voltage. In fact, a spacing of 6 inches worked almost as well. If the coupling is made too tight, signal levels drop and the noise level rises.

A tendency toward superregeneration in the oscillator was cured by omitting the usual r.f. choke in the plate circuit and substituting the 20,000-ohm resistor shown in the circuit diagram.

The crystal-rectifier output is tapped down on the i.f. transformer coil, the tap being located about one turn from the ground end.

Output from the converter may be fed into the front end of any sensitive receiver capable of tuning to 28 Mc. or higher. In our case the receiver was a 7-tube superheterodyne, using tubes of the 6D6 vintage and built some years ago for 56-Mc. reception. Its input is tuned to 40 Mc. and the intermediate frequency is 5 Mc.

Tests have covered the range from 112 Mc. to about 150 Mc. No direct comparison has been made with a superregenerative receiver, but comparisons with other superheterodyne receivers used on 112 Mc. indicate that this converter gives superior performance.

Extension of amateur interest to operation in the microwave region points to the desirability of experimentation with this receiving circuit, using an acorn oscillator tube and striving for every possible gain in efficiency. While constants for 112-Mc. operation are given in connection with the circuit diagram, such operation should be regarded only as a point of departure. — *Bernard W. Bates, W1BBM, North Harwich, Mass.*

SIMPLE TONE MODULATION FOR V.H.F. TRANSMITTERS

C. B. Seibert, W8SPY/TDJ, describes a simple system of tone modulation which he used with his v.h.f. transmitter.

The circuit diagram is shown in Fig. 704. A relaxation oscillator employing a neon bulb is used

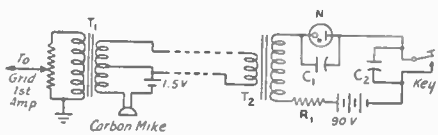

Fig. 704 — Arrangement for using a neon-bulb oscillator for tone modulation.

C_1 — 0.003-μfd. paper.
C_2 — 0.01-μfd. paper.
R_1 — 0.5 megohm, ½-watt.
N — Neon pilot lamp No. 5122.
T_1 — Double-button carbon microphone input transformer in existing speech amplifier.
T_2 — Single-button carbon microphone transformer, operated as step-down transformer.

as the tone source. This is coupled into the first audio tube of the modulator via the microphone transformer. The most convenient feature of the arrangement is that no switching is necessary to select either voice or tone input.

The oscillator is one which has been used for some time as a code-practice set with a pair of magnetic headphones in place of T_2. While standard neon glow lamps of the one-half or one-quarter-watt variety may be used, the values of C_1 and R_1 may have to be changed somewhat to obtain the desired tone. The resistor found in the base of the lamp should be removed.

SIMPLE V.H.F. TANK CIRCUIT FROM SALVAGED MATERIAL

An article on page 15 of the September, 1942, issue of *QST* suggested an added economy in the design of a tank circuit. The tank coil is made from an old coil shield. Opposite sides are clipped out, leaving a U-shaped segment, as shown in Fig. 705. If the shield is of rectangular shape, the curved corners are retained to provide strength. In any case some of the side is left near the closed end. Cylindrical shields provided with a separable bottom mounting offer an added advantage.

Small pieces of mica are inserted between the bottom ends of the "coil" and the friction mounting, constituting a tank condenser. Resonance may be adjusted roughly by inserting more or thicker pieces of mica. To preserve electrical balance, the same thickness of mica should be used on both sides. Finer adjustment may be secured by sliding the "coil" section up or down on the insulated mounting.

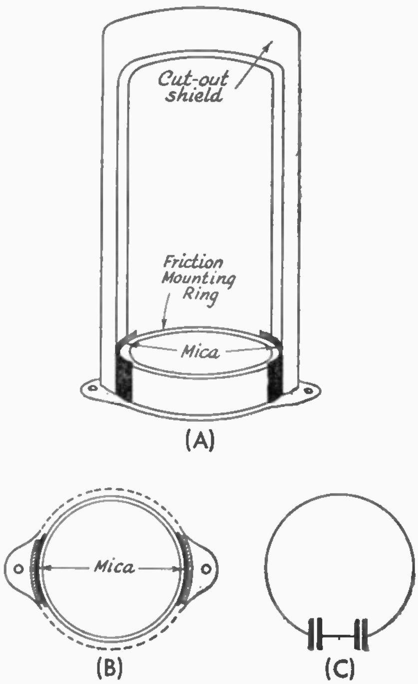

Fig. 705 — **A v.h.f. tank made from a cut-away coil shield. (A) perspective view; (B) top view, showing mica spacers to adjust capacity; (C) equivalent circuit.**

A short piece of bakelite tubing of the proper diameter to make a sliding fit with the shield "coil" may be substituted for the friction mounting if it is covered with thin copper or shim brass. The tube socket is mounted concentrically with the tank assembly to provide short grid and plate leads. The high-voltage lead is taken off the center or closed end of the "coil," opposite the tube. Experiment will determine whether a particular tube will operate best with the cathode grounded. A tab of shim brass and a small piece of mica may be used as a grid condenser. Any conventional circuit can be employed.

No dimensions are offered, as the material available will govern the constants of the circuit. After an assembly is constructed of whatever is at hand and placed in operation, the resonant frequency should be measured by Lecher wires or other means. The tank then may be trimmed in the proper direction to reach the desired frequency. Average-sized or large shields will resonate in the neighborhood of 56 Mc., while smaller shields may be trimmed to resonate in the 112-Mc. band.

No low-loss insulation is required except in the tube socket. A rubber band may be used to hold the ends of the "coil" firmly against the mounting ring. — *Charles A. Moore, K7LO.*

REMOVING LOKTAL BASES

Better performance at the higher frequencies may be obtained from loktal tubes, such as the 7A4, if the metal band at the base is removed. This can be easily done if the tube is boiled in water until the cement between the band and the tube has become softened. The ring then can be removed with a pair of gas pliers. — *Fred Craven, W3ERV.*

NOISE LIMITER FOR V.H.F. MOBILE INSTALLATIONS

Fig. 706 shows the diagram of a very successful noise-silencing circuit I used with my automobile radio receiver in conjunction with a Browning v.h.f. converter. Ignition interference from my own car had been cut considerably by the use of the usual condenser and suppressor precautions, but there was still enough noise left to bother me — especially when no signal was present, as in the case of police-station reception. The ignition interference caused by other cars near by was terrific, becoming nothing less than bedlam in heavy traffic.

The circuit suggested by W9ZWW in *QST* for March, 1940, was tried, but since it was designed to be most effective during signal reception, noise was still bad when no signal was present. Knowing of the effective noise silencer used by Hallicrafters in their S-27 v.h.f. a.m.-f.m. receiver, an adaptation of this circuit was worked out for inclusion in the automobile receiver. Acknowledgment of the suggestions made by W9WNE is made at this time. He suggested keeping the volume control out of the limiter bias circuit and also supplied the circuit used for the volume-control isolation.

With the noise-limiter tube in the circuit no ignition noise is heard from my own car at any time, signal or no signal. Ignition noise will appear under conditions of extreme saturation by other unshielded or unsuppressed automobile engines, but on the whole this limiter has been most satisfactory. It is possible to cruise in the city with the volume at a satisfactory level for signal reception and yet not have bothersome ignition noise when the signal is off the air. This limiter is preferred to a noise squelching circuit, both because of the greater ease of installation in the receiver and its better sensitivity to weak signals in general.

No noticeable effect on the quality of either voice or music reception has been experienced when the noise limiter is in the circuit. — *Paul M. Cornell, W8EFW.*

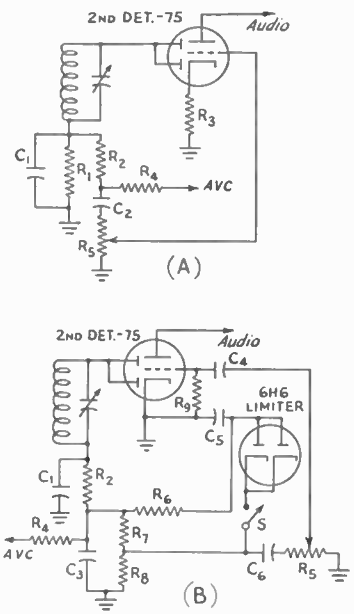

Fig. 706 — W8EFW's noise-limiter circuit for mobile receivers using v.h.f. converters. (A) shows original connections in the b.c. receiver, while the alterations required are shown at (B).

C_1, C_3 — 50-μμfd. mica.
C_2 — 0.01-μfd. paper.
C_4, C_6 — 0.005-μfd. mica.
C_5 — 0.05-μfd. paper.
R_1 — 250,000 ohms, ½-watt.
R_2 — 50,000 ohms, ½-watt.
R_3 — 250 ohms, 1-watt.
R_4, R_6 — 1 megohm, ½-watt.
R_5 — 500,000-ohm potentiometer.
R_7 — 40,000 ohms, ½-watt.
R_8 — 150,000 ohms, ½-watt.
R_9 — 10 megohms, ½-watt.

SUBSTITUTE CIRCUIT FOR TRANSCEIVER TRANSFORMER

Fig. 707 shows an arrangement we have been using in our 2½-meter transceivers since transceiver transformers are not now obtainable. I found the substitute circuit to work very well, although the voltage step-up provided by the

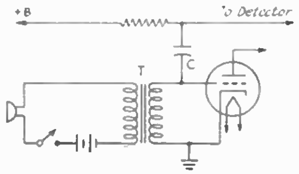

Fig. 707 — If a transceiver transformer cannot be obtained for your WERS unit, W8AQT suggests an alternative way of connecting the detector output by resistance-capacity coupling to the speech amplifier.
R is a 25,000-ohm ½-watt resistor and *C* a 0.01-μfd. paper condenser. *T* is the mike transformer.

transformer is sacrificed. In this arrangement, the detector is simply capacity-coupled to the first speech amplifier stage following the microphone. The connection does not interfere with proper operation of the microphone circuit.

I have also used a door-bell transformer as a substitute for a microphone transformer, with good results. — *Glenn V. Lichtenfels, W8AQT.*

SPEECH AMPLIFIER OR AUDIO OSCILLATOR FOR V.H.F. TRANSMITTER

The circuit shown in Fig. 708 provides a means of creating an audio tone in a speech amplifier and feeding it into a modulator. This may readily be keyed to provide type A-2 emission for the v.h.f. transmitter.

The s.p.d.t. switch shown provides normal input to the speech amplifier in one position. When thrown to the other position, it biases the speech amplifier grid 45 volts positive through a tuned audio circuit. This amount of bias causes the tube to operate on the negative-slope portion of the E_c-I_p curve; hence the grid circuit operates as an audio dynatron oscillator. This audio voltage controls the plate circuit in the normal manner.

It will be found that different tubes require different amounts of positive bias to get them to oscillate properly. The idea, however, should be easily adaptable to any speech amplifier. Some tubes might not be adaptable as a result of too

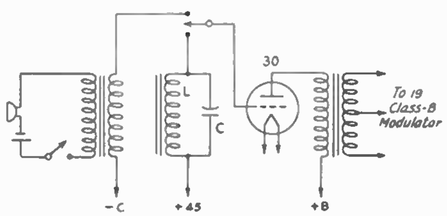

Fig. 708 — Combined speech amplifier or tone generator for 56-Mc. work.
L — Midget audio choke or the primary of a small audio transformer.
C — Small condenser to tune to desired tone.

high grid current under the positive bias conditions, which would, of course, damage the tube. — *Millett G. Morgan, W8OTD.*

A TRANSMITTER-RECEIVER FOR THE 112-MC. BAND

After constructing and operating several types of 112- to 116-Mc. WERS communication units, including linear-tank transmitters with separate receivers and a number of transceiver combinations, we decided on the transmitter-receiver diagrammed in Fig. 709. This equipment does not require much power, and therefore may be operated from an auto-radio power supply or from an a.c. power pack delivering about 250 volts at 60 to 100 ma.

The general plan of this equipment was to eliminate all unnecessary controls and, at the same time, provide tuning and volume controls on the receiver that would not cause the transmitted frequency to shift about and change in percentage of modulation. These items are especially important when the equipment is to be operated by personnel having little experience.

A Type 76 tube seems to operate best in the receiver, but may be replaced by a 6J5, 7A4 or the Philco XXL. The transmitter seems to perform best with the XXL, although Types 7A4, 6J5, 6V6 triode-connected, or any similar type, will work well. In the first audio stage a 6C5 apparently works as well as the 6J5, while the 6F6, 42, or any similar power-amplifier tube may be used in place of the 6V6 in the modulator. In other words, the unit is not too critical and may be adapted to use almost any tubes that happen to be available.

The transmitter inductance and tuning condenser are mounted underneath the 7 × 9 × 2-inch chassis, and are preset to the desired frequency. The receiver volume control is switched so that it may be adjusted for any receiver volume required without affecting the transmitter modulation; also, only one control is used to accomplish the required results at this point.

The 0.006-μfd. condenser, C_5, was merely included to improve the quality of speech, and may be changed to meet operating conditions and microphone quality. The 8-μfd. condenser, C_8, was found to reduce hum and vibrator hash very noticeably in some instances, depending on the type of filter used in the power supply which was available. It may not be required in all installations. Radio-frequency chokes were constructed of 30 turns of No. 28 d.c.c. wire, ¼-inch inside diameter, and were mounted in the set so as to be self-supporting.

Because of differences in the internal capacities of tubes, capacity and inductance of wiring, etc., it may be found necessary to experiment with different vales of C_4, R_2, R_7 and R_3 to obtain proper superregeneration with as low a voltage as possible and also to eliminate undesirable feedback, squeals, etc., in the first audio stage. T_1 is an ordinary audio transformer of about 3 to 1 ratio with the addition of one layer of No. 30 to

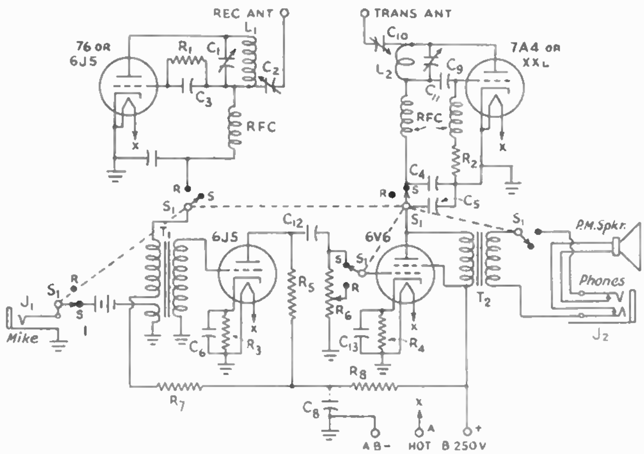

Fig. 709 — Circuit diagram of the 112-Mc. WERS transmitter-receiver.

C_1, C_9 — 7-35-μμfd. 2-plate variable.
C_2, C_{10} — 1.5-7-μμfd. air trimmer.
C_3, C_{11} — 50-μμfd. mica.
C_4, C_{12} — 0.01-μfd. 450-volt paper.
C_5, C_{13} — 0.006-μfd. 450-volt paper.
C_6 — 25-μfd. 25-volt electrolytic.
C_7 — 100-μμfd. 450-volt paper.
C_8 — 8-μfd. 450-volt electrolytic (see text).
R_1 — 5 megohms, ½-watt.
R_2 — 2000 ohms, ½-watt.
R_3 — 900 ohms, 1-watt.
R_4 — 200 ohms, 1-watt.
R_5 — 50,000 ohms, 1-watt.
R_6 — 250,000-ohm volume control.
R_7 — 25,000 ohms, 1-watt.
R_8 — 50,000 ohms, 1-watt.
L_1 — 4 turns No. 14, ⅜-inch inside diameter.
L_2 — 4 turns No. 14, ¼-inch inside diameter.
RFC — 30 turns No. 28, wound over ¼-inch diameter form.
J_1 — Single-circuit jack.
J_2 — Double-circuit jack.
S_1 — 8-pole 2-section rotary switch.
T_1 — 3:1 audio transformer with microphone winding added (see text).
T_2 — Output transformer.

No. 40 wire wound over the present windings and connected to the single-button carbon microphone. The connection for 'phones does not deliver optimum power output, but signal strength was found to be more than sufficient for headphone operation.

All power-plug connections are standardized so that any set or power supply, a.c. or d.c. vibrator pack, may be interchanged, keeping in mind that an a.c. supply having the filament winding center-tapped to ground will not work until the ground tap is opened.

The receiver works best with a long-wire antenna and is not critical when capacity-coupled as shown, while the transmitter performs best with a quarter- or half-wave rod antenna.

We were unable to obtain properly insulated parts for use at this frequency, and realize that we have considerable losses in sockets, etc., but in actual operation we found this unit to outperform some commercially built units using Type HY-75 tubes. — *L. R. Jenkins, Radio Aide, WJZY.*

A 6-ELEMENT VERTICAL ARRAY FOR 113 MC.

I HAVE had good luck with a six-element vertical array for 113 Mc., shown in Fig. 710, which employs the principle of the extended double "Zepp." It lowers the angle of the "dome"

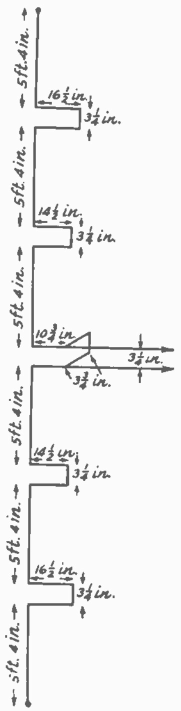

Fig. 710 — Arrangement and dimensions of a six-element stacked vertical array, using the extended double "Zepp" principle, designed to operate on 113 Mc.

radiation, putting it out at an angle of about 4 degrees in a pattern extending around the horizon. Consequently, the array does not need to be rotated and permits fast operating

The antenna is constructed of No. 12 copperweld wire. The transmission line and the matching stubs are of No. 14 copperweld wire, which is of course somewhat easier to handle than the No. 12. The copperweld wire is stiff enough so that the phasing stubs extend almost at right angles from the radiator. It is not important to have them in line with each other. They may whirl in space around the radiator, provided they remain approximately at right angles to the array.

The transmission line should extend at a right angle to the radiator for a distance of at least ten feet before making any bend. It is spaced with Johnson No. 134 feeder bars at intervals of 18 inches. Johnson No. 104 antenna insulators are used between each of the elements of the radiator at the points where the phasing stubs and the transmission line are connected.

The vertical radiator consists of six elements, each ⅝-wavelength long, and all connected by phasing stubs which are approximately 3/32 of a wavelength. The stubs connecting the two end elements to the array are 16½ inches long. The two next to the center elements are 14½ inches long. All are spaced 3¼ inches. The radiating elements are each 5 feet 4 inches long.

The matching stub at the center of the array is 3¾ inches long, also spaced 3¼ inches, as is the transmission line. The matching stub is connected to the feeders at a point approximately 10¾ inches from the radiator. Plus or minus ¼ inch from this point should cover the adjustment for maximum results.

My array is hung from a messenger cable between two 90-foot poles. In the preliminary testing, the array was raised and lowered several times before the exact maximum dimensions were determined. This was done with the aid of a field strength meter. — *Don C. Wallace, W6AM.*

FOLDING CAR-ROOF V.H.F. ANTENNA

FIG. 711 shows a sketch of a fitting for a vertical v.h.f. car-roof antenna which the gang around Torrington, Conn., favor because it provides a good mechanical arrangement for folding the antenna parallel to the car roof.

The pieces *A* and *B* are made from sections of brass rod ¾ inch in diameter. One end of *A*, which has an over-all length of 3½ inches, is turned down for a length of 2 inches to the diameter required to fit the inside of the bottom of the tubular antenna, which is soldered fast. At the other end is cut a tongue, 1 inch long and ¼ inch wide.

Piece *B* has an over-all length of 6 inches. One end is turned down and threaded with a ⅜-inch die, while a slot, 1 inch deep and ¼ inch wide to fit the tongue of *A*, is cut in the opposite end. The slotted end is then drilled and tapped on one side of the slot for a ¼-inch thumb screw, *C*. A vertical elongated hole is drilled and filed out in the tongue of piece *A*, so that, with the thumb screw loosened, *A* can be lifted up slightly to being folded down. The solid seating of the two pieces when the antenna is vertical provides little opportunity for the joint to work loose.

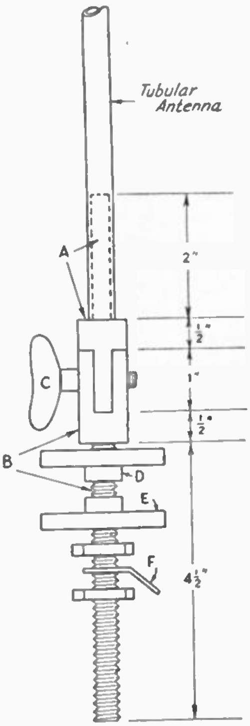

Fig. 711 — **Feed-through insulation and fittings for the folding car-roof mobile antenna. The joint hinges at C so that the antenna may be folded down parallel to the roof of the car.**

The threaded shank of piece *B* passes through a hole in the roof of the car. The polystyrene washers, *D* and *E*, provide the necessary insulation. Each is 2 inches in diameter and ¼ inch thick and has a collar or hub ¼ inch thick turned on one side to fit the hole in the car roof. The assembly is clamped to the roof by the locking nuts. *F* is a soldering lug for making the connection to the antenna.

If the assembly is placed near the forward part of the roof, the antenna may be folded back at the hinge without overhanging the rear of the car. — *Ed. Toloski, W1KXB.*

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SHUNT-FED MOBILE ANTENNAS

The shunt-fed arrangement shown in Fig. 712 was first tried after I had had some difficulty with my first antenna for mobile use, which was a vertical rod on the back bumper. This was fed in the conventional manner with a concentric line, using crystal-microphone cable for the purpose, and it apparently worked well on transmitting. I later installed a relay operating from the transmitter plate voltage to throw the antenna over to the receiver. This worked well while the car was stationary, but when in motion so much static was picked up by the antenna that it was impossible to receive. It was while attempting to eliminate this that shunt feed was first tried. It was the solution insofar as static was concerned, and I have since found it superior in other respects. Perhaps this is because of a better impedance match, since there is undoubtedly some mismatch between crystal-microphone cable and the bottom of a quarter-wave antenna.

The antenna proper is an adjustable bumper-rod whip of the usual type which has an extended length of 8 feet. This can be used as either a quarter- or half-wave antenna on 56 Mc. The feeder is crystal-microphone cable, which is very reasonable in price compared to the 34-ohm concentric line necessary to match correctly the bottom of a one-quarter-wave antenna. Crystal-microphone cable has a higher impedance, but it can be well matched by shunt-feeding the antenna. For quarter-wave operation the bottom of the antenna is grounded to the car frame and the outside conductor of the feeder is grounded at both ends. At the antenna end, a copper clip is fastened to the center conductor. This clip is moved about on the antenna until the best transfer of power is accomplished. A field-strength meter will be advantageous in making this adjustment, although it will not be found too critical.

Superior results may be obtained on 56 Mc. if the antenna is run out to its full length, making it one-half-wave long. In this case, it will be necessary to insert a quarter-wave loading coil (6 turns of heavy wire, 2 inches in diameter) between the bottom end of the antenna and the car frame. The center conductor is now connected somewhere about the center portion of the loading coil. Here, again, the field-strength meter will be helpful.

In my own installation, to facilitate antenna changes, I am using copper clips on the outside end of the feeder (both inner and outer conductors) with a short flexible lead from the bottom of the antenna, and on both ends of the loading coil. — *Eric W. Cruser, W2DYR.*

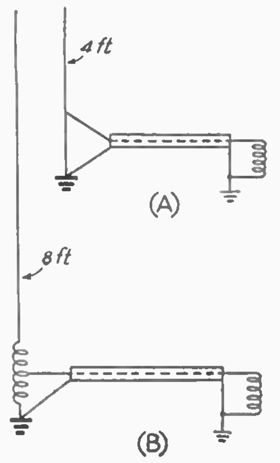

Fig. 712 — **Shunt-fed mobile antennas as used by W2DYR to reduce noise. (A) is for quarter-wave operation; (B) is for half-wave antennas.**

THREE-ELEMENT DIRECTIONAL ANTENNA FOR 112-MC. PORTABLE WORK

FIG. 713 depicts a simple directional antenna which may find application in v.h.f. work. It has been used successfully with a transceiver of conventional design employing a 1G4GT and a 1T5GT.

Wanting to try a beam antenna on 112-Mc. with a minimum of alterations, I hit on the idea of just building something I could add to the half-wave antenna already mounted on the transceiver. This antenna is a vertical ex-car antenna and is tapped at the base with threads of appropriate size to fit the hardware of a bee-hive insulator mounted on top of the cabinet. The reflector and director elements are supported from a pair of cross arms which rotate about the vertical antenna as an axis. These cross arms are made of wood, except where they come in contact with the reflector and director elements. At these points, pieces of plastic are used to improve the insulation. These cross arms should be made as light as possible to keep the weight down. The central holes should fit the antenna snugly; the telescopic joints make convenient points for locating the cross arms.

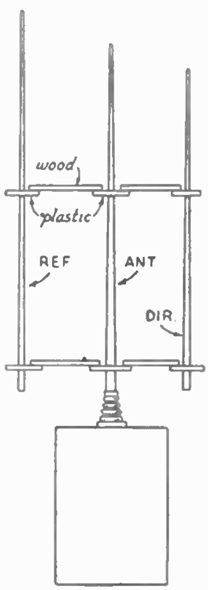

Fig. 713 — An efficient antenna for directional work with 112-Mc. band portable equipment.

Plexiglas discs are used for the reflector and director insulation. The holes for mounting these elements are made somewhat smaller than the diameter of the elements, which are forced through the plastic after heating it. After the plastic cools there is little danger of loosening of the elements.

For a frequency of 115 Mc. the antenna is 48¾ inches long, the reflector 51¼ inches long, and the director 46¾ inches long. The spacing between the antenna and the director should be 10 inches, while a spacing of 15 inches is used between the antenna and the reflector. However, these dimensions will work over a broad range, considering that it is a three-element beam. If telescopic elements are used for the parasitic elements their lengths may be adjusted on the nose for any desired frequency in the band, of course. In adjusting the elements it will be observed that the presence of the operator in the direct field of the antenna will have a noticeable effect, so he should keep out of the field as much as possible.

The antenna has a very good front-to-back ratio and it provides gain over a simple half-wave antenna equivalent to a power increase of several times. — *S/Sgt. J. H. Jearne, Det. Third Com., Hensley Field, Dallas, Tex.*

FEEDING A COAXIAL DIPOLE WITH AN OPEN-WIRE LINE

THE merits of the coaxial-type antenna are well-known. The chief object accomplished with this system is the feeding of a half-wave dipole at the center without bringing the line into the field of the antenna, thereby reducing the possibility of distorting the radiation pattern of the antenna.

However, it is customary to feed such an antenna with coaxial cable, which is more expensive in long lengths than many hams can afford. Fig. 714 shows a system I have been using in which an open-wire line may be employed to feed an antenna of this type. The transmission line is designed for a characteristic impedance of very close to 400 ohms. It consists of a pair of No. 12 wires spaced 1¼ inch, separated by 2-inch spreaders in which holes with the correct spacing have been drilled.

Referring to the sketch, the rod *A* and the 3-inch-diameter cylinder A_1 are the two halves of the half-wave dipole. They must be insulated from each other. The 1-inch-diameter metal tube *B* and the No. 12 wire *C*, mounted inside A_1 make up a concentric quarter-wave section of about 160 ohms for matching the 400-ohm line to the center of the dipole. The top end of *B* is, therefore, connected electrically to the top end of A_1, while the top end of the center conductor of the matching section is connected to the bottom end of the antenna rod, *A*. The 400-ohm line is connected to the lower ends of *B* and *C*.

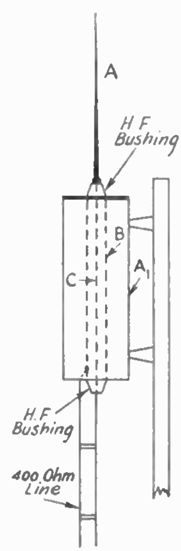

Fig. 714 — W8SR's scheme for feeding a coaxial antenna with an open-wire line. *A* and A_1 are halves of the half-wave dipole antenna, while *B* and *C* form a quarter-wave matching section.

A_1 is a 2-foot section of 3-inch round rain spouting, while B is a 2-foot section of 1-inch thin-wall electric conduit. A single National type XS-1 h.f. bushing is divided to form an insulating support at each end of B for the No. 12 wire C. The threaded rod is cut in half and each piece soldered to one end of the wire. The nuts may then be used to draw the wire up tight. The upper half of the bushing is also used to support the upper half of the antenna, A. A 3-inch ring of metal with a 1-inch hole at the center may be used to fasten the top ends of A_1 and B together. The bottom ends may be held together by a similar ring cut from polystyrene sheet, or 1-inch stand-off insulators may be used between the lower ends of A_1 and B. The whole assembly is mounted on the pole with heavy stand-off insulators. The line should be anchored to the pole to take the strain off the assembly. With the line coupled to the transmitter with a hairpin loop, this system has given very excellent results. — *H. R. Gebhardt, W8SR.*

A UNIVERSAL-ANGLE V.H.F. ANTENNA MOUNTING

The days when an electrician could build a satisfactory antenna for a radio transmitter seem to have gone out along with unrationed gasoline and Scotch whiskey. The construction crew for many a modern antenna system must include a couple of plumbers and a sheet-metal worker. After this a further complication arises. If maximum advantage is to be taken of the directional effects of such antennas, they must be steered. And the mechanism required may call for the combined services of a steam-shovel designer and an automobile mechanic.

The purpose to be served by the device here described is control of the position of the vertical plane of an antenna as well as its azimuthal rotation through all points of the compass. Since the energy taken from an electromagnetic wave by a receiving antenna will normally be greatest when the antenna polarization is the same as that of the arriving wave, it is clear that, unless we can expect the arriving wave to maintain a constant polarization, a convenient means of varying the polarization of the receiving antenna is desirable in order to avail ourselves of all possible transmitted energy. In the field of v.h.f. wave propagation the polarization of the arriving wave seldom bears any definite relation to the polarization of the transmitting antenna. Optimum adjustment of the polarization of the receiving antenna then can be determined only by experiment. The v.h.f. operator will appreciate a mounting device for his antenna which will enable him to control searching motion with the greatest possible ease.

Suppose we let the radio engineers take a back seat for a while, just asking them for a bit of advice occasionally, while we mechanics have our innings with the design of a universal-angle antenna mounting. The design of many an amateur's postwar antenna will necessarily depend largely upon what he can find in his junk box. There are probably a number of basic mechanical arrangements which will prove to be particularly suitable for mounting antennas for universal-angle motion. The one here described has been found very practical in actual use as the mounting of the writer's three-element 28-Mc. antenna. For antennas designed for higher frequencies the design should prove even more useful and workable, especially for the experimenter.

Yachtsmen and mariners will recognize in the sketch of Fig. 715 a device known as a gimbal, a traditional method of mounting a marine compass so that it will remain level despite the pitch or roll of the ship. A pair of gimbals constitute a sort of universal joint. Concentric rings, B and C, are cut from properly weatherproofed plywood or other suitable material. The dimensions will be determined by the size and weight of the antenna elements which are to be supported upon the outer ring, C. The bearings on which the outer ring pivots about the inner ring B may be short metal straps, as shown in Fig. 715, or they may simply be holes in the edge of the ring. In the latter case, for mountings intended to carry a heavy two- or three-element array, it would be an improvement to line the holes with sections of metal tubing to secure longer-wearing surfaces. The pivot pins may be short sections of metal rod or tubing, mounted tightly on the edge of ring B.

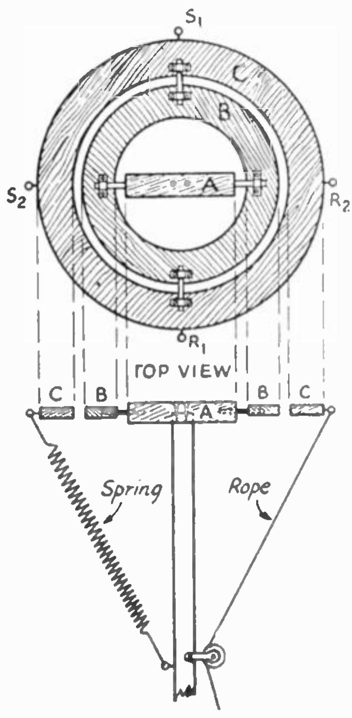

Fig. 715 — Gimbals-type mounting for universal-angle adjustment of the plane of a dipole antenna or a small directive array. Only one rope and spring are shown in the side view, although a second pair is attached at right angles to these, at points S_1 and R_1.

The assembly of outer and inner rings is pivoted about a central block, *A*, which may be a piece of hard wood mounted on top of the mast. The bearings between *A* and *B* are similar to those already described. To permit rotation of the complete assembly for horizontal directivity the central block, *A*, may be mounted so as to pivot about a vertical pin passing through a hole drilled in its center, or the block may be mounted solidly if the mast itself can be rotated. The latter plan is preferable, since it will simplify control of the rings in the gimbals. Such control can be accomplished by the very simple expedient of attaching ropes at points 90 degrees apart on the outer edge of the outer ring, opposite the axes of rotation of the two rings. Each rope pulls against a tension spring attached between the mast and a point diametrically opposite the pull of the rope. The method is illustrated in the lower detail of Fig. 715, although only the rope and spring controlling the outer ring are shown.

Various types of antennas may be mounted upon the outer ring, parallel to its plane. Since that plane can be varied about a horizontal axis the radiator, or the elements of an array, may be used as either a vertical or a horizontal antenna. The angle of the main lobe of radiation can be adjusted at will, as well as the polarization. Directional adjustment is taken care of by rotation of the mast. The writer's three-element 28-Mc. beam array was mounted on the outer ring of the gimbals, the gimbals in turn being mounted on the top end of a 20-foot topmast, and the whole topmast was rotated in bearings mounted on the ends of crossarms on a telephone pole. Motors were provided to pull the ropes as well as to rotate the topmast, and the whole system was operated by remote control from the usual station operating position. — *F. C. Beekley, W1GS.*

A COLLAPSIBLE ROTARY ANTENNA FOR 112-MC. MOBILE USE

The sketches of Fig. 716 show the construction of a simple four-element beam antenna which I have found very satisfactory for 112-Mc. mobile operation. The antenna system consists of a vertical half-wave antenna, fed by a short twisted-pair line and a "J" matching section, with two directors and a reflector.

The frame is made of ½-inch by 1½-inch furring-strip material. The "mast" is a "closet pole" which is 1½ inches in diameter. A hinge near the middle of the frame permits the structure to be folded for carrying in the trunk or on the back seat of a car.

For elements, ½-inch copper tubing is the most efficient, although aluminum is more convenient for portable work because of its light weight. The elements may be snapped into place in heavy-duty fuse clips mounted on the frame with stand-off insulators, as shown at *B* and *C*. An extra clip will support the "J" section.

The antenna element is 48 inches long, while the reflector is 51 inches long and the two directors each 45 inches long. A spacing of 12½ inches is used between all elements except the antenna and reflector elements, which are spaced 25 inches.

The "J" matching section is 24 inches long and the match is adjusted by moving the low-impedance line, fitted with clips, along the section.

The "mast" may be set in a fitting near the front door of the car so that the antenna may be rotated by hand.

The outfit sure did work wonders for me last summer, and it's simple enough so that no one should have any trouble making one up. — *John Klar, W1LFI.*

SHATTER-PROOF INSULATOR FOR CONCENTRIC ANTENNAS

I used several concentric antennas on 112-Mc. portable-mobile before December 7, 1941, and, as a rule, I rolled the coaxial up in a blanket and tossed it in the back of the car. After driving to the top of some distant peak, I usually found the ceramic feed-through insulator cracked or broken. At home, the one I had on my fixed antenna, 90 feet in the air, also broke in heavy windstorms frequently.

A visit to a radio store or electrical repair shop will provide a lot of empty spools which once held magnet wire. By sawing one of these spools in half and boiling it in paraffin for about 15 minutes, we have two bushings that are well-nigh unbreakable and whose losses do not appear to be excessive. All of the spools appeared to fit snugly into one-inch conduit but the inner hole varied from ¼ inch to ⅜ inch, with the ¼-inch size predominating. — *Clyde Criswell, W6QLZ.*

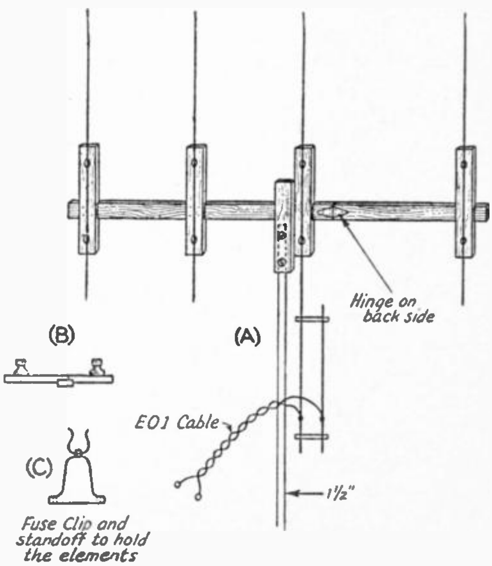

Fig. 716 — W1LFI's collapsible 112-Mc. four-element beam for mobile work. The frame is hinged, while the elements are held in position by fuse clips to make assembling and disassembling the array an easy job. (B) and (C) show the details of element mounting.

AN INEXPENSIVE MOUNTING FOR A 112-MC. ARRAY

It is not necessary to do without the advantages of a rotary beam for 112-Mc. work, if one is willing to forego one or two dispensable refinements. The four-element vertical array shown in Fig. 717 was easy to construct and cost only $2.90, including the price of a 20-foot length of ⅝-inch o.d. copper tubing. Four feet of the copper tubing remained for use in the tank circuit of the transmitter, so that the actual investment in the beam was $2.66 — prewar prices.

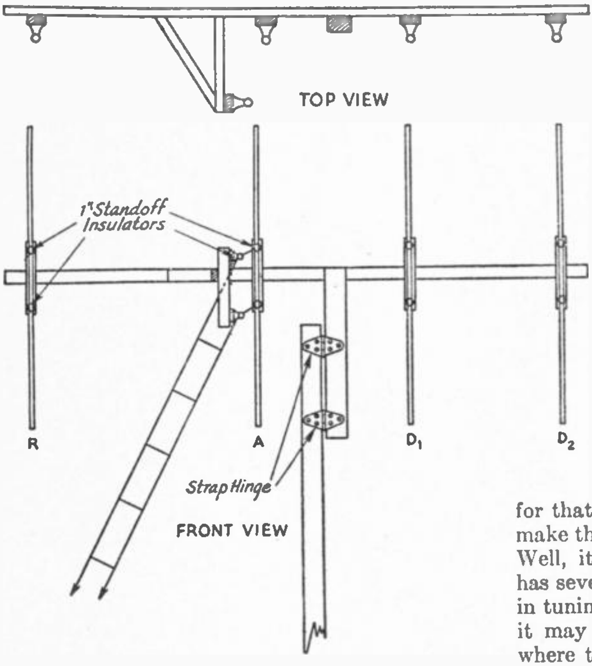

Fig. 717 — **Hinged mounting for a 112-Mc. array. The arm which supports the feed line at right angles to the cross-bar should be two feet or more in length, since its purpose is to prevent, insofar as possible, any interference with the field pattern of the antenna.**

The mast is a 16-foot length of 2 × 3. Two feet of the same stock is arranged to swing about the top two feet of the mast by means of very heavy strap hinges, about six inches in length. The cross-bar supporting the elements is of 1¾ × 1-inch stock, four feet in length. The elements of ⅝-inch copper tubing are each rigidly supported by two stand-off insulators, mounted on 2 × 12 × 1-inch strips which are fastened to the cross-bar at the proper intervals. The lengths of the elements will depend upon the desired operating frequency. In this case the radiator was 48¾ inches, the reflector 50⅞ inches, and the directors 44⅝ inches. The spacing should follow the suggestions given in *The ARRL Antenna Book.*

This scheme of rotating the array does not allow complete 360-degree rotation, but there is an advantage even in this handicap since the feeders do not have a chance to wrap themselves about the mast. The beam is rotated through a range of about 200 degrees by means of two ropes, one attached to each end of the cross-bar, which are passed through pulleys to the nearest window in the shack. Heavy grease should be applied to the hinges and the pulleys.

A 400-ohm line was used with a delta matching section measuring 12½ inches on the sides and spanning 10 inches across the center of the radiator. — *Herman Lukoff, W3HTF.*

SIMPLE METHOD FOR INVESTIGATING PERFORMANCE OF 112-MC. ANTENNAS

The adjustment of a 112-Mc. antenna for best performance usually requires not only some form of field-strength measuring device but also that a transmitted signal be put on the air. This is all right when such measuring equipment is available. It is not necessary, however, to have either measuring apparatus or a signal from a transmitter in order to determine with fair accuracy the field pattern of a directive array or the effectiveness of a quarter- or half-wave antenna.

Did you know that merely scraping one end of a piece of bare wire approximately one half wavelength long with another short piece of bare wire — or, for that matter, any other piece of metal — will make the half-wave wire radiate a minute signal? Well, it does, and a wire used in this manner has several very useful applications, particularly in tuning 112-Mc. antennas. As a matter of fact, it may be used to check any antenna system where the dimensions of the half-wave wire are not so large as to make its use unwieldy.

The first thing to do is to set up the antenna to be investigated in any location which will permit a person to walk around it. The antenna should be on the same level as the test wire when the latter is held by the person operating it. If the receiving antenna is vertical the test wire should be held vertically, since polarization is quite noticeable. Naturally, the preferred location is the spot where the antenna eventually is to be used.

Now couple the receiver (it makes no difference whether it be a superhet or superregenerative job) to the antenna, setting the coupling at its approximate optimum position. Turn the receiver on and set its volume control for full output, since the transmitting range of the test wire fortunately is very limited. It is this limited range that requires the preliminary test to be made while holding the test wire in close proximity to the receiving antenna.

A few words about the proper place to hold the test wire. Since this wire acts exactly like any antenna, it must be held in the operator's hand at a point where a current loop normally would exist. If one holds the lower end of a half-wave wire in one hand and scrapes the upper end with a metal rod held in the other hand, for instance, no signals will be generated, since the end held in the hand is effectively grounded. A quarter-wave or three-quarter-wave wire may be held at the end. However, since a person's body absorbs considerable energy from the test wire, just as it would from a transmitting antenna, do not stand between the wire and the receiving antenna.

Hold the test wire away from your body and close to the receiving antenna, and start scraping. The "signal" will sound just like what it is — the scraping together of two pieces of metal. Note the volume of noise from the receiver. Back away in a straight line until the noise disappears, and note this distance from the antenna. Repeat this process along lines radiating in different directions from the receiving antenna as a center.

It will be observed that the "fade-out" points vary in distance from the antenna in proportion to the gain of the antenna in any given direction. If these points are plotted on polar graph paper, a line connecting the points will provide a picture of the antenna's field pattern.

There are many applications for this type of checking. For instance, it is possible to judge the approximate front-to-back ratio of any directive array. Simply compare the maximum forward distance to the maximum backward distance at which "fade-outs" occur, and that's the ratio.

Whether or not a certain directive array has a worth-while gain over any half-wave or three-quarter-wave antenna also may be determined. Obtain the maximum "fade-out" distance from first one and then the other antenna, by the method described above. Comparison of these two distances gives the comparable effectiveness of the two antennas. In one instance it was found that a half-wave antenna could not pick up the test signal beyond a distance of five feet, while a three-element array connected to the same receiver made it possible to pick up the test signal at a distance of nearly twenty-five feet. Of course, actual distances in such cases will vary with the sensitivity of the receiver used.

The comparative sensitivity of two or more receivers can be measured, provided each receiver in turn is connected to the same antenna and the coupling is adjusted to the optimum position for each. This seems to suggest an interesting capability test for those who might like to know whether or not their receiver's performance actually is superior to the other fellow's. The receiver which can pick up the test signal from the greatest distance has the best sensitivity, of course. — *W. E. Bradley, W1FWH.*

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SENSITIVE BATTERY-OPERATED TEST RIG FOR V.H.F. WORK

A SENSITIVE field-strength and frequency meter employing miniature 1.4-volt tubes is shown schematically in Fig. 718. This compact unit has proved its usefulness in adjusting antennas and transmitters for maximum output, and for checking frequencies. It is also useful as an overmodulation indicator.

The circuit uses a 1T4 grid-leak detector and a direct-coupled 3S4 amplifier. When a signal is tuned in, bias on the grid of the 1T4 effects a decrease in the plate current of that tube. This decreases the bias on the grid of the 3S4, resulting in a rise in its plate current. The 3S4 is not biased to cut-off since to do so would bring the tube operation into an unfavorable portion of its cruve, resulting in lowered amplification.

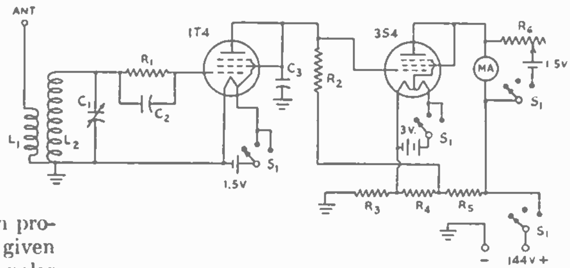

Fig. 718 — **Circuit diagram of a sensitive v.h.f. field-strength and frequency meter.**

C_1 — 2-plate midget variable.
C_2, C_3 — 0.0001-μfd. mica.
R_1 — 1 megohm, ½-watt.
R_2 — 0.5 megohm, ½-watt.
R_3 — 4000 ohms, ½-watt.
R_4 — 15,000 ohms, ½-watt.
R_5 — 10,000 ohms, ½-watt.
R_6 — 1200-ohm potentiometer, wire-wound.
L_1 — 2 turns No. 14, wound at grid end of L_2.
L_2 — 3 turns No. 14, ½-inch diameter, spaced diameter of wire.
S_1 — 4-gang 3-position rotary switch.
MA — 0–1 ma. or less.

The purpose of the battery and rheostat, R_6, in the meter circuit is to balance out the static plate current of the 3S4. The connections of the filament switch, S_1, are arranged to permit the tubes to draw current the instant that "B" voltage is applied. Otherwise, before the filaments were heated a reverse current of 4 or 5 ma. would flow through the meter, with possible disastrous results.

Everything except the "B" battery is assembled in a sheet-metal box measuring about 7 × 4 × 3 inches. The tubes and tuned circuit are mounted on a shelf placed just far enough down from the top so that tubes can be inserted and so that the tuned circuit will clear the box cover. Other components, including the 1.5-volt dry cells, are mounted below the shelf.

Flashlight cells are used for the filaments and meter circuit, while one of the Signal Corps BA-32s, made available for WERS installations, supplies the high voltage. A voltage divider, R_3, R_4, R_5, is placed across the 144-volt section of the BA-32 to supply the various voltages required in the direct-coupled amplifier.

When the unit is used for checking modulation it will be observed that the meter kicks up to about twice its normal reading, on peaks, with 100 per cent modulation.

Satisfactory indications can be obtained at distances of 20 to 30 feet from the usual types of mobile WERS rigs, and up to 100 feet from the more powerful fixed stations. — *Robert S. Smith, LSPH, 3019 Ruckle St., Indianapolis 5, Ind.*

8. *Hints and Kinks . . .*

for Keying and Monitoring

KEYING E.C. OSCILLATORS

HAVING built the e.c.o. described by Browning and Tilton in *QST* for July, 1938, I encountered trouble in keying the oscillator for break-in work. Since many others have undoubtedly built the same unit, the simple change I made should be of interest. The original circuit is shown in Fig. 801-A, while the revised circuit is shown at (B). With the original circuit, the short-

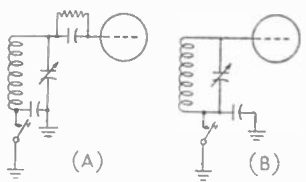

Fig. 801 — Removing the blocking condenser from the tuned circuit eliminated keying chirps for W9UUH in using the Browning e.c.o. B shows the revised circuit.

circuiting of the blocking condenser apparently changed the tuning sufficiently to cause a very decided chirp. Even the difference in lengths of the paths between the base and the dot and dash contacts of my bug was sufficient to cause a noticeable difference in frequency. With the revised circuit all of these difficulties were eliminated, and the unit keys very well.

The change requires insulating the tuning condenser from ground. — *Lafe H. Rees, W9UUH.*

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In the circuit shown in Fig. 802, an old anti-blinking scheme is used by W. Wallace, W9EYH,

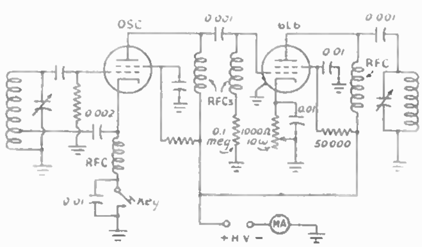

Fig. 802 — The variable cathode resistor in the buffer stage is adjusted so as to keep the plate voltage constant during keying in W9EYH's e.c.o.

to keep the plate voltage constant while keying his e.c.o. A variable cathode resistor in the 6L6 buffer stage is adjusted so that the total current read by the meter is the same with key open or closed. The load remaining constant, the voltage also remains constant under both conditions. Since the total current is between 45 and 50 ma. the 6L6 buffer need dissipate only about 12 watts, which is well within rating.

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ANCHORING THE BUG

FOR once, the brasspounder gets a lift from the bee-keeper. Those who are fed up with chasing a bug all over a slippery table top, but who do not wish to disfigure the table, may simply go to a bee-keepers' supply house and purchase a sheet of what is known as "brood foundation." This is a thin, waffle-like sheet of beeswax, used by the bees to build their comb upon. If the wandering bug is placed upon a sheet of this material, just laid upon the table, I defy a blow from a twelve-pound sledge to move it in any direction.

Why did I have to suffer for years before discovering this? — *H. Seymour Jones, W6AX.*

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CHEAP RELAYS FOR KEYING AND OTHER USES

PERHAPS many of the radio amateurs have overlooked an excellent supply of relays for keying, control and numerous other uses around the ham rig.

With simple adjustments and alterations, inexpensive auto generator cut-outs make reliable, fast-acting relays which can follow a "bug" at 40 w.p.m. These cut-outs can be picked up when discarded at garages. About half of these so-called worthless cut-outs are still serviceable as relays. If worst comes to worst, brand-new ones can be purchased at mail-order houses for as little as 27 cents each, prewar price.

The alterations are simple. Carefully remove the dust cover. Cut and remove the larger outer winding from the core, being careful not to damage the high-resistance winding of fine wire. Next, loosen the spring tension on the armature. This is necessary because the tension is factory-adjusted to require a generator voltage of about 7 to close the contacts. By loosening this tension, the relay will work satisfactorily on as low as 1½ volts, although 3 volts is better. The spring tension is adjusted by bending the spring holder or stretching the spring, according to the individual relay construction.

When the tension is okay, clean the contacts (if an old cut-out is used), adjust the spacing of the contacts, put a connecting lead on the lower contact strip, and replace the dust cover.

These units make excellent relays where single-contact single-throw is needed. They are fully shielded and quite noiseless in operation. I have found the Ford cut-out makes the best relay and is easiest to convert, although Delco-Remy and others are satisfactory.

Originally the upper contact is shorted to the frame of the relay, along with one lead from the high-resistance winding. If desired, a little ingenuity will show how to insulate these two connections. — *Harold K. Long, W7CQK.*

OSCILLATOR KEYING CIRCUIT FOR CLICK ELIMINATION

Fig. 803 shows an oscillator keying circuit which I have found effective in eliminating key clicks. Even with a 2A5 at 250 volts, clicks with ordinary cathode keying were ruining reception on all b.c. receivers here — and there are ten of them in the building. In this circuit an impedance, *L*, is inserted between the cathode and ground to prevent oscillation and yet maintain a d.c. connection between cathode and ground. This causes the oscillator tube to draw screen and plate current continuously and, if the load is adjusted to the correct value, a set of conditions may be found wherein these currents are essentially the same with the key open or closed.

Any inductance which, with the stray capacities connected across it, will tune the cathode circuit to a frequency lower than that of the crystal should prevent oscillation. I use an r.f. coil taken from an old b.c. receiver. The chief disadvantage of the circuit is that the key leads form part of the r.f. return circuit, although it works successfully with keying leads up to at least 6 feet long.

One nice thing about the circuit is that there is no d.c. across the key, so that you can put your

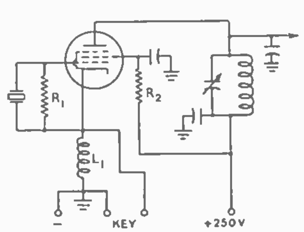

Fig. 803 — Keying circuit used by W5FXO to eliminate clicks. L_1 may be almost any coil resonating in the circuit at a frequency lower than that of the crystal. R_1 and R_2 are the usual grid leak and screen-dropping resistors, respectively, 50,000 and 20,000 ohms for a 2A5. Other tubes will require other values.

fingers across the key without getting hurt. It is a simple job to change over any standard cathode-keying system merely by substituting the coil for the usual by-pass condenser. While I have not tried the circuit with the 6L6, it should work equally well with a coil of appropriate size. However, plate voltage should be limited so that the rated dissipation of the tube is not exceeded when the circuit is not oscillating. — *Lucius Smith, W5FXO.*

Note. — This circuit is quite similar to the one in which a cathode resistor is used instead of the inductance. The resistance method has the advantage that the key leads may be by-passed, but it is not always possible to find a value of resistance which will stop oscillation and yet not cause considerable difference in plate current when the key is open. — Editor.

KEY-CLICK FILTER

Fig. 804 is a variation of the usual resistance-capacity key-thump filter as applied to center-tap keying. In ordinary practice the grid leak or bias supply return is to ground; in this case it is made to the junction of a resistor and condenser connected in series across the key.

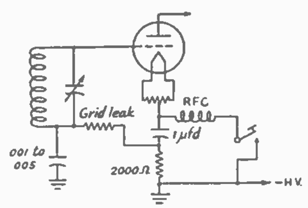

Fig. 804 — Key-click filter for center-tap keying.

The probable effect of the change is to slow down the cutting off and building up of grid bias, thus helping to round off the sharp break which results in clicks.

This suggestion, which comes from W8EWM, no doubt also may be applied to circuits having parallel grid feed as well as the series arrangement shown in Fig. 804.

SYSTEMS FOR BREAK-IN AND KEYING MONITORING

For several years I have been watching for a simple solution to the break-in problem for c.w. operation. I was after some system which would be foolproof and one which would eliminate the nerve-racking clicks and thumps that invariably occur when the receiver is tuned near the transmitter's operating frequency. I thought it would be nice if the system could include a means of monitoring when using a bug key.

Fairly good results had been obtained using a system of relays, although the relays did not seem to follow well enough for keying at higher speeds and the relay noise interfered with proper keying monitoring. After considerable experimenting I developed a system which requires no relays.

eliminates noise from the transmitter and provides for excellent monitoring of keying.

With a little experimenting, any amateur should be able to adapt the principles to his own equipment. Very few parts need be added to incorporate the system, as shown in Fig. 805-A.

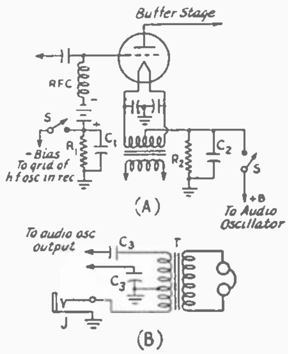

Fig. 805 — W8NCJ's break-in arrangement for obtaining plate voltage for the keying-monitor oscillator and blocking voltage for receiver from resistances in buffer stage. C_1 and C_2 are each 0.01 μfd. S_1 is an ordinary toggle switch which is necessary only in case it is desired to have means of cutting off either voltage. See text for suggested values for R_1 and R_2. (B) shows the method of coupling the output of the audio oscillator to the headphones. *J* is the headphone jack in the receiver, C_3 is 0.1 μfd. and *T* is a push-pull audio transformer.

Since most successful break-in systems require oscillator keying, the following amplifier and doubler stages must be biased to plate-current cut-off with excitation removed to prevent plate-current flow in these stages when the key is open. Clicks in the receiver are prevented by making the high-frequency oscillator in the receiver inoperative during the periods when the key is closed. This is accomplished by a blocking voltage which is automatically applied to the control grid of the high-frequency oscillator whenever the key is closed. This negative voltage is obtained from the drop across a resistance, R_1, placed in the grid return lead of one of the buffer or doubler stages. The value of this resistance may be determined from Ohm's Law by dividing the blocking voltage required (usually about 10 volts) by the grid current in decimal parts of an ampere. In my case, the grid current is 15 ma., so a 1000-ohm 1-watt resistor for R_1 gives a blocking voltage of 15. Receiver and transmitter chassis must be tied together and a 2.5-mh. r.f. choke connected in series with the wire to the control grid right at the tube. Since a 6J7 tube is used in the h.f. oscillator of my receiver, connection was made simply to the grid cap without disturbing any of the receiver wiring. If a single-ended tube is used in the h.f. oscillator circuit, it will be necessary to run the wire for the blocking voltage underneath the chassis to the receiver oscillator socket.

Tests were made with the blocking voltage applied to the grids of other tubes in the receiver, but blocking of the h.f. oscillator seems to remove the racket from the transmitter most completely. If it is desired to prevent possible damage to r.f. tubes, the blocking voltage may be applied in a similar manner to the grids of these stages as well, but I have not considered this necessary nor worth the added complications.

A monitoring signal for checking keying may be obtained from either an audio oscillator coupled to the headphones or an i.f. oscillator coupled to the i.f. amplifier. Plate voltage for either type of monitor may be obtained from a second resistor, R_2, connected in the plate return circuit. The value for this resistor may again be determined from Ohm's Law by dividing the plate voltage desired (usually 30 to 50 volts) by the combined plate and grid currents. My buffer draws 30 to 40 ma., so a 1000-ohm, 5-watt resistor gives 30 to 40 volts for the audio or i.f. oscillator.

The resistances should not be of higher value than required to obtain the necessary voltages for proper operation. This will be particularly important in case a very high-μ tube, such as the zero-bias type, is used in the transmitter stage, since the combination of resistances and fixed bias for plate-current cut-off may cause over-biasing of the transmitting tube. With low-μ types, the added bias from the resistance drops will not be of consequence.

Blocking of the h.f. oscillator in the receiver prevents blocking of the i.f. amplifier by the strong signal from the transmitter, so that a monitoring oscillator operating at the i.f. of the receiver will work satisfactorily. In case an audio oscillator is preferred, I would suggest that it be coupled to the headphones through a transformer as shown in Fig. 805-B. Simple capacity coupling will sometimes result in a.c. modulation of the received signals.

Since both voltage for blocking the h.f. oscillator in the receiver and plate voltage for the monitoring oscillator are developed automatically whenever excitation is applied to the buffer amplifier, no relays are required. — *R. R. Rosenberg, W8NCJ.*

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While this particular system of keying a transmitter is not new, it is not in general use among amateurs. This arrangement eliminates the necessity for bias batteries or packs and will work nicely regardless of whether the transmitter operates from a single supply or from individual supplies for each stage.

The keying system used is of the blocked-grid type in which all stages of the transmitter are keyed simultaneously and for which the blocking voltage is obtained from the drop across a common cathode resistance. This resistance is of sufficiently high value to limit the plate current of the stage requiring the highest cut-off bias to a low value. Other stages will be completely cut off. The key merely short-circuits this resistance. The only disadvantage of the system is that the amplifiers will draw high plate current should the oscillator fail to function but only so long as the key is closed so that there is little danger of damage to the tubes.

The circuit includes an ordinary audio oscillator employing a receiving triode which feeds into the audio amplifier of the receiver so that the keying may be monitored. This oscillator is keyed simultaneously with the transmitter, since its grid return is tied into the common return lead. The output level may be adjusted by R_7, making it unnecessary to disturb the setting of the receiver audio gain control.

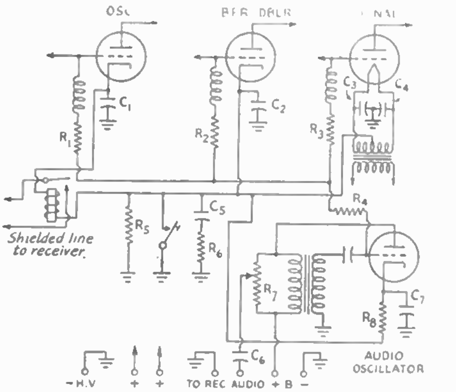

Fig. 806 — **Circuit of the break-in system described by W5DGP. See text for suggested values.**

The circuit, shown in Fig. 806, also includes a relay connected in the cathode circuit of the oscillator. A relay which will operate at the plate current of the oscillator may be used to disable or partially disable the receiver should this be found desirable. The leads between the relay and the receiver should be well shielded.

The resistances R_1, R_2, R_3 and R_4 are grid leaks of usual values appropriate for the tubes in use. C_1, C_2, C_3 and C_4 should have a capacity of about 0.01 μfd. C_7 should be at least 1 μfd.

The common cathode resistance, R_5, should have a value high enough to reduce the plate-current of the stage requiring the highest cut-off bias to a low value. The other stages will then be cut off completely. The value will probably be somewhere between 25,000 and 40,000 ohms, C_5 and R_6 form the key-click filter which may or may not be found necessary.

To further increase the smoothness of break-in operation and to reduce b.c. interference, it is advisable to use a line filter and a Faraday screen on the transmitter. With the break-in relay mentioned above and the Faraday screen, the 90-watt transmitter cannot be heard 10 or 15 kc. away from its frequency. — *Don B. Crouse, W5DGP and Harold Griffith, W5GEY.*

KEYING-MONITOR SYSTEM WITH AUTOMATIC RECEIVER BLOCKING

Having rejected most forms of monitoring arrangements requiring extra relays, power supplies, etc., I finally arrived at the one shown in Fig. 807 which seems to fill the bill perfectly here at W2GXW. As shown in the diagram, a simple triode audio oscillator feeds the monitoring signal into the headphones of the receiver through a 0.01-μfd. coupling condenser, C_2. J is the regular receiver headphone jack with the connection made to the ungrounded side.

Plate voltage for the audio oscillator is taken from the d.c. voltage drop across the grid leak (R_1) of one of the transmitter stages. Thus, the oscillator is keyed automatically with the transmitter. In my case, this stage is one in which an 809 is used where the biasing voltage developed across the grid leak is of the order of 75 to 100 volts. The scheme should work satisfactorily with any stage whose *operating* grid voltage does not exceed the plate-voltage rating of the audio oscillator tube. In cases where the operating bias voltage is higher, the grid leak could be tapped at a point which will give the right voltage. If a fixed biasing voltage is required for plate-current cut-off, it will be necessary to introduce it between the grid leak and r.f. choke as shown in Fig. 807-B to prevent continuous operation of the audio oscillator.

The biasing voltage is also applied to the grid returns of the r.f. stages of the receiver through R_2, effectively cutting these stages off whenever the key is closed. R_3 and C_3 form the usual a.v.c. filter in the receiver. The usual grounding switch which cuts out the a.v.c. is replaced with a s.p.d.t. switch so that the monitoring system may operate with the a.v.c. system off and that the monitoring system will not interfere with the a.v.c. system when it is in use. C_1 provides time delay which may be adjusted by a change in its capacity.

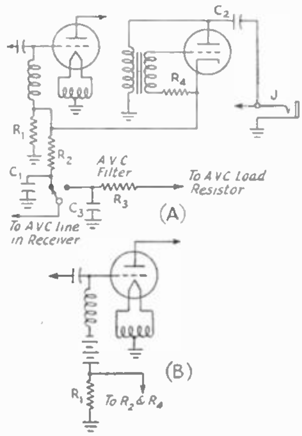

Fig. 807 — **Break-in keying-monitor system with automatic receiver blocking. R_1 is the usual grid-leak resistance recommended for the stage in use. R_2 is a 0.1 megohm 1-watt resistor. A capacity of 0.25 μfd. is recommended for C_2, although this value may be varied for a change in delay. C_3 is 0.01 μfd. C_3 and R_3 form the usual a.v.c. filter in the receiver.**

The circuit has no effect upon the operation of the transmitter since the current consumed by the audio oscillator is less than 0.25 ma.

The arrangement as shown in Fig. 807 has proved very satisfactory as only a few additional connections are required in the transmitter and receiver. The few extra parts for this device are also usually available. — *J. F. Masterson, W2GXW.*

ELECTRONIC MIXER FOR MONITORING

The circuit of Fig. 808 is suggested by Francis Higgins, W8RX, as a means of eliminating switching, split headsets, and other schemes which have been devised to permit feeding the monitored signal into the 'phones during trans-

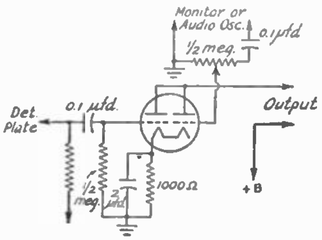

Fig. 808 — Using a twin triode for introducing the monitor signal into the receiver output.

mission. As the diagram shows, the first audio tube in the receiver is a twin triode. Its plates are in parallel but one grid is connected to the detector output and the other to the output of the monitor or keying oscillator. A gain control on the latter grid permits adjusting the monitor signal to the desired level.

This arrangement would seem to be ideal for monitoring with break-in.

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COMBINATION CODE-PRACTICE OSCILLATOR AND KEYING MONITOR

Fig. 809 shows the circuit diagram of a code-practice audio oscillator which may be converted for use as a keying monitor by a flip of the switch. This is a useful combination, since the unit may be used for code practice without the transmitter running or by keying in unison with a received signal from a tape transmitter. This practice has often been suggested as an excellent means of improving the correct formation of code characters.

When the unit is used for code practice the switch is thrown to position 2, in which 115 volts from the line is fed to the plate of the rectifier, the additional filter condenser, C_4, is connected across the output of the rectifier, and the key is connected in the circuit.

When the switch is thrown in the opposite direction the line voltage is removed from the plate of the rectifier, the key is short-circuited, and the extra filter capacity is removed. Plate voltage for the oscillator is now obtained from a pick-up loop, *L*, coupled to one of the transmitter stages. Thus no keying connection is required when the oscillator is used as a keying monitor because the oscillator operates only when the transmitter is being keyed.

The output of the oscillator is coupled to the headphones through a pair of condensers, C_1 and C_2. C_2 should be connected to that side of the 'phones which is grounded. This may be determined easily by interchanging the connections to the headphones. With the wrong connection very little, if any, signal will be heard. If a 'phone plug is used which leaves the 'phone tips exposed, it is a simple matter to make the necessary connections by means of clips.

The pitch of oscillation may be adjusted by varying the value of *R*. Only one connection for the 115-volt line is shown. The return is made by a connection to an actual ground, such as a water pipe or the station ground, as indicated in the diagram. If the power plug is inserted in the socket in the wrong direction, there is no danger of blowing a fuse should the chassis be grounded. Of course, no supply voltage will be obtained unless the plug is inserted correctly. — *1st Lt. J. M. Lattig, W9QJR/5*

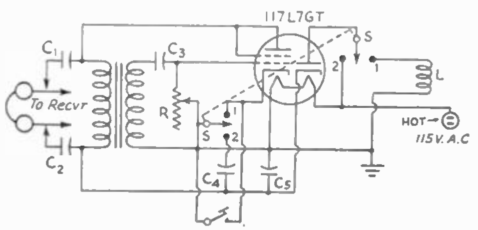

Fig. 809 — Circuit for a combination code-practice oscillator and keying monitor.
C_1, C_2 — 0.02 µfd.
C_3 — 0.002 µfd.
C_4 — 20 to 40 µfd. electrolytic, 200-volt.
C_5 — 0.1 µfd., 200-volt.
R — 0.1 meg. variable.
SW — D.p.d.t. toggle switch.
L — Pick-up link (see text).

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KEYING MONITOR

The 117-volt filament tubes can be conveniently applied to many amateur uses, for there are no dropping resistors nor transformers for the filament circuit. The keying monitor shown in Fig. 810 is a practicable application

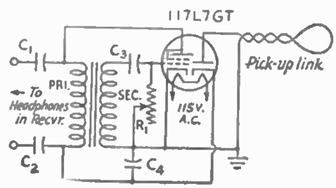

Fig. 810 — "Powerless" keying monitor used at W2FEN. Plate voltage for the audio oscillator is obtained by picking up and rectifying a small amount of r.f. from the output stage.
C_1 — 250-µµfd., mica.
C_2, C_3 — 0.01-µfd. paper.
C_4 — 0.1-µfd. paper.
R_1 — 0.1-megohm variable.
T — Audio transformer.

of the 117L7GT. It consists of an ordinary "growler" or audio oscillator which utilizes one-half of the tube, while the other half rectifies a small portion of the radio-frequency output of the transmitter to provide the required "B" supply for the "growler."

This circuit was developed to feed in parallel into the headphones which are connected at all times to the receiver. If the headphones are not to be used in conjunction with the receiver, C_1 can be increased to 0.01 μfd. This will give an increase in volume. On the particular receiver in use a ground hum could be heard distinctly until C_1 was reduced to a small value. The pick-up link consists of two turns of well-insulated wire, about 3 inches in diameter, connected to the monitor by a twisted pair. The amount of power used is very small, which allows the pick-up link to be coupled to almost any tank coil — with very loose coupling on high power. The grid leak, R_1, is a variable resistor to adjust the tone. This is the only adjustment necessary, since changing bands or varying the operated frequency has no effect.

Other types of monitors were tried but were either noisy in b.c. sets when coupled to the receiver, or needed adjustment for changes, in frequency, or were too complicated. This monitor is completely free from b.c. interference, needs no adjustment when frequency is changed, is very compact, and is easy to build. — *C. Ray Wagner, W2FEN.*

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BLOCKED-GRID OSCILLATOR KEYING

The circuit of Fig. 811 shows an arrangement for blocked-grid keying which, while somewhat limited in application, requires no extra supply for blocking voltage and has a certain

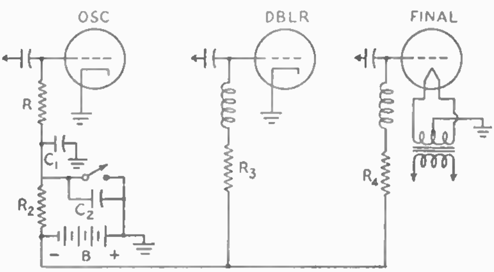

Fig. 811 — Circuit for obtaining grid blocking voltage for keyed oscillator from amplifier bias supply.
C_1 — Oscillator grid-leak by-pass, 0.01-μfd. paper.
C_2 — Lag condenser (adjust according to text).
R, R_3, R_4 — Usual grid-leak resistors.
R_2 — Keying resistance (adjust according to text).

advantage when battery bias is used. Its chief application is in the case of a keyed oscillator where some form of fixed bias is already provided for plate-current cut-off of following stages. The amount of fixed bias required for amplifier cut-off will in most cases be sufficient to block the oscillator.

When batteries are used for amplifier bias their service life is dependent chiefly upon the rectified grid-current flow, the life being approximately the same as though the battery were being discharged at the rate of grid-current flow. In this circuit this effect is offset by adjusting the resistance of R_2 so that the discharge current through the resistor with the key closed equals the grid current. The condenser, C_2, should be adjusted to produce the desired amount of lag for click elimination. Its value will depend upon the re-

low values of resistance for a given amount of lag. The scheme may also be applied in buffer or doubler keying in cases where the fixed bias required for plate-current cut-off of a low-μ final amplifier is sufficient to block a high-μ buffer or doubler. The circuit works very well with a keyed e.c.o. In this case, the use of C_1 is important to eliminate frequency variation.

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IMPROVING THE INEXPENSIVE BUG

Some of the inexpensive bugs tend to be unresponsive at speeds less than 30 w.p.m. This is often caused by an excessively stiff main spring. This fault may be corrected by increasing the flexibility of the main spring by decreasing its width at the point of vibration. The complete arm assembly should be removed and a notch ground out of each side of the main spring close to the supporting bar. The notches should be semicircular rather than V-shaped and enough metal removed to make the spring about one-half its normal width. The maximum dot speed is lowered, but the action is much snappier at all useful speeds. — *Chas. Rockey, W9SCH.*

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NOTE ON TUBE KEYING SYSTEMS

W5CY points out that a reduction in drive to a stage in which a tube keyer is connected may result if provision is not made to keep the operating bias at the same value as is used without the keying tubes. The amplifier grid return is normally made to ground as shown at (A) in Fig. 812 so that if the keyer tubes are connected between the amplifier center tap and ground the voltage drop across the keyer tubes will be applied as additional bias to the grid. W5CY suggests connecting the grid return to filament center tap, as shown at (B), but this leaves the keying tubes in the negative high-voltage line only. It should be possible to effect an equivalent remedy by simply decreasing the grid-leak resistance, leaving the grid return connected to ground and maintaining the center-tap keying arrangement.

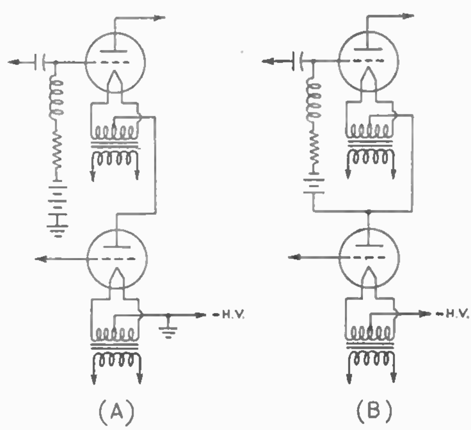

Fig. 812 — Grid returns with tube keyers. The common version shown at (A) may require an adjustment

9. *Hints and Kinks . . .*

for Test Equipment

SIMPLIFIED METER SWITCHING

To obtain meter economy, provide rapid meter circuit and range shifting, eliminate meter jacks, and avoid necessity of drilling many large holes in front panels, amateurs are now making wide use of meter switching. The installation at W3GKP incorporates a single 0–1 d.c. milliammeter in an arrangement for voltage and current measurements at the turn of a single knob. This simple metering system should interest fellows with multistage transmitters and limited measuring equipment.

The meter, a Weston model 341 with 33 ohms internal resistance, would require shunt resistance of 0.165 ohm for 200 ma. and 0.066 ohm for 500 ma. in the arrangement ordinarily used for milliammeter range multiplication. In view of the expense of such resistors and of the errors which would be introduced by an ordinary tap switch in series with the shunts, the higher-resistance arrangement of Fig. 901 is considered simpler and less expensive. A combination of series and shunt resistor values may be chosen which will permit use of stock sizes, and thus will make the cost of additional ranges only a few cents each. The resistor values should be held to reasonable limits, however, determined by permissible voltage drop across the milliammeter system.

Since a low-current milliammeter may conveniently be used for measuring electrode voltages, it was decided to incorporate a voltmeter in the switching system. The resulting voltmeter-milliammeter combination circuit is given in Fig. 902. Although there are shown only three voltage and three current ranges, the number which may be provided is limited only by the number of switch contacts and the available resistors.

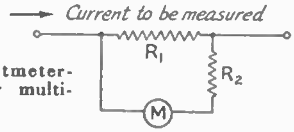

Fig. 901 — Voltmeter-type milliammeter multiplier.

With this switching arrangement all of the transmitter circuits involved are left in operating condition with the meter system connected, and the meter may be moved from one circuit to another, voltmeter or milliammeter, without interference to the transmitter operation.

The current shunt resistors, R_4, R_5, and R_6, are all 10-ohm 1-watt carbon units, except R_6 when used for 500 ma., which then should be a 5-watt wire-wound resistor. The values of voltmeter

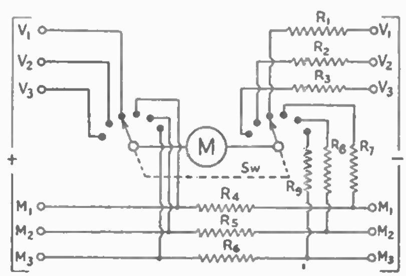

Fig. 902 — Complete three-range voltmeter and three-range milliammeter which may be used to read on any of six circuits by rotation of switch to proper position. Resistor values are given in the text.

series resistors, R_1, R_2 and R_3, and the milliammeter series resistors, R_7, R_8, and R_9, may be obtained from the table below:

Voltage Range	*Series Resistor*
100 volts	0.1 megohm
200 "	0.2 "
500 "	0.5 "
1000 "	1.0 "

Current Range	*Series Resistor*
25 ma.	200 ohms
50 "	450 "
100 "	1000 "
200 "	2000 "
500 "	5000 "

All of the above may be 1-watt carbon resistors except the 1-megohm resistor for the 1000-volt range, which should be two 1-watt 0.5-megohm carbon resistors in series, so that not more than 500 volts is placed between the ends of any resistor. Also, for each voltage range above 500, a 1-watt carbon resistor of 5000 ohms should be connected across the pair of switch points that are to be used.

One-watt carbon resistors can be obtained in a wide range of even values and have a reasonable constancy when not subjected to overloads. They can be supplied with tolerance of 5 per cent upon request, or the constructor may select accurate resistors by means of a calibrated ohmmeter. This provides an over-all meter accuracy well within 10-per-cent limits, an accuracy quite suitable for most amateur purposes. An exception to this is the measurement of current and voltage of an amplifier of more than 900 watts input. — *William L. Smith, W3GKP–N3GKP.*

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A MULTIRANGE V-O-M

I NEEDED a double-section multipoint rotary switch in the construction of a multirange volt-ohm-milliammeter, but couldn't get it. Since I had only a single multipoint switch section, the circuit shown in Fig. 903 was used.

For voltage measurements, a range is selected on the switch, and jacks J_2 and J_3 are used for the input. Resistors R_4 and R_5 (points 4 and 5) are the series multiplier resistors.

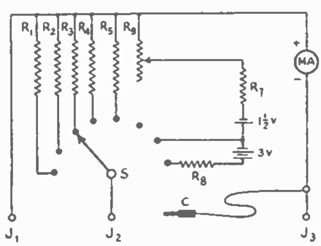


Fig. 903 — Circuit of the simplified multirange V-O-M.

R_1, R_2, R_3 — Current (shunt) multiplier resistors (values depending upon ranges desired).
R_4, R_5 — Voltage (series) multiplier resistors (values depending upon ranges desired).
R_7 — 1000 ohms, ½ watt.
R_8 — 3000 ohms, ½ watt.
R_9 — 1000-ohm potentiometer.
S_1 — Single section multipoint rotary switch.
J_1, J_2, J_3 — 'Phone tip jacks.
C — Flexible lead with 'phone tip.
M — 0-1 ma. milliammeter.

For current measurements, range 1, 2, or 3 is selected, flexible connector C is plugged into J_2, and J_1 and J_3 are used for the input.

For high-range resistance measurements, range 7 or 8 is selected and J_2 and J_3 used for the prods.

For low-range resistance measurements, C is plugged into J_2, while J_1 and J_3 are used for the prods.

The low-resistance range was designed for minimum current consumption. The number of ranges shown is merely suggestive and each builder may suit his own needs, within the limits of the switch available.

No values are given for shunts or multipliers, since these will depend upon the meter used as well as on the choice of ranges desired. [Data on their design will be found on page 420 of the 1945 *Radio Amateur's Handbook.* — EDITOR] A 1-ma. movement was the basis of my own meter.

This V-O-M is a practical, economical and efficient all-around service instrument. — *Pvt. David M. Rice, W2NXR.*

EXTENDING THE USEFULNESS OF A 100-KC. OSCILLATOR

A 100-kc. e.c.o. secondary frequency standard, such as one of those described in past issues of *QST* and in the *Radio Amateur's Handbook*, may be used for calibrating points between the usual 100-kc. intervals if advantage is taken of the fact that its frequency may be varied a few kilocycles either side of the 100-kc. point. If care is used, accurate points every few kilocycles may be obtained in the amateur bands, using b.c. station carriers as reference frequencies.

As an example, one of our local b.c. stations operates on 1320 kc. By increasing the frequency of the e.c.o. so that the thirteenth harmonic falls at 1320 kc. instead of 1300 kc., new harmonics at 3553.846, 3655.385, 3756.924, 3858.461 and 3960 kc. are obtained. Again increasing the frequency of the e.c.o. until the *ninth* harmonic zero beats with a carrier on 930 kc., still more frequencies may be spotted in the 80-meter band, viz., 3513.333, 3616.666, 3720, 3823.333 and 3926.666 kc. In certain cases, the same b.c. carrier may be used as a standard for more than one set of ham-band harmonics. For instance, a carrier at 1270 kc. will permit the calibration of both the twelfth and thirteenth harmonics of the e.c.o. with only a slight change in e.c.o. frequency. Thus two sets of ham-band points may be obtained with the single b.c. carrier as a standard. It is advisable to use only local or clear-channel stations, so that interference will not hamper adjustment to zero beat.

Considerable care must be exercised in making sure of the order of any particular harmonic being used, both in the b.c. band and in the amateur band. To minimize chances of error in the selection of the proper harmonics, it is advisable first to set the e.c.o. standard at 100 kc. by WWV, working from there as a starting point and marking the 100-kc. points on the dial of the ham-band receiver. Any changes in the 100-kc. setting of the standard should be made in very small steps, so that there may be no inadvertent shifting to harmonics above or below the desired one.

As an illustration, let us return to the case previously cited where a b.c. carrier on 930 kc. is used as the standard. The b.c. signal on 930 kc. is first tuned in on the b.c. receiver. Then the e.c.o. secondary standard is set to 100 kc., its ninth harmonic falling at 900 kc. If the frequency of the e.c.o. now is increased slowly until a beat is heard at 930 kc., it may be safely assumed that this is the ninth harmonic.

The harmonics in the amateur band should be watched simultaneously. With the e.c.o. set at 100 kc. the 35th harmonic will be found at 3500 kc., the 36th at 3600 kc., the 37th at 3700 kc., etc. As the frequency of the e.c.o. is increased the frequencies of these harmonics will also increase. When the e.c.o. is set so that a harmonic of known number is at zero beat with a carrier of known frequency, the frequency of the harmonic falling in the amateur band may be obtained by dividing the frequency of the b.c. carrier by the number of the harmonic being used in the b.c.

band and then multiplying by the number of the harmonic being used in the amateur band. For instance, in the example given above, the b.c. frequency is 930 kc. and the harmonic used in the b.c. band is the 9th, while those used in the ham band may be the 35th, 36th, 37th, etc. Therefore the frequencies in the amateur band are

$$\frac{930}{9} \times 35,\ \frac{930}{9} \times 36,\ \frac{930}{9} \times 37,\ \text{etc.}$$

Accuracy will not be materially affected by the use of broadcast-station carriers in the place of WWV for setting the e.c.o., since modern stations rarely approach the limit of the required tolerance of a deviation of 20 cycles from the assigned frequency. The inherent instability of a self-excited standard probably presents more of a limitation on accuracy than does the signal used for calibration. — *Allen Davis, W4CZN.*

CURRENT VS. COLOR OF PILOT BULBS

ALTHOUGH charts giving comparisons between percentage of emitted light and bulb current have been published, such charts are of little value without some means of making light intensity measurements. For example, how is one to know the percentage of full brilliancy of a bulb when the filament has just begun to glow with a dull red color?

To provide a means of using the apparent filament colors of pilot bulbs to indicate current values, various pilot bulbs were connected in series with milliammeter and batteries, and approximate data were taken for color-current comparisons. The results of the tests are shown in the graph of Fig. 904.

It will be noted in the chart that when the filament of the bulb becomes just visible, the current

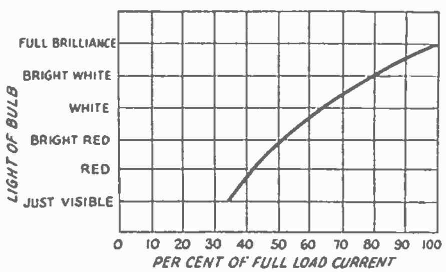


Fig. 904 — Variation in color of pilot-bulb filaments plotted against current values.

is approximately one-third full current rating of the lamp. For a No. 40 bulb this would be one-third of 150, or approximately 50 ma. With a No. 46 bulb the current would be one-third of 250 ma., or about 80 ma.

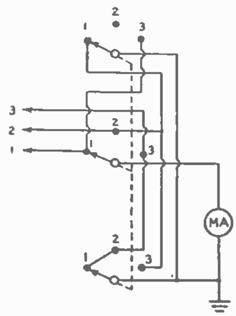
When the filament of a bulb becomes white, the current is approximately ⅔ full rating of the lamp — 100 ma. with a No. 40, or 160 ma. with a No. 46 bulb.

It is easy for the eye to distinguish between the various brilliancies from "just visible" to "white," and less easy for those between "white" and "full brilliancy," but the latter range applies only to approximately the maximum-current third of the range. The middle third of the current measuring range is accompanied by the most easily distinguished color changes in the bulb, and thus selection of the type bulb used for a definite purpose should be based on this range. When no light is visible in the bulb, the current is known to be between zero and one-third full rating of the lamp. — *Fred Sutter, W8QBW.*

METER SWITCHING

THE circuit of Fig. 905 shows a meter switching arrangement used for shifting a milliammeter to any one of three circuits. A three-pole three-gang switch does the job. The meter

Fig. 905 — A meter-switching circuit for handling three stages. A three-pole three-gang switch is required.



is connected in the cathode circuit of each tube, the extra gangs being needed to complete the cathode circuits of the unmetered tubes.

In common with all circuits in which the meter is in the cathode circuit, in this arrangement the current reading is that of the total tube space current. With triodes, the sum of grid and plate currents is read; with screen-grid tubes, the screen current also registers simultaneously with the grid and plate currents. — *Ted Hansen, W9IX.*

A USE FOR METER BOXES

A MEASURE of protection for meter and for operator results from a simple and ready use of the boxes in which meters are purchased. These boxes are usually provided with cardboard insert with large hole for the body of the meter.

In order to place the meter in immediate use, the meter and the small envelope of mounting screws are first removed from the box. A hole of ¼- to ½-inch diameter is then punched in one side near the bottom, and the meter connecting wires are carried through the side, then through the front of the box, and connected to the meter. The meter is then replaced in the box, and a sharp instrument is used to punch three small holes in the positions of the three meter-mounting holes. The three mounting screws then are pushed through the front of the meter into the holes, in which they should make a firm fit. This "boxed" meter is suitable for horizontal or vertical use on the operating table, and danger of having the connections contact metal objects or stray wiring is eliminated. — *George H. Jette, W1LEW, USN*

COMBINING THE FREQUENCY METER, 'PHONE MONITOR, AND KEYING OSCILLATOR

One of the most indispensable items of the well-dressed and well-operated ham station is the monitor, and no law-abiding amateur should think of doing without one even in these days of extensive crystal control. The best of crystals act up at times and the best of transmitters cannot always, therefore, be depended upon to perk merrily along right where it belongs; the only safe thing to do is consistently to check its operation to make sure that the signal is all in one lump, all in one place. The writer speaks from experience, remembering very vividly the expenditure of a brand-new five spot for a crystal guaranteed to hold the signal of VE2EE on a frequency of 14,398 kc.; the itch to ride the edge was upon me. Two ARRL Official Observers checked the signal at 14,403 kc. and sent me QSLs. Was my face red! At that time the station sported a monitor of the single-tube type which up to that time had been considered sufficiently reliable, but with trouble sneaking up on me so unsuspectingly I decided to build something that could be trusted. A search through *QST* brought to light articles on various frequency meter and keying monitor combinations. Culling the best features from all of these articles, and with apologies and thanks to the other boys, I worked out the useful multi-purpose gadget described here.

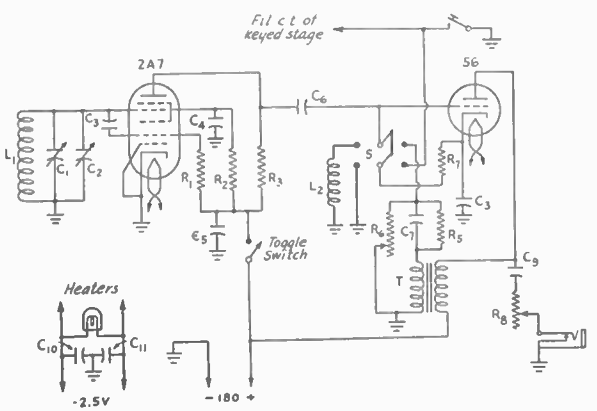


Fig. 906 — Circuit of the combination frequency meter, 'phone monitor, and audio oscillator.

C_1 — 25-μμfd. variable (bandspread).
C_2 — 50-μμfd. variable.
C_3 — 0.002-μfd. mica.
C_4, C_9 — 0.1-μfd. paper.
C_5, C_8 — 0.5-μfd. paper.
C_6 — 0.01-μfd. paper.
C_7 — 250-μμfd. mica.
C_{10}, C_{11} — 0.004-μfd. mica.
R_1 — 40,000 ohms.
R_2 — 100,000 ohms.
R_3 — 10,000 ohms.
R_4, R_5 — 0.5 megohm.
R_6 — 100,000-ohm variable.
R_7 — 15,000 ohms.
R_8 — 0.25-megohm.
L_1 — Inductance adjusted for frequency band desired.
T — Audio transformer.

The question of stability is naturally of prime importance. After talking the matter over with some of the boys the 2A7 was chosen for the oscillator, with the 56 to function as the detector. The unit was constructed and its performance exceeded all my expectations. The 2A7, after being allowed to settle, held the calibration error on the 14-Mc. band down to close to 1 kc., which is tol'able good.

It seemed to me that a 56, while doing a mighty fine job as a detector, could still be called upon to perform another duty. By rearranging the grid circuit it is made to function as an audio oscillator which provides a beautiful signal for listening to that bug. The circuit shown in Fig. 906 is easily constructed. Following through the d.p.d.t. switch it will be seen that on one side the cathode resistor is grounded, while the grid is connected to L_2. The coil L_2 consists of 5 turns of No. 20 on a tube base; without any tuning condenser it resonates at around 14 Mc. well enough to provide an S9 'phone signal with the switch in the oscillator plate in the "Off" position. *Voila*, the phone monitor!

With the oscillator plate switch closed, the carrier or keyed transmitter signal can be tuned in, by means of C_1. *Ici* . . . the frequency meter! With the d.p.d.t. switch in the other direction the grid of the 56 is connected through the grid leak and condenser, R_5C_7, and the audio transformer secondary to ground, while the cathode is connected through one wire to the center-tap of the keyed stage on the transmitter, above ground until the key or keying relay contacts are closed. The audio oscillator is thus keyed simultaneously with the transmitter. R_6 gives front-panel control of audio tone, and the pitch of the note can be varied for different ears between 300 and 5000 cycles. The volume control, R_8, provides a means of controlling the volume of the oscillator without affecting the frequency; this is essential, as the level of the audio oscillator is up about 15 db. over the output of the frequency meter. The toggle switch in the plate circuit of the 2A7 is necessary to prevent the r.f. oscillator signal from killing the audio oscillator, since C_6 is always in the circuit.

The 2A7 functions as a negative-resistance oscillator of the retarding-field type, with electron coupling to the output circuit. Its use was suggested to the writer by J. C. E. Mitchell, VE2LO. In the circuit shown, the No. 2 grid functions as a screen, the Nos. 3 and 5 grids together as a plate, and the No. 4 grid as a suppressor. The screen and suppressor are at the same r.f. potential, and when the potentials of both vary together, increasing screen potential will be accompanied by decreasing screen current and vice versa, thus giving the negative-resistance effect. The No. 1 grid is connected to the cathode. The circuit is simple to use, since no feed-back tap or coil is needed. — *Stan Comach, VE2EE.*

A SIMPLE TEST OSCILLATOR

The circuit of a simple test oscillator for lining up receivers is shown in Fig. 907. The tetrode section of the 117L7 is connected as a triode in a simple Hartley circuit, while the rectifier portion supplies plate voltage through the resistance-capacity filter, consisting of R_2 and C_2. Plate voltage may be adjusted by altering the value of R_2. With the value given, a plate voltage of about 10 will be obtained.

C_1 may be an old b.c.-receiver tuning condenser with a maximum capacity of 250 to 350 $\mu\mu$fd. I used two discarded i.f.-transformer windings in series for L_1, although other inductances may be used, depending upon the frequency desired. For instance, a 2.5-mh. r.f. choke with a 350-$\mu\mu$fd. condenser will just about cover the range of 465 kc. to 175 kc. This range includes all of the most commonly used intermediate frequencies, while harmonics will cover the higher-frequency ranges.

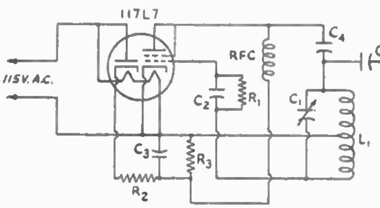


Fig. 907 — **Circuit diagram of a simple intermediate-frequency test oscillator for receiver alignment.**
C_1 — **Old b.c. condenser, about 350 $\mu\mu$fd.**
C_2 — **250-$\mu\mu$fd. mica.**
C_3 — **40-μfd. 250-volt electrolytic.**
C_4 — **0.001- to 0.005-μfd. mica.**
R_1 — **0.1 megohm.**
R_2, R_3 — **50,000 ohms, approximately.**
L_1 — **See text.**
RFC — **10 mh. or larger, or the winding from an old i.f. transformer.**

The most common type of r.f. choke is wound in four pies, so that a tap may be brought out from the center. It may be necessary in some instances to add a mica trimmer condenser in parallel with C_1 to cover the desired range.

The oscillator may be calibrated quite accurately, if desired, by beating harmonics against signals of known frequency in the b.c. band. Frequencies between 465 kc. and 275 kc. may be spotted by using the second harmonic of the test oscillator, while the remainder of the range to 175 kc. may be checked using the third harmonic. — *Bert Felsburg, W8VD.*

100-KC. CALIBRATING OSCILLATOR

The circuit of Fig. 908 is used for getting 100-kc. calibrating points. The oscillator uses a 6L6 tube with a self-resonant plate coil, and gives harmonics of good strength at frequencies as high as 30 Mc. The extremely low-C plate circuit and high-resistance grid leak contribute to the harmonic output.

Dimensions of the plate inductance, L, used at W9LSZ are given in the cut legend for Fig. 908. Its inductance should be such that the plate circuit will be resonant, in conjunction with the self-capacity of the coil plus the output capacity of the tube and the wiring capacity, at a frequency somewhat higher than 100 kc. — *Charles O. Becht, W9LSZ.*

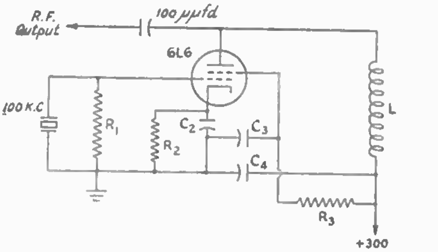


Fig. 908 — **100-kc. crystal oscillator using 6L6 for harmonic generation. The inductance, L, consists of three π sections, each of 500 turns of 10-strand Litz wire.**
C_2 — **0.25-μfd. paper.**
C_3, C_4 — **0.01-μfd. paper.**
R_1 — **8 megohms.**
R_2 — **500 ohms, 1 watt.**
R_3 — **25,000 ohms, 2 watts.**

BAND CHECKER

Here is the description of a gadget which I have found handy to have around the station. It is the absorption frequency meter in new form, consisting simply of a cardboard tube from a flashlight cell, on which a coil of No. 22 d.c.c. wire is wound, with a mica condenser of capacity anywhere between 100 and 250 $\mu\mu$fd. held inside by Duco cement. Pasteboard disks are cemented to the top and bottom of the tube, and a hole is drilled in the top disk for a flashlight bulb, to which wires are soldered. The bulb is held by more cement inside. All three are connected in series, as shown in Fig. 909. The turns are juggled until maximum brilliancy of the bulb is obtained when placed near a transmitter tank operating on the desired frequency. When the correct number of turns has been determined the coil is heavily doped. Final adjustment is made by squeezing the coil together or spreading turns before the dope sets. One can be made for each amateur band used, and also for troublesome harmonic ranges such as those in the vicinity of 10.5-12 Mc., 17.5-20 Mc., etc.

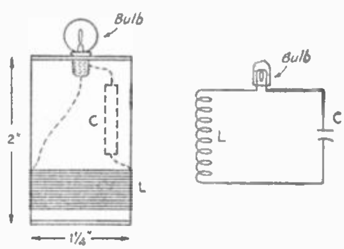


Fig. 909 — **Tuned-loop band indicator. Useful for checking the band to which a stage is tuned, also as a neutralizing indicator. C is a midget mica condenser of any convenient capacity, L a coil with turns adjusted to resonate with C at about the middle of a band.**

These pick-ups are considerably more sensitive than the usual loop and flashlight bulb. An indication can be obtained from a low-power transmitter about 7 inches from the tank, using the proper coil. The wrong coils have to be placed almost inside the tank coil before the bulb will light. — *Theo. J. Mesh, W1CCO.*

SIMPLIFIED FREQUENCY STANDARD

IN CASES where a strong local signal at the higher-frequency harmonics is not required for calibration purposes, the usual frequency standard may be simplified.

The abbreviated circuit is shown in Fig. 910. It will be noticed that the harmonic-modulated amplifier has been eliminated. The output of the 10-kc. multivibrator is used to modulate the 100-kc. oscillator directly.

The multivibrator (6N7) is locked at 10 kilocycles when $R_5 + R_6$ is about 20,000 ohms, using the constants shown in the figure. C_7 introduces the control voltage at the cathode and C_{10} connected to the suppressor of the 6SK7 results in suppressor modulation of the 100-kilocycle signal. The 10-kilocycle beat notes are slightly weaker than those at 100-kilocycle intervals and on 80 meters and higher every alternate beat note has quite a bit of hum, but this does not interfere with the ease of calibration. Output on the higher order of harmonics is naturally down, but the 14- and 28-Mc. bands can be calibrated using direct connection between the output condenser and antenna binding post of the receiver. — *W. B. Thompson, W8OKC.*

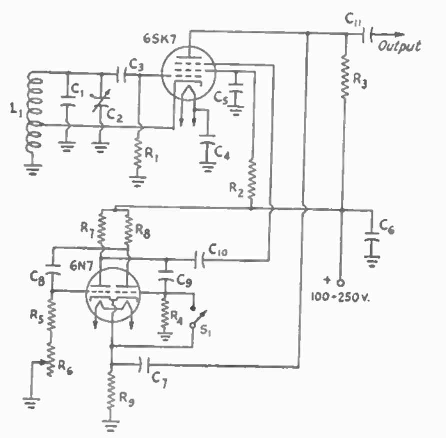


Fig. 910 — Circuit of simplified frequency standard.

C_1 — 0.0015-μμfd. mica (low-drift silver, if possible).
C_2 — 100-μμfd. variable.
C_3 — 250-μμfd. mica.
C_4, C_5, C_6 — 0.1-μfd. paper.
C_7 — 50-μμfd. mica.
C_8 — 0.003-μfd. mica.
C_9 — 0.002-μfd. mica.
C_{10}, C_{11} — 250-μμfd. mica.
L_1 — Coil from i.f.t. tapped.
R_1 — 250,000 ohms, 1-watt.
R_2, R_3 — 50,000 ohms, 1-watt.
R_4 — 40,000 ohms, ½-watt.
R_5 — 15,000 ohms, ½-watt.
R_6 — 30,000-ohm potentiometer.
R_7, R_8 — 3000 ohms, 1-watt.
R_9 — 300 ohms, 1-watt.
S_1 — S.p.s.t. toggle.

A SIMPLE BRIDGE FOR *C* AND *R* CHECKING

AN AUDIO test oscillator furnished the 100-cycle audio note for the *C* and *R* bridge shown in Fig. 911.

A double-pole, multiposition switch taken from the junk box, was used to switch from condensers to resistors in the standard position. A simple audio oscillator and power supply were built in so the unit would be complete and permanent. The oscillator can be any audio oscillator giving good headphone volume. The one used here is quite simple, with more than ample output. The only parts which may need adjustment are R_1 and C_1. They should be changed if necessary to get the desired note.

The bridge was calibrated by substitution of condensers and resistors of known accuracy in the position of the unknown "X." With two

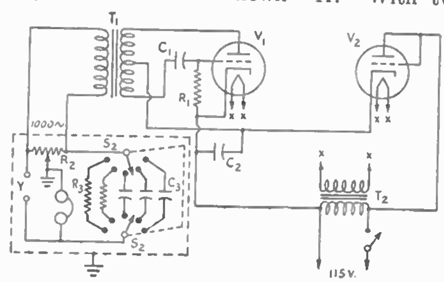


Fig. 911 — Circuit of a simple bridge for rough checking of unknown capacities and resistances.

C_1 — 0.002 μfd. mica (see text).
C_2 — 4-μfd., 300-volt filter condenser.
C_3 — Standard condensers (see text).
R_1 — 50,000 ohms to 0.1 meg., ½-watt.
R_2 — 2000-ohm potentiometer (see text).
R_3 — Standard resistors (see text).

resistors or condensers of like value in the two positions of the bridge circuit, a null point (or point of lowest volume in the 'phones) will be at the center of rotation of the variable resistor. Interchanging two resistors or condensers of known value, one of which is exactly ten times the value of the other (such as 10 ohms and 100 ohms, or 0.0001 and 0.001 μfd.), points can be found on the scale of the resistor control dial where the value of the unknown part is one tenth or ten times the value of the known standard. Other divisions can be found by substituting values of other relationships, such as two-to-one or three-to-one. Additional points can be found by careful interpolation between known points.

The only precautions in construction are to shield the bridge circuit proper from the rest of the unit, and to keep all leads solid, short and well spaced. The new silver-plated mica condensers made by several reliable companies make good standards, as they can be obtained with accuracies as high as 1 per cent at reasonable cost in the lower-capacity values (up to 500 μμfd.).

While this bridge definitely does not have the accuracy of some types described in *QST*, it is simple to construct and inexpensive. It is quite adequate for the occasional use required by most hams. — *Harry K. Long, W7CQK.*

10. *Hints and Kinks . . .*

for Code Practice

IMPROVING BUZZER TONE

Two of the objections to the buzzer for code practice have been its irregular tone and unstable operation. In trying to find the cause of this, it was observed that the buzzer tone became bad whenever the contacts took a spell of sparking excessively. It became apparent that the vibration of the armature would be more regular if the sparking could be stopped. The old stunt of placing a condenser across the contacts was tried. Various values were tried experimentally and it was found that a condenser of about 8 or 10 μfd. worked best.

The buzzer contacts should be cleaned and the condenser connected. Then the buzzer should be adjusted for optimum operation, since the adjustment will be different when a condenser is used. There appears to be a resonant frequency of the condenser and the inductance of the buzzer winding to which the armature vibration can be adjusted. The contacts then do not spark, the tone is smoother and stability of operation is greatly improved. — *Horace J. Marriman, W5AYO.*

B.C. AUDIO AS CODE-PRACTICE OSCILLATOR

Fig. 1001 shows the circuit of an audio oscillator which may be easily applied to any b.c. receiver having transformer coupling to the output tube. The arrangement makes an excellent code-practice oscillator, and for the busy person wishing to build such an oscillator with a minimum of parts this may be the answer.

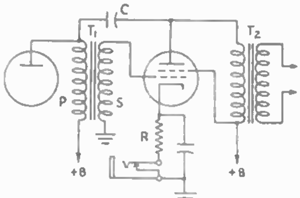


Fig. 1001 — Circuit connections showing how the audio end of a b.c. receiver may be converted to an oscillator for code practice. T_1 and T_2 are the input and output transformers, respectively. *C* may be varied from 0.01 μfd. to 0.1 μfd. for best tone. *R* is the usual value of cathode resistor.

The alterations required are very simple. The connection between the output tube cathode resistance, *R*, and ground is opened up and a closed-circuit jack for the key inserted. The only other addition necessary is the connection of a condenser of 0.01–0.1-μfd. capacity between the plates of the last two audio tubes. The pitch of the oscillator tone may be varied by changing the value of *C*. If desired, a switch may be placed between *C* and the plate of either tube so that the feed-back may be cut out for normal operation of the receiver. If the circuit fails to oscillate, it will be necessary to reverse connections to either primary or secondary of the input transformer, T_1. This reversal should not affect normal operation of the receiver.

In receivers employing resistance coupling, the input transformer would have to be added. — *Henry N. Fones, ex-W4GYV.*

A SURE-FIRE AUDIO OSCILLATOR

Recently the urge to own a good audio oscillator came up and, having plenty of old parts around the shack, I made up my mind that I would keep working at it until it would operate correctly.

The diagram of Fig. 1002 is the result, and it certainly is a sweet outfit considering the few parts needed. The audio tone can be varied over a considerable range; it can be adjusted to feed into any reasonable impedance load; the power output is high enough for any practical purpose; and, best of all, it is not a bit critical in regard to filament or plate voltage. The 6C5 tube will operate with less than 3 volts on the heater and I

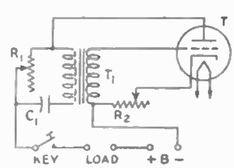


Fig. 1002 — Circuit of the sure-fire audio oscillator.

C_1 — 0.01-μfd. paper.
R_1 — Variable resistor (Old Bradleyohm was used here. Resonance was obtained at about 4200 ohms).
R_2 — Variable resistor that will cover 0–10,000 ohms or more (preferably with fine adjustment such as on Bradleyohm, in order to pick the correct note easily).
T — 6C5 tube (probably any triode can be used).
T_1 — Audio transformer.

have varied the plate voltage from 200 down to 45 volts without any trouble with oscillations stopping. The 45-volt tap was the lowest voltage tap that was available here at the time, but I believe that it would have continued working at very much lower voltages than that.

The best feature of this hook-up is the ability to change the tone pitch to any desirable note. This feature is particularly handy for i.c.w. work on the very-high frequencies since the note can be varied to just the correct pitch to cut through automobile interference.

Just a word about adjusting the outfit. You will find that both resistors will have to be varied at first to get the rig working, but a setting of R_1 will be found (in my case it was about 4200 ohms) where the resistance may be left alone and all changes in pitch will be obtained by varying R_2 in the cathode circuit. Any changes in load impedance or voltage on the tube may make it necessary to change both resistors again, but I have yet to find an impedance that will stop it from oscillating.

I hope this will help out some of the boys who have had their troubles trying to get an oscillator working. — *Gordon V. N. Wiley, W1AUN.*

A SIMPLE A.C.-D.C. CODE-PRACTICE OSCILLATOR

FIG. 1003 shows the circuit diagram of a simple code-practice oscillator which will operate from either a.c. or d.c. and which requires no transformers or other hard-to-get parts. The

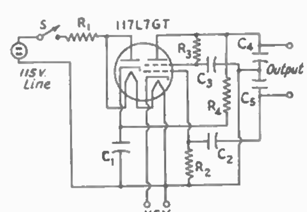


Fig. 1003 — Circuit diagram of the simple a.c.-d.c. code-practice oscillator.
C_1 — 8-μfd. 150-volt electrolytic.
C_2 — 0.01-μfd. paper.
C_3 — 0.05-μfd. paper.
C_4, C_5 — 0.02-μfd. paper.
R_1 — 50 ohms, 1-watt.
R_2 — 0.25 megohm, ½-watt.
R_3 — 1 megohm, ½-watt.
R_4 — 0.1 megohm, ½-watt.
S — S.p.s.t. toggle switch.

components can be thrown together on a baseboard within a few minutes. The oscillating circuit is a Colpitts with the headphone windings serving as the inductance. Either one or two pairs of headphones may be used across the output, or a dynamic speaker may be used by substituting the primary of the speaker transformer for the headphones. Naturally, the circuit will not work with crystal headphones.

The output of the rectifier section of the 117L7GT is filtered by C_1. The frequency of oscillation will vary depending upon the inductance of the headphones or output transformer used. This may be compensated for by altering the value of either C_4 or C_5. One-half-watt resistors will do for all except the line resistance, R_1. The toggle switch, S, should be connected in the "hot" side of the line and the key inserted in the grounded side. — *George Masin, Long Beach, Calif.*

HINT FOR BATTERY-OPERATED CODE-PRACTICE OSCILLATORS

IN using battery-operated code-practice oscillators, it is a common headache to find the filament turned on after not using the oscillator for several days. To minimize this possibility, we

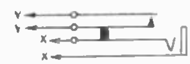


Fig. 1004 — Diagram showing connections to the filament-lighting jack. Terminals marked X go to the headphone circuit, while those marked Y are connected in series with one side of the filament.

use an old-style filament-lighting jack for the headphone connections. Thus the filaments are automatically turned off when the 'phone plug is removed. For those who have been born since 1920, the diagram of connections is shown in Fig. 1004. — *Fran Beck, W9DB.*

A "TRANSFORMERLESS" CODE-PRACTICE OSCILLATOR

THE diagram of Fig. 1005 shows a simple audio oscillator that requires no audio transformer and which can be built entirely from parts and tubes of any obsolete receiver. A pair of triodes of almost any type will prove satisfactory. Types 71A, 10, 45, 26, 30, 76, 56, 6J5 and 6C5 have all been used with equal results. A double triode, such as a 6N7, could be used to save space. When using directly heated tubes, the cathode connection should be made to a center-tapped resistor across the filament supply which consists of a transformer filament — winding or batteries, according to the types of tubes used.

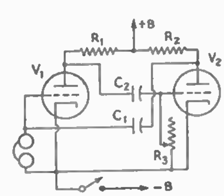


Fig. 1005 — Circuit diagram of the simple "transformerless" audio oscillator for code-practice use.
C_1, C_2 — 0.1- or 0.01-μfd. paper.
R_1, R_2 — 50,000 ohms, ½-watt.
R_3 — 0.5 megohm variable.
V_1, V_2 — Any pair of similar-type triode tubes.

The two condensers should be equal in value and may be either 0.01 or 0.1 μfd. The generated frequency, variable from about 120 c.p.s. up to the inaudible, is controlled by the variable resistor, R_3, which may be any rheostat or potentiometer having a resistance of 500,000 ohms or more.

With any type of tubes (or a combination, when rated filament voltages are equal), a supply voltage of 90 volts d.c. will be sufficient to drive a small p.m. speaker for group code practice. An increase in plate-supply voltage will raise the output level accordingly.

This circuit is a variation of the multivibrator oscillator circuit, and the note contains a certain amount of harmonics and is not altogether independent of the supply voltage. Inserting a variable high resistance in series with the output will make it possible to lower the frequency to as low as 20 c.p.s. Larger values of capacity at C_1 and C_2 will also serve to lower the frequency. — *Herbert F. Spirer, Springfield, N. J.*

CURING CROSS-TALK IN CODE-PRACTICE TABLES

THOSE who have constructed code-practice tables for group instruction and have had trouble from cross-talk between circuits when using the usual type of high-resistance headphones will be interested in the results of an investigation of the problem made by J. R. Ortiz, W2KEV, in connection with three tables patterned after the model described in the Defense Edition of *The Radio Amateur's Handbook* and also in *QST* for May, 1941. The original circuit is shown in Fig. 1006.

Three code-practice tables, each containing ten positions, were wired strictly in accordance with the diagram. Each table developed cross-talk trouble: that is, the table could not be divided into several independent communications circuits without interference between circuits. Capacity between key contacts was first suspected and several tests were made to determine if this was responsible for the trouble. All keys were disconnected and removed entirely. The cross-talk still prevailed, indicating that the key capacity was not responsible. Next the keys were replaced and all switches removed. Since the switches are open when it is desired to send to oneself, removing them entirely did not upset the wiring. The tone background immediately disappeared. The trouble reappeared when the s.p.s.t. toggle switches were restored, however. The toggle switches were then replaced with knife-type switches in which the contacts were quite distant from each other. The tone background reappeared but it was very weak, indicating that it was the capacity between contacts of the toggle switches that was responsible.

While working with the tables, W2KEV went a little farther. Two tables were wired with the knife switches. These are giving satisfactory service. In the third table, the toggle switches were again installed and the tone reappeared as expected. One by one the ten operating positions were cut out until, even with the toggle switches, the tone disappeared entirely. This occurred when five of the ten positions were out. With six positions, the tone reappeared; with seven, the strength increased; and with eight, it was as strong as before. Thus it would appear that five positions is the limit when toggle switches are used.

If the signal is sufficiently strong to allow some reduction, cross-talk may be reduced by shunting the 'phones with as low resistance as practicable.

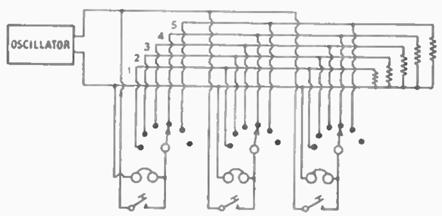


Fig. 1007 — This arrangement provides greater flexibility than the one shown in Fig. 1006. The two outside wires transmit the steady signal from the oscillator to each station, while the numbered wires each provide an independent communicating circuit. Stations wishing to communicate switch to the same line. The seven lines shown will take care of five independent communication circuits and any line may be monitored from any position. The loading resistors are discussed in the text.

While on the subject of code-table circuits, a slightly different arrangement is shown in Fig. 1007. With this circuit any combination of stations may work together on the same circuit or on different circuits. Each additional line provided will furnish an additional independent circuit. This arrangement is an improvement over that shown in Fig. 1006 in that stations which are not adjacent may work together independently of stations in between. For instance, with the circuit of Fig. 1006, should station No. 10 wish to work station No. 8, it would be necessary for station No. 9 to be included in the circuit also. With the system of Fig. 1007, any stations wishing to communicate merely switch to the same line. Those working on other lines are not disturbed. Monitoring of any circuit can be done from any position, and a student may send to himself without disturbing others by switching to the "off" position. The tap switches should be of low capacity, or a system of clips and screw contacts may be substituted. Each line should be loaded with resistance if cross-talk occurs. For a system including ten positions, a resistance value of a few hundred ohms should be sufficient.

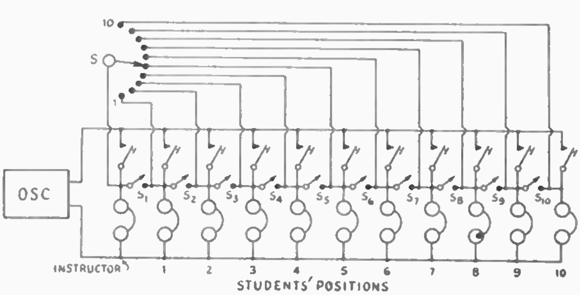


Fig. 1006 — Circuit diagram of the code-practice table wiring arrangement discussed by W2KEV. Switches marked S_1 through S_{10} are the toggle switches discussed in the text.

SIMPLE WIRING HARNESS FOR CLASS-ROOM CODE INSTRUCTION

Code instruction at the Pittsfield (Mass.) Vocational School must be carried on in a class-room which at other times is used for chemistry classes. The students' desks cannot be wired permanently, and no special code-practice table is available.

To solve this problem, a flexible wiring harness equipped with double Fahnestock clip connectors, together with a control panel for use on the instructor's desk, was constructed in such a way that it could be very easily installed and removed.

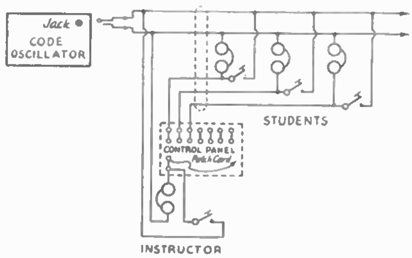


Fig. 1008 — Diagram of a flexible wiring harness and control panel for code-practice class use.

At the close of a class period the students simply remove their 'phones and keys. The harness is then rolled up around the control panel and the entire set-up is stored away until it is necessary to get it out for the next session.

Although fundamental ideas were drawn from the flexible code-table circuit described by W9LBJ in April, 1944, *QST*, a simplified circuit, shown in Fig. 1008, was designed to save wire and connectors. The smaller amount of wiring in the cable should reduce any possible tendency toward cross-talk and background tone. — *Milton A. George, W1BKG.*

A CODE-PRACTICE MACHINE

I have a code machine with which I mastered the continental Morse code, which can be built for little or nothing if one has or can get an old phonograph spring motor. I believe it will be of considerable interest to the would-be hams who read *QST* and the old-timer who desires to increase his code speed.

I thoroughly cleaned the motor, part by part in gasoline to remove any grit that would prevent smooth operation. The motor was carefully assembled and lubricated with a good grade of machine oil. In running a test on the motor I found that the speed of turntable shaft was too great and the power not sufficient to pull the tape, so the turntable shaft was sawed off at the frame and the gear shaft next to it was extended so as to obtain power there. In running a test on the motor again the speed was found to be correct and the power sufficient to pull the tape.

Constructional details are shown in Fig. 1009. I tape-mounted the motor with rubber shock absorbers on a sheet-steel foundation from the junk box and allowed the shaft mentioned above to protrude through. An old radio dial was mounted on it as a receiver for the tape. A post was mounted for the roll of tape. Guides were adjusted to assure accurate travel of the tape. A brass roller was used for the contact to make electrical connection through the tape. The tape travels on this brass roller similar to a belt on a pulley. The contact was filed from a brass screw in such a manner as not to damage the tape and mounted on a piece of spring brass in such a manner that it would make contact with the brass roller, thus making the dots and dashes as the tape traveled past. There are several adjustments on this contact strip to set the contact for proper pressure, etc.

The last thing to make was the cabinet which was made of wood, then stained and varnished. A buzzer and oscillator were tried on the machine, and both work FB. After about two months of steady practice of about two hours per day, I mastered 18 w.p.m. and passed the code test the first time I tried.

The machine made such a hit with other would-be hams that it has been in constant use since I finished with it, and is engaged for months to come. Only four tapes were purchased and they are in perfect condition after six months of continuous use. Tapes may be purchased for one dollar each.

The machine has a wide range in speed from about 3 w.p.m. to 60 w.p.m. and it is very easy to control the speed to suit the operator. Since these speeds cover all types of code practice, from learner's to expert's, I have not seen much of the machine, but if I am ever lucky enough to get it back, I hope to try it out on the air as an automatic sender and use it sometime for calling CQ, etc. Hi! — *J. S. Branch. W4FWO.*

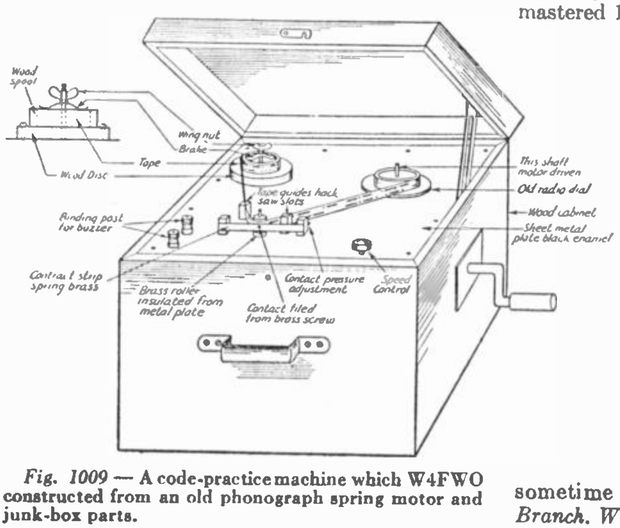


Fig. 1009 — A code-practice machine which W4FWO constructed from an old phonograph spring motor and junk-box parts.

11. *Hints and Kinks . . .*

for the Shack

DESIGN FOR A RADIO TABLE

The bench or table shown in the diagram of Fig. 1101 may be built by anyone possessing a fair degree of mechanical skill and with a minimum number of carpenter's tools. There are no complicated joints to make, and for the most part it is simply a matter of cutting the material and nailing it together. A bench similar to the one described has been in use at W6HGW for more than two years, and it has proved to be very satisfactory.

The most important, and at the same time the most difficult, part of a table to construct is the top. It must be smooth to permit writing with ease. At the same time it must be perfectly rigid. For one who is not equipped or inclined to go to the labor of joining and gluing several boards together to form a top there are two solutions. One is to buy a panel of ¾-inch five-ply Douglas fir veneer, which may be obtained in widths of four feet and any desired length. This sheet has a perfectly smooth surface and makes an ideal table top.

The other alternative is to fasten together several fairly smooth boards with cleats, and then cover the top with a sheet of one-eighth inch Masonite or Presdwood, which is sold under various trade names in different localities. The "tempered" variety is preferable, as it has a hard, almost varnish-like surface. It is fastened to the board top with small brass escutcheon pins, by drilling small holes in the Masonite along the edges about 6 inches apart and driving the heads of the pins down flush with the surface of the Masonite. A neat-looking edge may be secured by planing the edges of the boards and the Masonite after the latter is fastened in place. A more finished job is made by using some of the brass binding which is used for covering the seams of linoleum and tacking it down along the edges of the table.

The top must be supported, which can be done in two ways. If the landlord or the XYL will permit, the better plan is to build two brackets of 2 × 3-inch material, as shown in the sketch, and fasten them to the wall by means of large wood screws driven through the plaster and into the studding of the wall. In this way there are no table legs to get in the way of one's feet. The studding in the walls may be located by tapping along the wall with a hammer until it feels solid. The studding is generally on 16-inch centers. Hence, having located one stud, it is an easy matter to locate the others by a little measuring plus a bit of patience.

If the bracket form of construction is used, it will be necessary to stiffen the top between the brackets. This may be done by nailing a 1 × 3-inch piece across the front end of the brackets, and a 1 × 6-inch piece across the front of the vertical legs of the brackets, notching it so as to clear the horizontal bracket members.

By buying all lumber surfaced on four sides, the labor of building this table is reduced to a

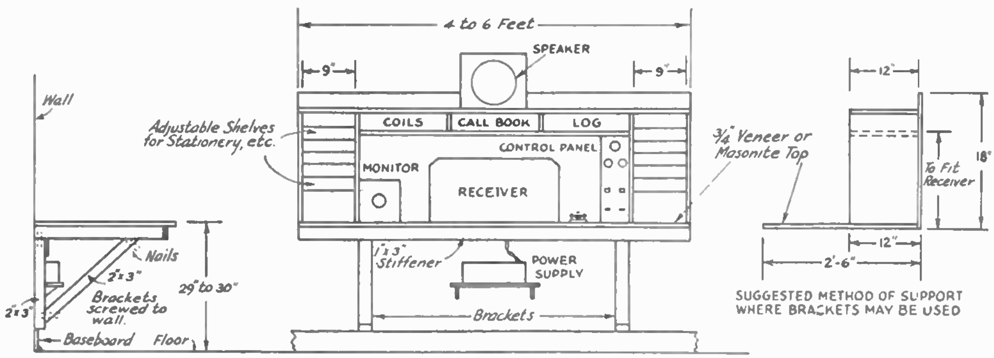


Fig. 1101 — **A home-constructed operating table incorporating maximum convenience and efficiency.**

great extent. The greater part of the work will consist of cutting the material and fastening it together. A good grade of pine looks well and, when sandpapered and finished with dark mahogany stain, it will make an operating table of which no one need be ashamed.

The table should be about 30 inches wide, and from 4 to 6 feet long, depending upon one's individual wishes. For best operating convenience the table top should be from 29 to 30 inches above the floor.

If the mention of fastening the table to the wall brings forth the storm clouds, it would be best to employ the more orthodox method of using four legs, as shown in Fig. 1102. These may

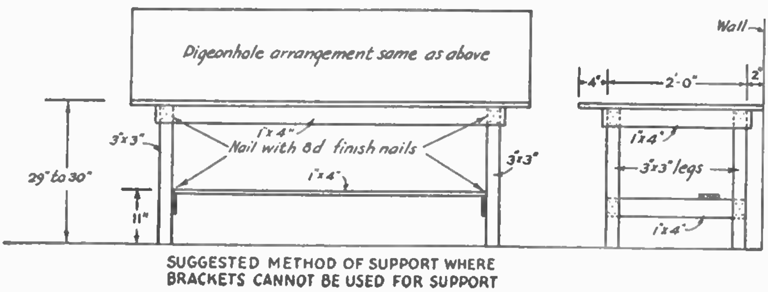


Fig. 1102 — Another method of supporting the operating table shown in Fig. 1101.

be made of 3 × 3-inch material, fastened at the top with 1 × 4-inch pieces, and with a cross piece at each end about eight inches from the floor and a longitudinal brace between them, as shown in the sketches.

Now, having the table, there is the question of arranging for log books, stationery, spare coils, a monitor, control panel and other miscellaneous gear besides the receiver. One's personal likes and dislikes enter into this to such an extent that it is hard to plan any definite set-up. However, the arrangement shown has proved satisfactory, and it is offered as a suggestion. The back panel may be the 18-inch piece left over after having cut the four-foot panel down to 30 inches. The rest of the shelves and pigeonholes may be made of 1 × 12-inch pine, which may be bought at the lumber yard surfaced on four sides, ready to be cut, and then nailed into place. All joints should be nailed with eight-penny finishing nails.

The receiver occupies the center of the large space, with the key and control panel on the right and the monitor on the left. The power supply rests on a small shelf under the table out of the way. The long spaces above the receiver are for spare coils, log book and call book. The speaker sits on the top shelf along with an electric clock. The small shelf on each side will hold stationery, pencils, magazines and books. These shelves may be made of wood, or better, of metal. By making saw-cuts in the side pieces about an inch apart and ⅛-inch deep, pieces of 20-gauge galvanized iron may be slid into them to make shelves which are easily adjustable to suit one's convenience. — *Thomas O. Crow, W6HGW.*

RACK-STYLE OPERATING POSITION

It is always somewhat of a problem to decide upon the operating position which offers the greatest advantages. My solution is shown in Fig. 1103. The space is put to use as follows:

A — loud speaker.
B — antenna tuner.
C — small monitor.
D — final amplifier.
E — exciter stages (two or three).
F — power supplies (receiver supply included).
G — receiver.
H — log, call book, writing paper, etc.
I — panel for switches controlling the 115-volt lines.
J — key.
K — tools, QSL cards, neon bulb, plug-in coils, etc.

The shelf at *L* is mainly a support for the bottom of the structure. It can be used for the speech amplifier and its power unit, and also to accommodate magazines, books and the miscellaneous boxes of screws which, I believe, are standard equipment in every well-equipped amateur station.

The space *H* may be made as a sort of pedestal setting inside the space for the receiver, and the receiver rests upon it. The writing desk is hinged at the bottom and may be folded up when not in use thus hiding the equipment.

Panels may be used on the shelves that slide out, if so desired. The top and bottom shelves are put in permanently while the ones in between slide out in case repairs to the apparatus become necessary. — *Winston V. Bradbury, W5CIQ.*

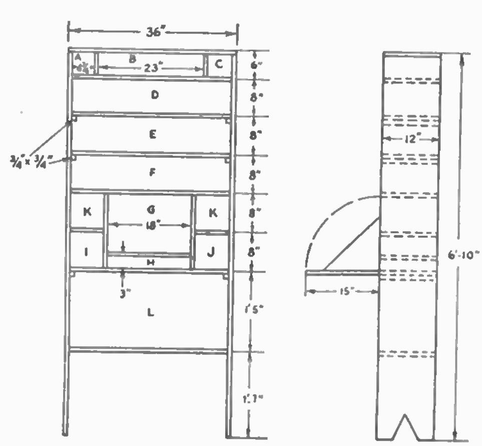


Fig. 1103 — A rack-type operating position and writing shelf requiring only three square feet of floor space.

UNUSUAL IDEAS IN TRANSMITTER CONSTRUCTION

The question of a simple and inexpensive design which will afford protection for the transmitter against dust and most accidents is at least partially answered by G. P. Anderson of G2QY. The essentials of construction are shown in Fig. 1104. The transmitter consists of a series of chassis bases for the various units mounted on a simple arrangement of shelves. The unusual feature is the depth of the bases which is sufficient to accommodate all circuit components except the tubes and the tank coils which are accessible for changing. With the tubes and coils removed, the tops of the bases present comparatively smooth surfaces which may be easily dusted. Power supply connections are made through cables with attached plugs, so that each unit can be readily removed if servicing becomes necessary.

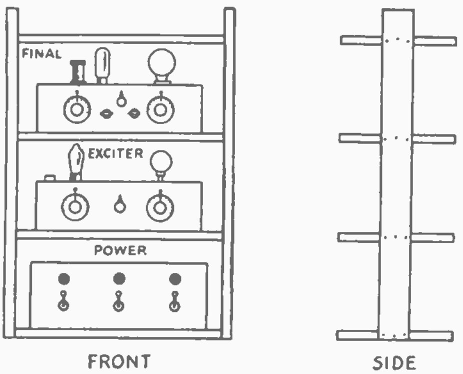


Fig. 1104 — A simple design for low- and medium-power transmitter construction which affords protection from dust and provides easy access for alterations.

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William M. Hildebrand, W8LOF, describes the novel construction of his rig, which is built into a cedar chest:

"Very few mothers or wives, who are obliged to tolerate the presence of a ham in the home, would object to an attractive cedar chest full of radio apparatus even if it is in the living room. Although it might not be their idea of good furniture arrangement to have such a chest in the living room, it would be much preferred to that of any other type of construction in which many dials, switches and other gadgets would protrude from the panel.

"The chest may be purchased at a surprisingly low cost at nearly any furniture store, or it may be built if one is particularly apt in the construction of such things. Neatness in appearance is the prime factor in the mind of the mistress of the household, and this factor should be reckoned with in the decision as to whether to buy or make the chest.

"The exterior appearance is very appealing, as shown in Fig. 1105. Only the meters, name plates, and jewel lights are to be seen. The insulators for feeder connection may be mounted on the end, while all wires leading to the chest should enter from the rear.

"For the greatest accessibility the transmitter is constructed on removable breadboards. The breadboards are supported at each end by 1 × 1-inch wooden strips, and are securely fastened to the inside of the chest with screws. The condensers are mounted on end so that the dials will face upward and the plug-in type of coil is used in the transmitter.

"All connections to the meters, key and power leads should be made with plugs and jacks to facilitate the removal of the breadboards from the chest. The breadboards need be only as wide as the apparatus requires and the remaining space may be used advantageously by building in small boxes in which to store the extra coils, soldering iron, reserve tubes, screwdriver, neon lamp, and other items which are convenient to have at hand. The power supply unit is mounted on the bottom breadboard and the r.f. unit on the top breadboard. By merely raising the lid, the necessary tuning or coil changes may be accomplished with the minimum of effort.

"It is necessary to bore small holes in the bottom of the chest and others toward the top of the back panel to furnish the necessary ventilation. The short legs of the chest raise it far enough above the floor to permit air to circulate freely through the chest, thus keeping the apparatus at a moderate temperature. [A small electric fan might help to lower the internal temperature. — Editor.]

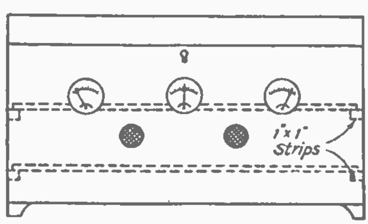

Fig. 1105 — W8LOF overcame family objections by building his entire transmitter in a cedar chest. Tuning controls are under the cover.

"A transmitter in a chest of this design would not only overcome the undesirable appearance of the usual transmitter, but would provide accessibility for coil changes or minor alterations and yet permit enclosing the entire unit against dust-accumulation and tampering by visitors or other members of the household."

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Another novel and neat arrangement of transmitter gear is that depicted in Fig. 1106. It is described as follows by Ernest L. Moline, W9SWT:

"It so happens that this problem parallels one from which I, in my own opinion at least, emerged victorious after having been plagued by it for months. Though the problem is mutual, there might be a vast difference between the architectural arrangements of respective homes which would prevent operation in the living room; but if a fellow is fortunate enough to have a clothes closet adjacent to his living room, or for that matter any unoccupied anteroom, I'm sure he will benefit from the solution which I am about to describe.

"While actual construction has not been commenced, the closet door has been measured and its cost meditated upon, as have the prices of costumers which must inevitably carry the burden of the evacuated clothes closet. After careful perusal of various mail-order catalogs, it has been found that the combined costs of a new door and a costumer is far below that of a standard commercial relay rack.

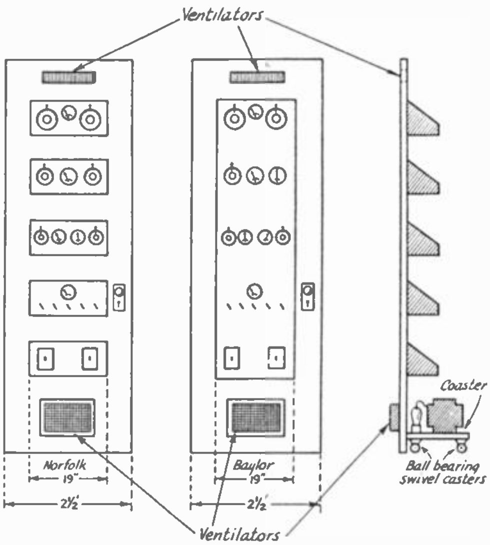

Fig. 1106 — A spare clothes closet adjacent to the operating position makes an ideal location for a transmitter, with the equipment mounted on the door.

"It may not be absolutely necessary to purchase a new door, but in most cases it will be much safer to stow the old door away somewhere in the attic for future replacement in the event that the experiment goes awry, and equip the closet or anteroom with a new door of identical style and finish. The reason for this precaution is obvious after it is learned that the door is to become the victim of drills, chisels and what-not; and will eventually emerge from the operation full of meter-holes and the like. With the anticipation of such mutilation in the mind of whoever must grant permission, that permission is more easily gained if the disfiguring is done to something besides an old heirloom or the property of a disagreeable landlord. In the end, if the work is painstakingly done, there is no reason why it shouldn't be attractive; and the chances are that the old door will be permitted to rest peacefully — and in one piece — in the attic.

"Door styles best suited to transmitter mounting are the Norfolk and the Baylor. If something more fancy is desired, the Windsor, which is basically the same as the Baylor, may be used. The Norfolk has five individual panels framed by the door proper and run horizontally, while the Baylor has only one vertical panel approximately four-fifths as long as the door and similarly framed. The width of the panels between the vertical parts of the frame on a door two and one-half feet wide is exactly nineteen inches, which makes this size door readily adaptable to the standard relay rack panels, if those are desired.

"Various methods of mounting the chassis can be employed and are best decided upon by the individual constructor. If the Baylor-type door is used, the paneling may be broken up into separate panels for mounting each deck from the front in conventional relay-rack fashion; or the mounting may be done from the rear, leaving the door panel intact, and presenting a much neater appearance. An example of the latter type of construction can be clearly understood and appreciated by reference to the article by George F. Wunderlich, W6DUW, on page 38 of the November, 1937, issue of *QST*.

"Now that the method of mounting has been decided upon, let's see if we can find any disadvantages. Possibly the only objectionable feature of mounting a transmitter on a door is the strain exerted on the hinges by the weight of the power supplies in high-power rigs, but this strain may be alleviated by mounting the power supplies permanently in the closet since there are no coils to change in a power supply. As an alternative, the power supplies could be mounted on a coaster to be moved back and forth into and out of the closet by the door.

"With the power-supply angle successfully overcome, this method of mounting the transmitter can offer nothing but advantages. Everything is flush with the wall and does not clutter up the room as a superfluous piece of furniture and, when adjustments need be made, the entire rig can be swung in an arc of 180 degrees for ease of accessibility. The high voltage is in a safe place during operation and away from inquisitive visitors; and it may also be kept away from the operator by providing interlocking switches to cut out the primary voltage to the hot stuff when the door is opened. Likewise, interlocking switches may be provided for connecting tuned feeders in the event that they are used. And when the rig is put off the air a master switch inside the closet may be opened and the door locked with the key hidden safely in the operator's pocket, insuring a thoroughly disabled rig until he returns to pound out another CQ."

SUGGESTIONS FOR DISPLAYING QSL CARDS

Little did we realize how vital the question of displaying QSL cards is to the modern amateur. His receiver tubes may burn out when he operates his transmitter, he may risk his life operating an exposed transmitter, his antenna relay may be noisy and he may catch pneumonia from draughty lead-in openings, but — by gosh! — he's extremely finicky about the way he cares for his QSL cards and how he shows them off to visiting firemen!

In writing a summary of the various ideas and combinations of ideas, we deemed it impracticable to make specific mention of the sources, in most cases, because most of the ideas were duplicated many times.

The problem resolves into three major portions, the first dealing with that of protecting the cards against dust, etc.; the second, that of devising a suitable mounting which would prevent marring walls; and third, methods of fastening the cards to the mounting with as little damage to the cards as possible.

Cellophane was chosen as a protective covering by the majority. Some wrapped each card in cellophane, fastening it at the back with glue or Dupont cement. Others used a large sheet to cover a group of several cards. Another scheme consisted of strips of heavy cellophane or celluloid the width of a card. Diagonal slits were cut in the cellophane strip to receive the corners of a card in a manner similar to that used in old-style photo albums. The use of adhesive photographic art corners also was suggested. In both latter cases, the cards were mounted on the cellophane strips with the faces of the cards against the cellophane. These strips, containing the cards, were suspended from the picture moulding. Still another scheme consisted of long horizontal pockets of cellophane made of a strip, somewhat wider than the height of a card, cemented at the ends and lower edge only. A series of these long pockets was mounted, one above the other on a suitable background. The cards may be inserted from the top. In another slightly modified form both top and bottom edges were fastened and the ends left open, so that a string of cards fastened together could be pulled through the pocket from end to end.

Several samples of wrapping were submitted and we tried some of our own. The chief objection to the use of cellophane seems to be that most of the inexpensive light-weight grades are affected seriously by changes in temperature and humidity. From the condition of most of the samples received, it seems very advisable to wrap cards very loosely to prevent buckling of the card when the cellophane shrinks. Ready-made envelopes in standard sizes are available at most stationery stores and were suggested by several. Perhaps the selection of a size which will fit the card loosely is the most satisfactory way of using cellophane for protection.

While we did not try the idea of a large sheet for covering a group of cards, it seems that wrinkling or bulging would still be a problem. A wrinkled or ripply surface makes it difficult to find any suitable position from which the cards may be viewed without experiencing the glare from reflected light.

To our minds, the most satisfactory method of protecting cards against soiling consists of brushing or spraying the cards with a protective waterproof preparation. We doubt if the process would be any more tedious than that of preparing a cellophane covering. It should be less expensive, the problem of wrinkles is avoided, and the cards are furnished with a permanently preserved finish which permits washing the cards, if necessary, without damage to the cards. Clear lacquer, clear shellac, French lacquer, clear varnish, map varnish, clear liquid celluloid, water glass and drawing fixer are suggested as being satisfactory for the job.

Most of the preparations mentioned produce a glossy surface. W1BYJ suggests a solution of 40 per cent clear metal lacquer and 60 per cent lacquer thinner. Two coats seemed to change the original surface of the card but little. W1BYJ coats the cards by dipping them vertically into a container of the solution, holding the card with a pin at one corner to prevent finger marks. The cards are suspended by means of the pin while drying, which requires about seven minutes. *He cautions against smoking or having any open flame in the vicinity of the solution which, like most lacquer preparations, is highly inflammable.*

W5ASD suggests a solution made by dissolving clear celluloid in airplane "dope" or by thinning down "liquid celluloid."

Care must be used with any of these solutions to provide a uniform surface when applied with a brush. Perhaps the best method of application is by means of a small atomizer or "blow" type sprayer, either of which may be obtained at little cost from art or stationery stores.

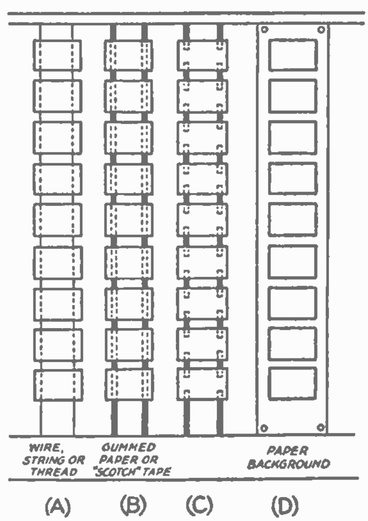

Fig. 1107 — Four methods of suspending QSL cards.

Several schemes for mounting the cards without marring the wall were suggested. Perhaps the most popular scheme of all consisted of a pair of strings, thread, small diameter wire, gummed paper strips or strips of so-called "Scotch" tape or masking tape. ("Scotch" tape may be obtained in rolls at any stationery store. It is coated on one side with a permanently adhesive surface somewhat similar to that of adhesive medical tape but is less expensive. It is obtainable in a variety of forms, colors and sizes. One type is transparent.)

Each pair of strips is run vertically from the top to the bottom of the wall with a separation somewhat less than the length of a card. By means of Dupont cement, stamp hinges, bits of "Scotch" tape or adhesive tape, the cards are fastened, one above the other, to the strips. (See Figs. 1107-A and 1107-B.) In the case of gummed paper strips or "Scotch" tape strips, additional fastening is unnecessary, of course. If the cards are wrapped in cellophane, they may be attached to the wires or strings by folding the cellophane over the string or wire before fastening the cellophane at the back of the card.

Another popular method is to arrange the cards in chain fashion, each card being fastened to the one above it by two small pieces of adhesive material such as those mentioned above. (See Fig. 1107-C.) With either of these methods, when necessary, the rows of cards may be taken down and folded into compact packs. A variation in this method involves punching four holes in each card and suspending one card from the one above it by means of small wire hooks. Others suggest sewing the cards in long strips with needle and thread. A rather novel method of linking the cards together is shown in Fig. 1108. This scheme was suggested by ON4CC.

Another group preferred mounting cards in groups on backgrounds of studio board, drafting paper, wall board, plywood, cardboard, quarter board and similar material with the surface covered with colored paper, cloth or oilcloth. A suitable frame or moulding was often suggested. The cards were fastened to the mounting by means of thumbtacks, Dupont cement, bits of "Scotch" tape, stamp hinges or photographic art corners. As an alternative, some suggested slitting the background material for the corners of the cards where this was practicable. W9YRF assembles several cardboard squares, on which his cards are mounted in "calendar" form, so that cards on any particular sheet may be examined by lifting the sheets above it.

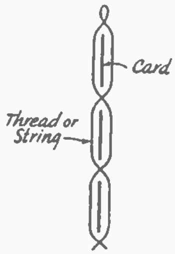

Fig. 1108 — A novel way of linking cards together.

An idea which seems to come halfway in between the two preceding methods consists of strips of colored shelf paper or wrapping paper, somewhat wider than the length of a card, extending from top to bottom of the wall, on which the cards are mounted. (See Fig. 1107-D.) W9TCK suggests a paper roller shade as a mounting and this method would be satisfactory unless some smart Joe pulled the shade and let it run up! The spring had better be removed if a shade is used.

Another novel and effective presentation of QSL cards is through the use of overlapping where only the important feature of a card is shown thus permitting many more cards to be displayed in a given area. These layouts can then be placed behind glass or cellophane in the usual manner.

A RECEIVER OR A.F. AMPLIFIER AS AN INTERCOM SYSTEM

Owners of communication receivers, or any receiver or audio amplifier for that matter, can convert the receiver or amplifier into a useful inter-room communication system by the simple addition of a d.p.d.t. anti-capacity switch as shown in Fig. 1009. The switch need not be in-

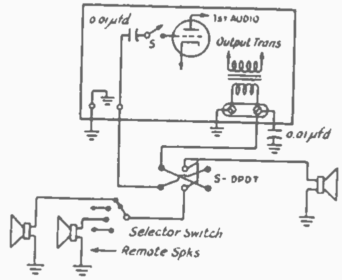

Fig. 1109 — W8PCQ uses the audio amplifier and loudspeaker of his receiver as an intercommunicating system. Only a few simple connections to the receiver are required. For transmission, using the receiver speaker as a microphone, the d.p.d.t. switch is thrown to the right, while for reception it is thrown to the left.

stalled in the receiver proper nor need the receiver be changed in any way. In my case, the switch is installed on a panel close to the receiver. The input and output wires are run to the switch together with the wires from the local and remote speakers. The input is nothing more than one wire with a condenser in series, plus a switch to the control grid of the 6SQ7, first audio of the SX-25, or the first audio of any receiver or amplifier. The input-to-grid connection is easily made by removing the first audio tube and wrapping one turn of fine wire around grid pin, keeping this wire as short as possible. Shielding is practicable but was not necessary in my case.

My receiver, an SX-25, has a 5000-ohm output with one side of the coil grounded. This ground connection makes it possible to use but one wire between the remote speakers and the amplifier, the ground being the return. However, somewhat better quality is possible if two wires are run directly to all remote speakers and the one wire grounded at the receiver proper; otherwise the tone is affected. If any trouble is encountered with feed-back due to input and output wires being in close proximity to each other at the switch, it can be eliminated simply by addition of a 0.01-μfd. by-pass condenser from one side of the output transformer to ground of the receiver.

In the case of other types of amplifiers or receivers which do not have permanent-magnet type dynamic speakers and output transformers for such speakers, it is a simple matter to use a 0.1-μfd. condenser off the plate of any amplifier — or receiver — output tube to magnetic speakers, which work quite well although the p.m. type is better for this purpose.

An anti-capacity switch is not absolutely necessary. A knife or rotary switch is practical so long as feed-back from input and output circuits is not excessive due to close spacing of contacts.

As for volume and pick-up, this system is quite adequate for the purpose. Sounds 50 to 100 feet and more from the remote speakers can be heard plainly.

One remote speaker located at the door and one in another part of the house connected to this switching system saves quite a few steps, as well as time, in the course of a day. — *Ben J. Hummel, W8PCQ.*

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A TWO-WAY INTERCOM

Believe it or not, there is a "Little Rock" in the central Pacific ocean which boasts a modern intercommunication system. The circuit diagram of the "Mechanical Rat," as we call it, is shown in Fig. 1110. I designed it and built it from such parts and tubes as were available for our use. While I am not at liberty to disclose the specific types used, the principle and the circuit are in no way restricted, and it will operate very satisfactorily with the tubes and constants shown in the diagram.

The 5-inch Permamag speakers serve also as microphones. We are using only two, although a larger number can be employed by connecting them through a single-pole multithrow switch as indicated in the diagram. The transformers, T_1 and T_2, are identical output transformers, although the impedance-match at the input end of the circuit no doubt would be better if a transformer with a higher-impedance primary were used.

If, as in our GI version of the circuit, all fixed resistors are of 1-watt rating, it becomes necessary to parallel two of them for the filter resistor, R_9. A 200-ohm and a 300-ohm resistor were used in parallel at this point in the original model. The circuit values given are not to be considered ideal in each case, as this was a rush job and, since the system is in constant use, we have little time to experiment with it. The gain and fidelity are sufficient for our purpose.

Some economy would result from replacing the present power supply with a half-wave rectifier circuit and an *RC* filter. The tubes would be a 45Z5 rectifier, 12SJ7, 12SF7 and 50L6. The heaters could be connected in series without any need for a dropping resistor.

If the equipment is to operate in the field of a transmitter, it is best to shield the lines to remote stations of the system. Otherwise, distortion is apt to be present. — *Pfc. William H. Hull, APO 457, c/o Postmaster, San Francisco.*

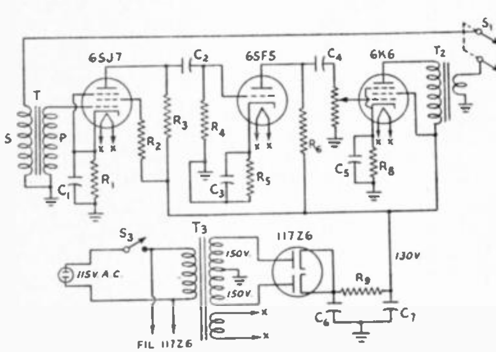

Fig. 1110 — Circuit diagram of the GI two-way intercommunication system showing equivalent civilian components.

C_1, C_3, C_5 — 0.1-μfd. paper.
C_2 — 0.05-μfd. paper.
C_4 — 0.01-μfd. paper.
C_6, C_7 — 40-μfd. 150-volt electrolytic.
R_1 — 1000 ohms, 1-watt.
R_2 — 47,000 ohms, 1-watt.
R_3, R_4 — 100,000 ohms, 1-watt.
R_5 — 3300 ohms, 1-watt.
R_6 — 15,000 ohms, 1-watt.
R_7 — 0.5-megohm potentiometer with switch.
R_8 — 220 ohms, 1-watt.
R_9 — 120 ohms, 2-watt.
S_1 — D.p.d.t. switch with spring return.
S_2 — Multi-point rotary wafer switch.
S_3 — S.p.s.t. switch on R_7.
T_1, T_2 — Identical output transformers to match 6K6 to speaker.
T_3 — Midget power transformer, 150 volts each side of center tap.

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INTERCOM SYSTEMS BETWEEN STATION AND FAMILY

An intercommunicating telephone system can hardly be classed as amateur radio equipment. We have discovered, nevertheless, that a surprisingly large number of amateurs consider it an essential part of the station. It may not add a mile to the range of the transmitter, but it often preserves peace in the household when it becomes necessary to communicate with the operator when the station is located in some remote corner of the house or in a shack in the back yard.

The solutions include descriptions of both the simple telephone systems and those more complicated systems employing speech amplifiers and loudspeakers.

Four different schemes for simple telephone systems are shown in Fig. 1111. In each case a headphone unit is used for the transmitter instead of a microphone. In view of this, those more complicated systems requiring microphones, batteries and transformers were eliminated.

The simplest idea submitted was that of Winfred C. Lowe, of New Brunswick, N. J. It is shown at (A) in Fig. 1111. The system operates with only a single wire and ground connection. The 60-cycle "buzz" in the single headphone at either end, when either push-button is operated, is used for calling. The size of the series condensers may be varied to produce the best results. The single-headphone unit is used both as microphone and receiver. The 115-volt lamps are used as a precaution against short circuits. Care should be taken to arrange the 115-volt plug so that the grounded side of the 115-volt line is connected to ground to prevent a short-circuit of the line. The danger of a short-circuit if the 115-volt plug is reversed could be eliminated by placing another fixed condenser between the 115-volt line and ground. The battery indicated for energizing the talking circuit is not always necessary.

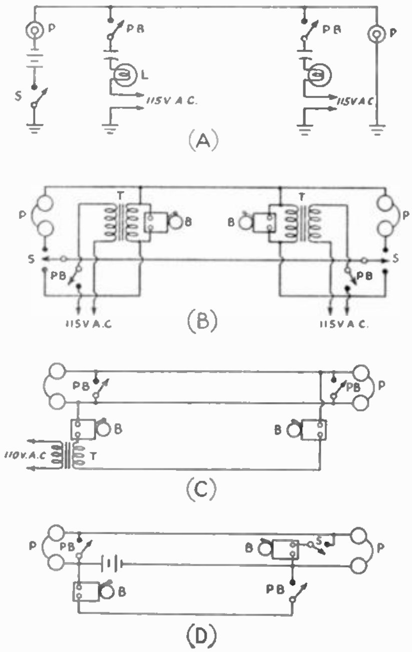

Fig. 1111 — **Simple line telephone circuits. In most cases the system will work satisfactorily if a good ground connection is substituted for one of the talking lines. *B* — battery, bell or buzzer, as indicated; *L* — 115-volt lamp; *P* — headphone unit or set; *PB* — push-button switch; *T* — bell-ringing transformer.**

Several ideas requiring two and three lines are included. When using but two wires (or one wire and a common ground, such as a water pipe), a power supply is required at each end of the line for ringing, as shown at (B). Switches also are required at each end to switch from the ringing circuit to the talking circuit. Both switches are normally thrown in the downward direction. With the switches in this position, either push-button may be used to call the other station. When the second station answers, both switches are thrown in the upward position for talking, after which the switches must be returned to the original position. In this particular case, bell-ringing transformers are used to supply the calling circuit. Ordinary headphones are used at each end, one unit being used at each end as the microphone. This particular arrangement was described by J. T. Simpson, New Orleans, La., although very similar schemes were suggested by several others.

A three-wire system requiring but one supply is shown at (C). This circuit, submitted by W9TO, has the advantage that no switching is necessary.

The circuit suggested by W9DFD, and shown at (D), is rather novel in that the same battery is used for both ringing and talking circuits. The switch at one end is normally closed to complete the ringing circuit. In the arrangement described, this is a hook-type switch on which the headphones are hung. It opens when the headset is removed from the hook for talking.

Turning to more elaborate installations of the speech-amplifier-loudspeaker variety, a popular circuit is shown in Fig. 1112. This circuit was supplied by Harry Moreton, jr., of Cincinnati, Ohio. The 25A7G is similar to the 12A7 and includes a rectifier for the power supply. The capacity of C_8 may be changed to suit personal preference as to tone quality. The chief disadvantages of this type of circuit are that it may be operated from only one end of the line and that it is necessary to switch from "send" to "receive."

A circuit which requires no switching is shown in Fig. 1113-B. It is a circuit commonly used in telephone "repeater" service and is described by G. Smith of Chicago, Ill. For the benefit of those who are not familiar with the principles involved, a brief explanation is given.

Referring to the diagram at (A), T_1 and T_2 are the input and output respectively of the amplifier. It will be noted that they are on opposite sides of a bridge. When Z_1/Z_2 is equal to R_1/R_2, the bridge is in balance and none of the voltage across T_2 can appear across T_1, and therefore the amplifier will not "sing." But, if a signal voltage is impressed across Z_1, the voltage will divide across R_1 and T_1, with that part across T_1 being amplified through the amplifier and applied across T_2. As

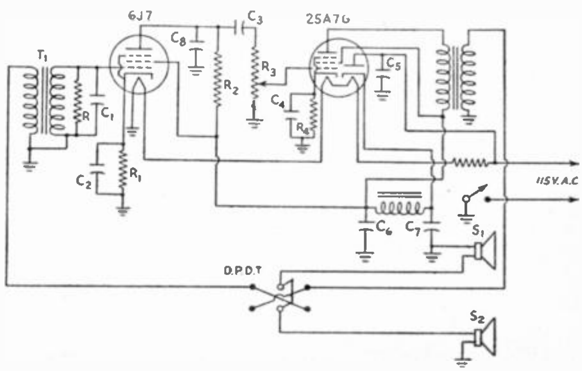

Fig. 1112 — **Loudspeaker system including power supply.**

C_1 — 0.001-μfd. mica.
C_2, C_3 — 0.1 μfd. 200-volt paper.
C_4 — 10 μfd. 25-volt electrolytic.
C_5 — 0.01 μfd. 200-volt paper.
C_6 — 16 μfd. 200-volt electrolytic.
C_7 — 12 μfd. 200-volt electrolytic.
C_8 — 0.001-μfd. mica.
R, R_2 — 100,000 ohms, ½-watt.
R_1 — 10,000 ohms, 1-watt.
R_3 — 0.5-megohm variable.
R_4 — 600 ohms, 5-watt.
R_5 — 290-ohm Candohm or Ohmite resistor cord.
T_1 — Line-to-grid transformer.
T_2 — Plate-to-line transformer.
S_1, S_2 — Magnetic speakers.
S — D.p.d.t. switch.

T_2 is in balance with T_1 through the bridge, it will not feed back, but the signal voltage appearing across T_2 will be impressed across Z_1 and Z_2 in series.

A practical circuit is shown in Fig. 1113-B. Comparing this with Fig. 1113-A, Z_1 and Z_2 are permanent-magnet speakers which serve as microphones as well. R_1 and R_2 are the same arms of the bridge as those correspondingly numbered in Fig. 1113-A and are supplemented by the potentiometer, R_7, for balancing the bridge. R_3 is a gain control for adjusting the output of the amplifier. T_1 should have a step-up ratio. T_2 should have characteristics suitable for matching the load consisting of Z_1 and Z_2 shunted by the series of R_1, R_2 and R_7 to the optimum load specified for the output tube used. With speakers of about 5000 ohms and resistors R_{11}, R_7, and R_2 respectively of 10,000, 5,000, and 10,000 ohms, T_2 should have a ratio of about one-to-one to provide a proper load for the 6F6. The two speakers to be used in the system should be as nearly identical in their characteristics as possible.

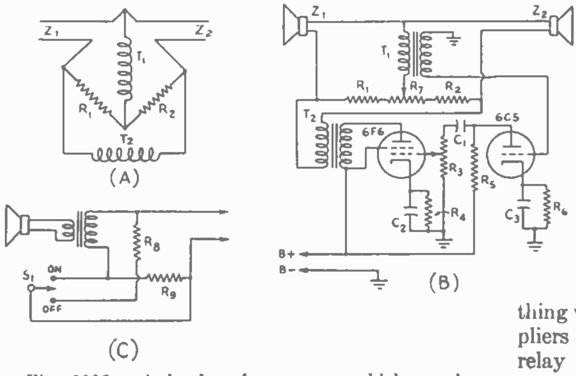

Fig. 1113 — A loudspeaker system which requires no switching.

C_1 — 0.01-μfd. 400-volt paper.
C_2, C_3 — 25-μfd. 25-volt electrolytic.
R_1, R_2 — 10,000 ohms.
R_3 — 0.5-megohm volume control.
R_4 — 400 ohms.
R_5 — 50,000 ohms.
R_6 — 2500 ohms.
R_7 — 5000 ohms.
R_8 — 5000 ohms (see text).
R_9 — 10,000 ohms.
T_1, T_2 — See text.

If, for any reason, either speaker needs to be cut out, a double-pole double-throw switch is necessary to remove the speaker and replace it with a resistance equal to the speaker impedance. If this is not done properly, the bridge will become unbalanced and the outfit will "sing." A single-pole double-throw switch in series with resistance can be used, as shown in Fig. 1113-C, to cause the circuit to feed back and "sing" which may be useful in calling. R_8 and R_9 are placed in each terminal set along with S_1. When S_1 is closed, both speakers are muted somewhat due to the shunt of R_8 and the voltage-dividing action of R_9. But when the switch is changed to the "on" position, the bridge will unbalance and "sing" until the other switch is thrown to the "on" position. R_8, at the operator's position, should be made variable to allow an additional bridge balance when both switches are in the "off" position. A similar change in both lines will not affect the balance, and therefore one of the shunting resistors may be made variable to compensate for the irregularities of the other.

If it is desired to be able to turn the amplifier on from either end of the line, it will be necessary to run another pair of lines between the two stations with both switches connected in parallel across the line.

A SIMPLE, RELIABLE AND INEXPENSIVE PHOTO-TUBE RELAY

The irresistible urge to be doing something with a soldering iron and a pair of long-nose pliers has resulted in the very simple phototube relay circuit shown in Fig. 1114. This circuit seems especially appealing, since it does not require material that is critical or otherwise difficult to obtain. Most ham shacks could supply parts for two of these units by looking behind the work-bench. The relay used for controlling the external circuit need not be especially sensitive, and good results can be expected from one constructed from odds and ends; for instance, the poles and coils from a discarded high-impedance headphone. The circuit shows a meter in the plate lead of the tetrode. This was included to make comparisons between photocells and light intensities. This meter can and should be left out of the circuit.

The compact 117L7GT was used because of its dual-purpose features. By employing the diode portion in a half-wave rectifier circuit, reasonably smooth d.c. voltage is available for the operation of the amplifier section of the tube. This arrangement also eliminates the condenser used across the relay in self-rectifying types of photocell-relay circuits. The 117-volt filament makes unnecessary the use of dropping resistors or ballast tubes. While the 117L7GT seems to be the logical tube to use, there is no reason why a separate rectifier or amplifier tube could not be used if a 117L7 is not under the work-bench. The photocell is an RCA 868. The author is a theater projectionist and finds discarded 868s relatively numerous. Almost any projectionist would be glad to donate a discarded photocell to a ham, if only to keep him from collecting butterflies for the duration. The discarded cells are not necessarily "duds." In theater amplifiers the gain is usually rather high, on the order of 125 db. Consequently, a cell which is low is usually discarded rather than having to lower the sensitivity of the remaining cell and then raise the gain of the amplifier. The discarded cell is usually far from being useless.

Here is how the circuit works. The power supply delivers d.c. at a voltage depending on the capacity of C_1. The condenser value shown was used because it happened to be the highest value on hand. If experience shows the cell being used to be free of excessive gas, the plate voltage could be raised by using a 40-μfd. tubular condenser rated at 200 volts. The 868 cells are rated for 90 volts of applied potential. New cells often glow at this voltage, while on the other hand a "hard" cell can be operated at 135 volts without glow. All cells have some gas introduced to assist the electron transit from the cathode to the anode and to increase the sensitivity by secondary emission, so beware when increasing the supply voltage. Do not expose the cells to direct sunlight. If they are used out of doors in the daytime, efficient shielding will be required to exclude all but the operating light beam. Ionization within a cell is indicated by a faint glow, purple in color. When this takes place you have a VR tube instead of a photocell. With as poor a cell as could be found, the plate current of the amplifier could be driven as high as 12 ma. with sufficient light to reach the saturation point of the cell.

To select the proper value of R_3, the drop-out current of the relay to be used should be determined by performing the following experiment. With the photocell removed from the socket, try increasingly higher values of resistance, starting with 1000 ohms, until the relay will no longer stay locked up when the armature is pressed toward the pole face with the finger. Adjusting the resistance value closely will give a plate current just under the release-point of the relay. This allows the relay to operate by itself when the plate current is increased by the application of light after the photocell has been inserted in the

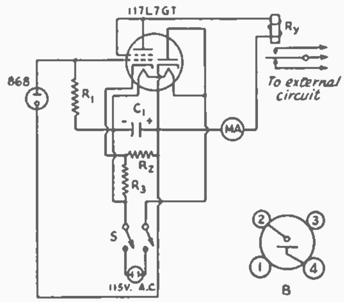

Fig. 1114 — Circuit diagram of the photocell relay.

C_1 — 16-μfd. 450-volt. electrolytic.
R_1 — 10 megohms, ½-watt.
R_2 — 25,000 ohms, ½-watt.
R_3 — See text.
Ry — 1000-ohm (approx.) relay.
M — 0–15-ma. d.c. meter.
S_1 — D.p.s.t. switch.
B — Base connections for 868, bottom view.

socket, since increased light reduces the bias on the grid of the control section of the tube. The amount of plate-current increase necessary is the difference between the pick-up and drop-out values, plus the difference between the static and drop-out values. By narrowing down this difference to as small a value as possible without making the relay action sluggish, good sensitivity and quick action are insured. This action can be more easily understood if it is realized that the photocell is in reality a variable resistor between the positive end of the power supply and the grid of the tube. More light in the cell simply overcomes the negative bias applied through R_1.

In the dark, a two-cell focusing-type flashlight gave positive operation at a distance of 28 feet. A stronger light source with a simple lens to direct the filament image of the source directly into the cell would, of course, operate over a greater distance. Sensitivity also can be increased by adding a condenser lens in front of the cell to pick up light over a greater area and converge it onto the cathode of the cell. Those who would like to conceal the light beam will find the 868 photocell especially sensitive to infra-red radiation, and good performance can be had with an ordinary tungsten-filament lamp and a filter composed of alternate layers of dark red and purple gelatine sheet. Do not use blue. Sufficient attenuation of the visible spectrum can be had without too serious a decrease in operating distance, using the invisible beam which cannot be seen even when looking directly at the light source.

This circuit, with the relatively slow-operating telephone-type relay employed, followed keying accurately at 20 w.p.m. when the light beam was completely interrupted. The relay should have a single-pole double-throw arrangement of contacts so that an external circuit can be completed or broken when the light is applied or removed.

Go ahead and open your garage doors with it, too; we don't care. — *John T. Seiler, W6TGD.*

A "LIGHT-BEAM" TRANSMITTER AND RECEIVER

Several years have passed since the writer first became interested in the possibilities of "talking" over a beam of light, but nothing was done about it until the XYL persuaded me, against my better judgment, to give a talk before the local women's clubs, on the general subject of radio.

It was while digging up things to amuse the ladies that the old interest was revived, and we decided to give it a try. A bit of experimenting gave results far better than expected, and distances up to 100 feet were covered without any noticeable decrease in volume. Excellent results were obtained even in broad daylight.

In building the outfit, our first consideration was that of cost. Discarded radio parts had to be used whenever possible, and the final rig contained nothing in the way of new equipment except the photocell in the receiver. Even if all the parts were to be purchased, the costs should not run too high.

The neon-tube and light-sensitive-cell circuits are shown in Fig. 1115.

The receiver is simply a high-gain amplifier with about 5 watts output. Your preamplifier should do the trick nicely. We found it convenient to mount the amplifier, speaker and photocell in an old portable radio case. This made it necessary to shield carefully the photocell and first tube in the amplifier with double shield cans.

The space between the cans was painted black and a half-inch hole cut in one side to admit the light. In order that the rig could be used in anything but total darkness, a tube about 5 inches long, painted black inside, was mounted so that the light to the cell must pass through it.

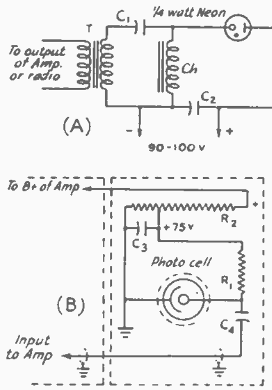

Fig. 1115 — (A) circuit of neon-bulb generator on transmitting end fed by microphone, phono-pick-up or radio through suitable audio amplifier. C_1 should be 0.5 to 2 μfd., C_2, 8 μfd. *Ch* is a 30-henry audio choke.

(B) photocell pick-up on receiving end feeding loudspeaker through suitable audio amplifier. R_1 is a 500,000-ohm resistor. C_3, 8 μfd. electrolytic, and C_4, 0.5-μfd. paper. R_2 is a voltage divider of usual value.

The photocell and its own voltage divider were mounted in and on a separate chassis, so they were shielded from the rest of the amplifier, and a shielded lead (as short as possible) was run to the control grid of the first tube. The voltage on the cell is not critical and may be anything from 45 to 90 (we used about 75), but this must be as nearly pure d.c. as possible. Batteries were first used, but the arrangement shown in the drawing gave good results without hum.

The cell itself, a Cetron Type CE-2, selling at $5.40 (prewar price), was chosen for its small size. However, any cell of the type used in movietone work should work as well.

The transmitter consists of a source of light and a method of modulating that light. It was here that we were stumped for a time. Millen and Kruse, in their booklet, "Below Ten Meters," give a circuit for such a device, but we didn't have a "Zetka" recording lamp and did not know where to get one. However, after considerable experimenting we found that a 35¢ ¼-watt neon lamp, such as those used in tube testers and other service equipment, would do very nicely. This may seem low power, but its small size makes it possible to focus the beam and get almost perfectly parallel rays. A reflector, such as those used in automobile spot lights (from the nearest junk yard), and a double-lens system obtained from an old post card projector made the system complete. A large reading glass at the receiver serves to focus the rays on the photocell.

The modulator is practically the same as that shown in "Below Ten Meters," but the input transformer is an old 3-to-1 audio, and the choke is a 30-henry model from an old radio. Also, the ignition voltage for the lamp was obtained directly from the "B" supply of the amplifier. The polarity of this ignition voltage does not seem to matter, but the condenser should be poled right if it is of the electrolytic variety.

The modulator may be fed from a radio receiver for experimental work, but since we wanted to talk over the light beam ourselves, an amplifier was made from the audio portion of a discarded four-tube t.r.f. a.c.-d.c. midget. The tuning condenser, r.f. coils and r.f. tube were removed and the detector revamped to act as the first audio. This was connected to input transformers to match a single-button microphone and phonograph pick-up and a switch was mounted so that either source could be used at will.

The rig will work as far as you can shine the light, so it simply becomes necessary to concentrate the beam into parallel rays to duplicate our results. Only a small amount of light is necessary and, if you have as good luck, you will have to turn down the volume to prevent overloading the receiver. — *L. W. Floorman, W8RWP.*

A CARD INDEX FOR YOUR QSOs

The practical value of a card index file for recording all QSOs is generally recognized, but some hams may associate the idea with a lot of hard work and drudgery.

If a workable system is used, little extra effort is required because the cards may be filled out during a QSO. Since this system takes care of a lot of the information usually recorded in the log, we may say there is no *extra* work involved!

The cards, 3 × 5 inches, ruled on one side, may be obtained in any dime store. On the top line of the card, left to right, is placed — the call, the QTH and the sine or "handle." On the second line we place his frequency and "ARRL — ORS —" etc. Dope on the QSL is marked "QSL R/S," "R" meaning received and "S" meaning sent.

Personal information is recorded on the back of the card. It might read something like this, ". . . Age, 34 (1940); married; 12 kids; manager, Hayseed Hogwash Co.; ham since '27; 6L6, 25-w.; 3-tuber. Hunts, fishes, and likes gooseberry pie. . . ." You wouldn't have any trouble remembering a former QSO with that fellow if you had that data to freshen your memory.

Now, we must place the cards alphabetically in a file using tabs to indicate the location of the cards for each district. The dime store sells these tabs, but since they are marked "A" to "Z," it is necessary to turn them over and mark them "W3," "W5," "W9," "VE," "ZL," etc.

We have so much information on the cards that it is no longer necessary to put the QTH and other dope in a log.

Once this system is put into use, we would not consider parting with it. The index was started at W9FB in 1936. It grew until it now includes over 1900 cards covering over 5000 QSOs. One can spend many an interesting hour browsing through a file of this kind. — *Amos Utterback, W9FB.*

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VOLUME FOUR

HINTS & KINKS

for the Radio Amateur

. . . . . A Symposium of 222 Practical Ideas for the Workshop and Station Plus War-Surplus Conversion Section

$1

Published by the AMERICAN RADIO RELAY LEAGUE • West Hartford, Conn.

VOLUME FOUR

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..... A Symposium of 222 Practical Ideas for the Workshop and Station Plus War-Surplus Conversion Section

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THE AMERICAN RADIO RELAY LEAGUE, INC.

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Volumes One, Two and Three of this publication are now out of print.

Foreword

The successful radio amateur is, by nature, an ingenious fellow. Without a high order of resourcefulness and an ability to improvise he could never overcome the ever-present problem of inadequate workshop equipment and the equally common handicaps of insufficient apparatus and money. Evidence of this inherent ingenuity is to be seen on all sides. One cannot visit any good amateur station without finding clever improvisations, either in the construction of individual components or in the manner in which the whole station is assembled. It may be just a different way to mount a coil, or a scheme for getting a broken antenna halyard back upon the mast, or a fabulous remote-control system. Whatever the idea, it is invariably of value to the rest of us.

With the object of putting the best of these "brain storms" into circulation there has appeared in *QST*, these many years, a department devoted to the general subject of "Hints and Kinks." This department has enjoyed great popularity. The ideas contributed to it by ingenious amateurs have helped us all in our search for ways and means to improve our equipment. Unfortunately this garnered gold of amateur experimentation often has been lost to sight, shadowed by some big article or forgotten in the excitement of some major development. Then, too, there has been the annoying business of vaguely remembering a squib bearing on the problem at hand but being unable to locate it when it is most needed.

These factors led us, in May, 1933, to publish a collection of the best ideas, schemes and methods offered by *QST* contributors during the three years prior to that date. The first edition of *Hints and Kinks* was well received and established definitely the value of a single grouping of selected "experimental expedients," carefully classified and arranged. In 1937 a second volume of *Hints and Kinks* was published, containing a larger and more comprehensive collection of newer ideas culled from the offerings of *QST* contributors in the period 1934–1937. The success of this second edition motivated the publishing of an equally-popular third volume, which appeared in May of 1945.

Since the war amateur technique has been materially refined and much development of newer tubes, circuits and constructional techniques has occurred. Additionally, amateurs have found wide application in their stations for the large variety of war surplus equipment which has made its appearance. These trends, of course, have been faithfully recorded in postwar *QSTs*. Accordingly, this fourth volume of *Hints and Kinks* has been assembled to correlate the best of the postwar ideas. Much of the material has appeared in the "Hints and Kinks" and "Surplus Corner" departments of *QST*. Some of it has been gleaned from larger articles where it was doubtless lost to the view of many. Arranged in its present form, the material should constitute a potent help both in new construction and conversion. It should suggest many intriguing possibilities for putting back to work older apparatus or surplus gear now gathering dust in cellars and attics. Above all, it should enable each of us, in one way or another, to increase the efficiency of our present-day stations.

We express our thanks to those amateurs whose willingness to offer the result of their efforts to the fraternity as a whole has made this publication possible.

A. L. Budlong,
Managing Secretary, A.R.R.L.

West Hartford, Conn.
October 1, 1949

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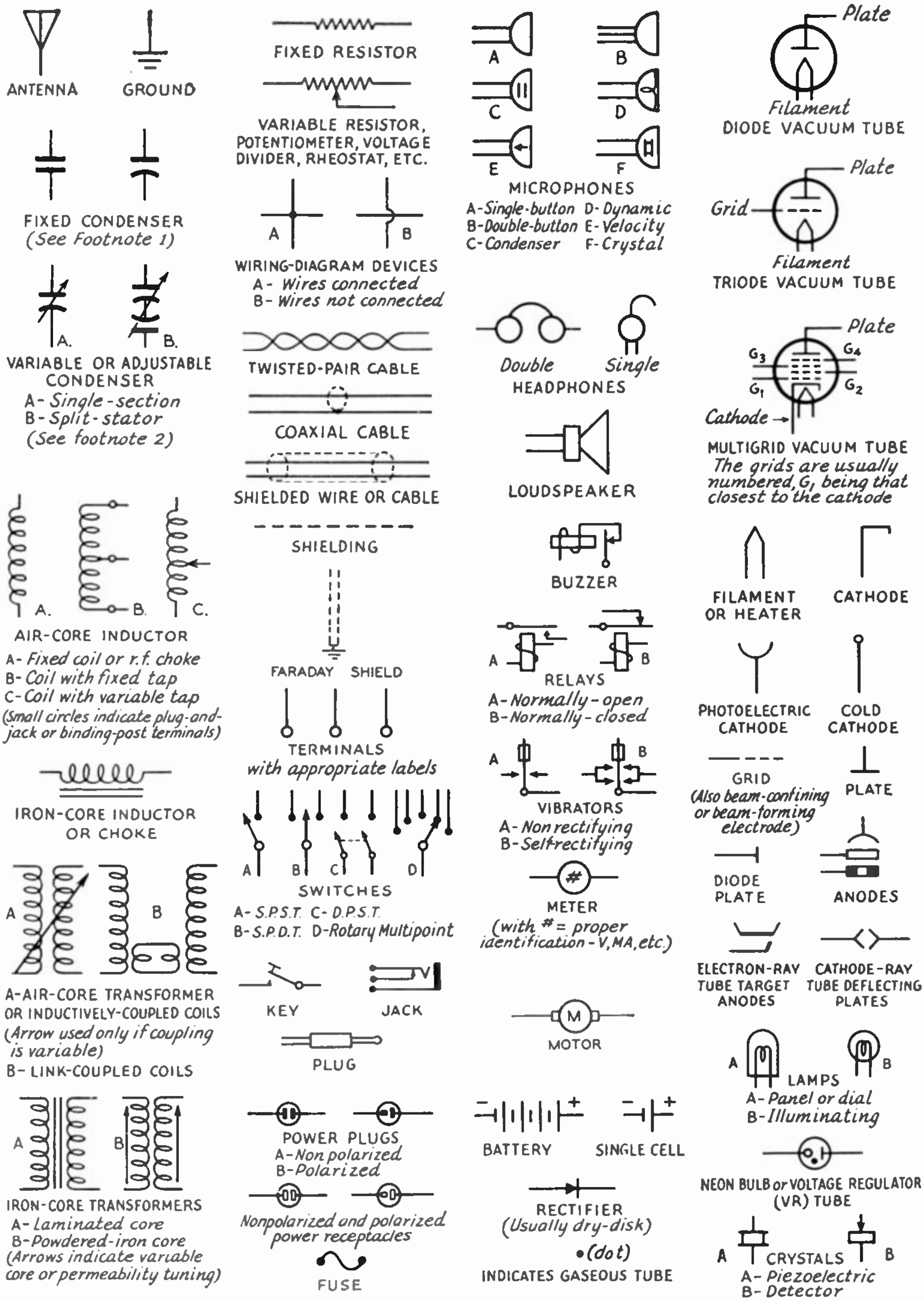
SCHEMATIC SYMBOLS USED IN CIRCUIT DIAGRAMS



[1] Where it is necessary or desirable to identify the electrodes, the curved element represents the *outside* electrode (marked "outside foil," "ground," etc.) in fixed paper- and ceramic-dielectric condensers, and the *negative* electrode in electrolytic condensers.

[2] In the modern symbol, the curved line indicates the moving element (rotor plates) in variable and adjustable air- or mica-dielectric condensers.

In the case of switches, jacks, relays, etc., only the basic combinations are shown. Any combination of these symbols may be assembled as required, following the elementary forms shown.

1. Hints and Kinks . . . for the Workshop

SCREWDRIVER — MINIATURE STYLE

Have you ever had a sudden need for a really small screwdriver . . . one that can be used in those tight spots that always manage to show up at the worst times? Fig. 1-1 shows how to make your own.

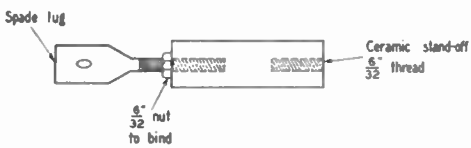


Fig. 1-1 — A "pee-wee" screwdriver that you can make from parts out of your junk box. It's just right for getting into those tight corners.

A small ceramic stand-off insulator becomes the handle, and a spade lug is threaded into one end to make the blade. Then all you need is a nut to lock things in place, and the handy gadget is complete.

— *Mel Dunbrack, W1BHD*

TAPPING MINIATURE COILS

It is always difficult to make a movable tap arrangement for small coils such as the National AR series, where the turns are so close together that almost any of the usual clip arrangements merely short out several adjacent turns.

This problem can be solved easily by using a shortened bobby pin "swiped" from the XYL's dresser. Cut off all but the last "wiggle," clean the enamel off, and solder a flexible lead to the top. This gadget makes a swell movable tap that will fit between the turns of any of the small coils, and will make a good contact without shorting turns.

— *Don Geary, VE3BTS*

A TIMESAVING IDEA FOR COIL CONSTRUCTORS

I have found a simple way to assemble coils or adapters using coil forms or tube bases. I cut the lead for the No. 1 pin about one inch longer than required, then cut each following lead about one half inch longer than the one preceding it. This makes it easier to assemble the unit. After the wires are put through the pins, they are pulled tight, soldered, and then cut off.

— *Fred C. Barker*

CONVENIENT TIE-POINT SUBSTITUTE

Many times it proves inconvenient to mount a tie point inside a chassis at a place where several components have a common junction point. This is especially true in experimental work where it may be found necessary to add components for which no mounting provisions could be made in advance planning. A simple, yet rugged, substitute can be made by forming a few inches of uninsulated small-gauge wire, such as No. 20, into a coil as shown in Fig. 1-2, and inserting the leads from the components involved. Solder is flowed in around the "coil" which then becomes a joint that is solid enough to be permanent. If

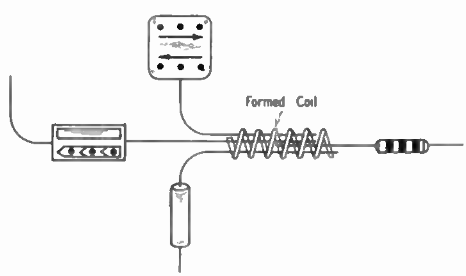


Fig. 1-2 — A simple way of making a neat connection out of what might otherwise look like a rat's nest.

later changes are found to be required, the component involved can be disconnected by simply pulling it out of the coil while heat is being applied to the joint. The inside diameter of the coil can be made large or small, depending upon the number of leads to be joined.

TOOL FOR FORMING WIRE LOOPS

Here's a handy tool for forming loops of wire to fit over meter studs or bolts. Take a screwdriver having a tapered shank and grind or file off the blade or bit of the screwdriver. If the shank is not tapered sufficiently, cut it down until you have a round tool, shown in Fig. 1-3, slightly larger than the diameter of the studs to be fitted with loops. (A tapered shank permits the forming of various sizes of loops; thus one tool will take the place of several.)

Fig. 1-3 — An easily-made tool for forming wire loops.

Now, by grasping the end of the wire with a pair of long-nose pliers, you can wrap the wire around the tool. A little practice using scrap wire will result in a neat, professional-looking loop.

— *Bert Felsburg*

TWO USES FOR BLOWN FUSES

The life of small glass cartridge-type fuses does not need to end when the fuse element blows. They make excellent forms for small v.h.f. chokes, and when pigtail leads are soldered to the ends, they can be mounted firmly the same as a resistor or condenser.

— *J. C. Nelson, W2FW*

The need for an insulated coupling device to tune small condensers in v.h.f. gear can sometimes be filled by using a blown glass-cartridge fuse. The diameter of many of these fuses is 1/4 inch, making them a "natural" for use with the usual tuning condenser. The fuse can be attached to the shaft by soldering the metal tip to the end of the condenser shaft. This method is ideal for use with the many screwdriver-adjusted padder condensers that are so plentiful in surplus gear but which are often unusable because of the lack of suitable means of tuning by knob or dial.

— *Harold Held, W9OCK*

STRIPPING CHASSIS AND WIRES

A "non-creeping" liquid that quickly strips finishes from metal, known as Fidelity Stripper No. 306, has been developed by Fidelity Chemical Products Corporation of Newark, N. J. Made especially for the quick removal of insulating coatings from wires, it also does a thorough job of removing baked-on enamels from objects that cannot or should not be submerged.

The liquid stripper is applied by brush at room temperature. Usually in less than a minute it causes the finish to puff and leave the metal, which is then wiped clean. Since there is no residue or corrosive action, the stripped part may be soldered or refinished immediately.

CUTTING SHEET ALUMINUM

While I was butchering away on some heavy-gauge aluminum, W8INL suggested that I throw the hack saw out the window and use a carpenter's crosscut saw. With considerable misgiving, I gave it a try, and discovered that it really does work. Naturally, any carpenter will froth at the mouth at such a ghastly procedure, but what ham uses anything as it should be used? Using the saw on aluminum will not ruin it permanently, although it will probably dull faster than in wood. It does, however, speed up work in aluminum, gives a much straighter cut, and allows a long cut to be made.

— *Bill Wildenhein, W8YFB*

MAKING CUT-OUTS IN STEEL CHASSIS AND PANELS

It is often necessary or desirable to alter a manufactured unit, using odd-shaped holes and brackets for parts mounting. In any metal under 1/16 inch thick, holes are best cut with a sharp cold chisel and a metal backing plate. For metal thicker than this, it is often necessary to drill holes around the outline, knock out the metal with a small chisel, and file around the edges. An even better method, where a small power-driven jig saw is available, is to drill one hole, slip the blade through, and saw the desired outline. Believe it or not, an ordinary run-of-the-dime-store three-for-a-nickel jig-saw blade is good for cutting a 2-inch meter hole in 1/8-inch steel panel!

— *John Alvin Weber, W5JJL*

LAYOUT KINK FOR METER HOLES

A problem frequently encountered in the radio workshop and in the drafting room is that of drawing the bolt circle on which to lay out the three mounting holes of a meter or a special socket. The problem is that of finding the radius of the bolt circle to be drawn. The following method provides an easy solution when the three holes are equally spaced:

First, measure the center-to-center distance

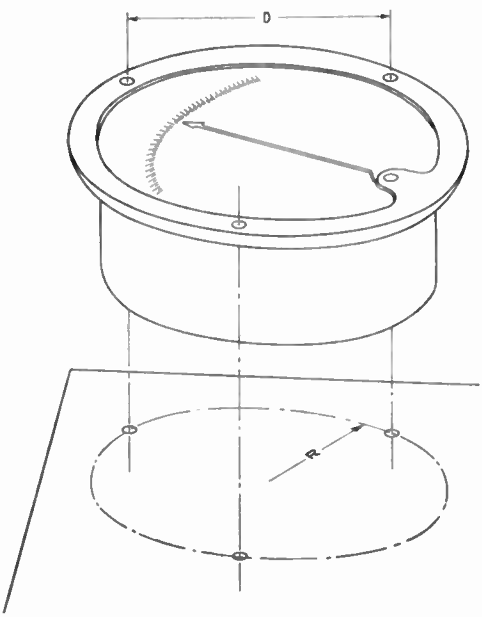


Fig. 1-4 — Spotting the mounting holes for a meter has always been a tough job. Here's a simple way that will result in cleaner-looking gear for you.

between mounting holes. This is the distance *D* in Fig. 1-4. Then multiply this distance by 0.577, which is actually two-thirds of the cosine of 30 degrees. The result is the radius of the desired circle.

— *George L. Downs, W1CT*

CONNECTOR FOR TWIN-LEAD

The small FT-243 crystal holders that are available in the present surplus market make neat and inexpensive plugs for use with almost any small-diameter two-wire cable, such as the

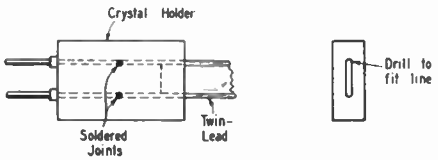


Fig. 1-5 — Efficient connector for small two-wire cable made from an old FT-243 crystal holder.

75-, 150- and 300-ohm Twin-Lead, as shown in Fig. 1-5. The holders fit the new ceramic crystal sockets, and make convenient connectors for coupling links and antenna input connections.

— *James A. Gundry, W8KNP, ex-KA1AA*

INEXPENSIVE MOUNTING FEET

A short length of ½-inch rubber tubing, available in almost any hardware store, may be used to provide cheap mounting feet for the usual steel chassis used in ham construction. Cut the tubing into four pieces, and then slit each piece lengthwise. Slip one piece on each corner of the chassis. The feet will prevent the chassis from scratching the furniture, and if you're afraid of scratching the chassis when you have it on the bench for testing or repair, a set of "feet" can be kept handy to be slipped on until the chassis is returned to the rack.

— *J. C. Nelson, W2FW*

MAKING OUT COLOR CODE ON OLD MICA CONDENSERS

Old mica condensers on which the color code is faded, scorched, or just plain dirty, will show their original identifying colors if a drop of water is placed on each spot of paint.

— *Thomas E. G. Abbott, W5DTJ*

PERFORATED METAL SHEETING

The perforated metal used in some types of acoustic ceilings is readily adapted to other uses around the ham shack. It can be used as a speaker grill, as protection over ventilation openings, as barriers over high-voltage bleeders, rectifier tubes or filter components.

The metal sheet is easily cut to the desired size with tin snips and can also be bent to the required shape without difficulty.

Scrap pieces can usually be obtained without cost from contractors engaged in acoustical treatment of buildings.

— *William G. Walker*

A SOURCE OF ALUMINUM STOCK

Heavy sheet aluminum may be inexpensively obtained from broadcast studios. Aluminum-base records and transcriptions are usually available at broadcast studios as they clear out their files of old transcriptions regularly.

The acetate or "Q" coating on the aluminum base may be easily removed by boiling the disks in water and peeling off the coating while the disks are still hot.

The 16-inch transcription disks will provide material for many uses around the ham shack.

— *Paul M. Bossoletti, W0GZD*

STORING PAINT

Proper storage of leftover paint represents a big saving if much work is done. If the can is over half full, put the lid on tightly, turn the can over a minute, then turn it back and put it away. This leaves a thin film of paint around the top which dries and keeps scum from forming in the can. If the can is less than half full, there is enough air in the can, even with the lid on, to form a scum. In this case, carefully pour a little thinner over the top of the paint and then close the can and put it away. In case scum forms, pouring the paint through cheesecloth will get rid of the lumps. (This is hard to do with fast-drying lacquers, however.)

— *John Alvin Weber, W5JJL*

A UNIQUE COUPLING

This device permits placement of the shaft of a variable condenser parallel with the panel and yet allows it to be turned by a front-panel dial in the usual manner.

The drawings and photograph (Figs. 1-6, 1-7) depict a 90-degree coupling. However, any angle

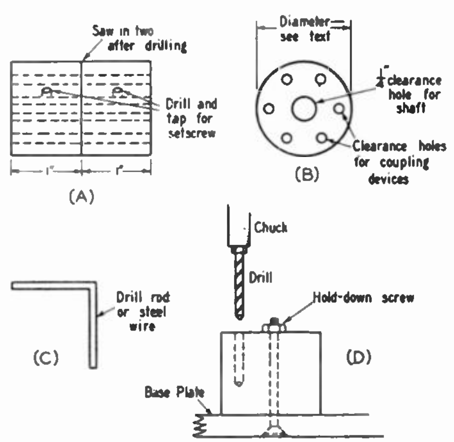


Fig. 1-6 — A — The barrel of the shaft coupling before sawing. Drill the holes lengthwise, as shown in A and B, by placing the piece on a mounting base as shown in D, and drilling the holes vertically. Setscrews fasten the barrel onto the condenser and the dial shaft. Steel drill rod or wire is bent accurately to the angle desired as shown in C. All connecting rods must have the same angle for smooth operation of the coupling. A drop of oil should be placed in each hole when assembled.

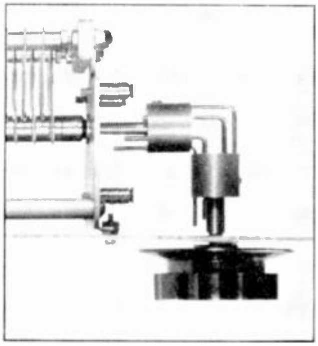


Fig. 1-7 — The homebuilt coupling when assembled.

up to 90 degrees can be provided for, if the steel rods are bent accurately to the desired angle.

The coupling may be made from brass or steel and if insulation is desired, from bakelite. However, in the latter case a coupling of sufficient size should be used to allow for adequate separation between connecting rods.

The coupling may be any size desired, and the length should be about one inch, for convenience in drilling.

— *Isaac L. Newton, VE3ACW*

JIG FOR CENTERING HOLES IN SHAFTS OR SCREWS

Many times I have tried to drill a hole in the end of a screw or a volume-control shaft, but I always have had difficulty centering the hole. I finally devised a jig which permits the drilling of an accurately-placed centering or starting hole.

The jig, shown in Fig. 1-8, consists of a piece of soft iron, or brass, about one by three inches and one-half inch thick. I first drilled three holes clear through the block using a No. 40 drill. One

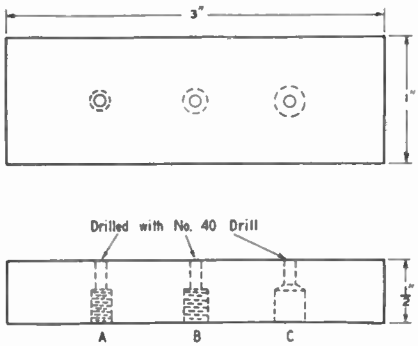


Fig. 1-8 — A jig for use in drilling a centering hole in the end of a screw or shaft.

of the holes, *A*, was then redrilled halfway with a No. 35 drill and tapped for 6-32; *B* was redrilled halfway with a No. 29 drill and tapped for 8-32 thread. The third hole, *C*, was redrilled halfway with a ¼-inch drill to accept the standard-sized shafts of variable controls.

The small holes serve as guides for a small drill which will make a centering or guide hole in the end of the screw or shaft.

— *Felix W. Mullings*

STENCILLING NAMEPLATES

There are many stencils and "decals" on the market for ham use, but all of them lack one thing or another. Either they are not the right color, not the desired type style, or not the right inscription to do the whole job. You can make your own very simply with a typewriter and a mimeograph stencil.

Type the desired wording on the stencil, and then cut it into small strips. Place the strip on the panel, hold it firmly against the surface, and rub some thick paint over it with your finger. Rub only in one direction, and be sure that the paint is the approximate consistency of vaseline. The results are well worth the effort.

— *C. Harvey Haas, W6EAH*

HAM-MADE CABLE-LEAD MARKERS

Two different methods that may be used to mark leads fanned out from a multiwire cable are shown in Fig. 1-9. In A, a small paper marker

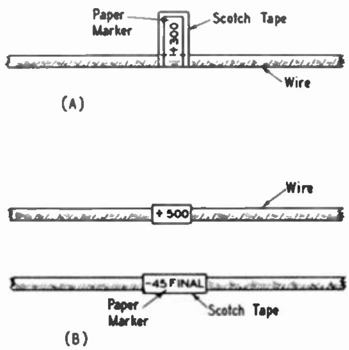


Fig. 1-9 — Two methods of marking cable leads. The tab type shown in A is suitable for leads that are infrequently handled. The wrap-around type in B may be handled without danger of tearing.

is protected by a piece of Scotch Tape that encircles the lead and is pinched together on both sides of the identifying marker.

In B, the marker is wrapped around the lead and then a piece of Scotch Tape is wound around the lead over the marker, thus protecting it from being defaced or torn off.

— *J. C. Nelson, W2FW*

SOCKET HOLES IN BAKELITE

A neat, workmanlike job of making socket holes in bakelite can be accomplished with a Greenlee socket punch. Use the tool in the same manner as for cutting metal chassis.

— *Earl F. Hart*

TIPS ON CLEANING CRYSTALS

Undoubtedly there is hardly an amateur who has not removed the crystal from his transmitter and taken the holder apart for some reason or other. Usually it was because the crystal did not operate properly. The remedy was to wash the crystal with carbon tetrachloride or another cleaning fluid. Nine times out of ten, the rig would then operate correctly and everyone was happy for a few months until the action had to be repeated.

However, during and since the war techniques in the manufacture of quartz crystals for frequency stabilization have changed tremendously, and there will be relatively little need for cleaning a crystal made in these years.

It was learned during the war that crystals changed frequency while resting on the shelves awaiting shipment. The ultimate solution of the fault was to eliminate the use of abrasives as well as carbon tetrachloride in the final finishing. It was observed that abrasives left a broken surface which rearranged itself constantly, and that carbon tetrachloride left a residue which was detrimental to the oscillating qualities of the crystal. Thus was adopted the acid-etch or fluoric-etch process to finish the crystals, plus the use of warm water and soap to keep them clean. The result is that now, with the use of air-tight and hermetically-sealed holders, it is not necessary or even possible to remove the blank!

If you do happen to have a prewar crystal and it does need cleaning, do it in the following manner: Lay the crystal on a piece of clean cheesecloth or kitchen toweling, and, using a toothbrush, white castile soap and warm water, scrub both sides of the blank carefully. Then rinse in clean water and make absolutely sure that the crystal is free from all soap and dirt. Rest the crystal on edge and let dry. While it is drying, wash the crystal electrodes in the same manner, and blow all of the dust and residue from the holder, being careful not to get any moisture in the holder. After everything is dry reassemble the works. Cleanliness is an important factor, so keep your fingers off the surface of the crystal and electrodes. If you take the extra precaution of sealing the top carefully with shellac, you will probably never have to take the holder apart again.

— *H. Edwin Dorr*

CRYSTAL-GRINDING COMPOUND

Anyone interested in good fast-cutting and easy-to-obtain crystal-grinding abrasive should try ordinary automobile valve-grinding compound.

The writer has been using it very successfully to grind 160-meter crystals to the 80-meter band. The grinding operation takes about twenty minutes.

— *Louis D. Breetz, W8QLP*

BEAM-HARDWARE CONSIDERATIONS

The natural tendency for most of us is to use durable material when building beam antennas. Thus we think first of brass screws and hardware, because of their weather-resistant qualities. What we forget, however, is that when two dissimilar metals, such as aluminum and brass, or copper, are in contact in the presence of moisture, electrochemical action takes place and sooner or later something has to break loose. If, therefore, you plan to use aluminum tubing for your beam elements, round up some aluminum nuts and bolts to go with it. Stainless-steel hardware may also be used with safety. Most large hardware stores have such things in stock.

— *Joseph Engels*

If you're searching for strap-iron "U" brackets to brace that new antenna boom or mast, contact your local railroad signal depot and get permission to look over their scrap heap. W2VP found just what he needed on such a jaunt — discarded pipe-line hangers that fit a 2 × 4 snugly.

R.M.A. COLOR CODE FOR MULTIWIRE CABLES

Instead of keeping elaborate records of the colors of wires and the terminals used in a multiconductor cable hook-up, I hit on the idea of using the well-known RMA color code for this purpose. This new system works exceedingly well. Fig. 1-10 shows the basic idea. It will be noted that the terminals are numbered from top to bottom (or left to right), with No. 1 at the top or left. The colors start brown, red, orange, etc. Wire No. 11 would be brown with a brown-and-white tracer. Wire No. 12 would be brown with a red tracer. This system proved extremely useful in connecting up 127 thermocouple gauges in a special job.

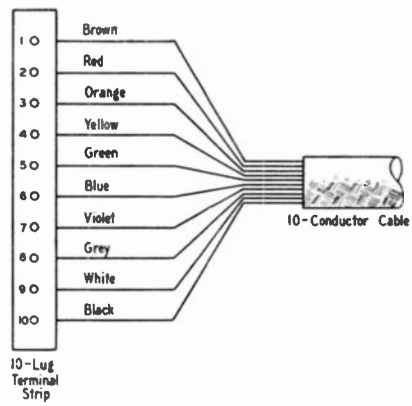


Fig. 1-10 — **Using the RMA color code to terminate multiconductor cables.**

— *Dwight Stebbins*

HINT FOR DECAL USERS

While the Millen panel-marking "decals" work well on almost all finishes, difficulty is sometimes experienced where a poor grade of lacquer has been used in painting the panel. The solution supplied with the decals acts almost like a paint remover with the cheap lacquer, ruins the finish, and makes application of lettering impossible.

A sure remedy is to apply a small layer of white shellac with a camel's-hair brush over the spot where the decal is to be placed. In five or ten minutes the shellac will be dry enough to permit application of the decal in the usual manner.

Shellac can also be applied to bare metal surfaces such as bakelite, metal, or fiber, allowing decals to be placed on these surfaces as easily as they are on painted surfaces.

— *William J. Kuehl, W9VQX*

SIMPLIFIED METHOD FOR CALCULATING *L* AND *C* ON THE SLIDE RULE

HERE is an easy way to find inductance and capacity values on a slide rule, requiring only one setting of the slide.

The formulas used are as follows:

$$f \text{ in cycles} = \frac{1}{2\pi\sqrt{LC}} \text{ when } L \text{ is in henrys, } C \text{ in farads.}$$

$$f \text{ in Mc.} = \frac{159}{\sqrt{LC}} \text{ when } L \text{ is in } \mu\text{h., } C \text{ in } \mu\mu\text{fd.}$$

$$\text{Therefore, } f\sqrt{LC} = 159;\ LC = \left(\frac{159}{f}\right)^2, \text{ when } f \text{ is in Mc.}$$

To find *LC* for, say, 7.3 Mc. on the slide rule, first set 7.3 on Scale C above 159 on Scale D. Then read the *LC* value on Scale A — in this case 475.

If *L* is given, *C* may be found by setting its value on Scale B under the *LC* value. The reading appearing on Scale *A* over the index (1) on Scale B will be the value of *C*.

This method may be used for cycles, kilocycles or megacycles, farads, microfarads or micromicrofarads, henrys or microhenrys, when the correct placing of the decimal point is mentally calculated.

Murray MacKenzie

POINTERS FOR BETTER SOLDERING JOBS

A GOOD way of eliminating the messy stains on soldered joints has been turned up by W1JEQ. As soon as the solder has "set," but while the joint is still hot enough for the rosin to be in a semiliquid state, he brushes the surplus rosin away with a small fairly-stiff brush. This leaves the joint shining and clean. The rosin hardens on the brush and is easily removed by flexing the bristles with the fingers.

—•••—

ONE of the most annoying temper-raising finger-burning operations in rig building is the holding of small parts in cramped places while soldering. These headaches can be completely done away with by the use of a surgeon's Hemostat, which can be purchased for about a dollar at any second-hand medical supply store. This handy gadget looks like a pair of scissors but actually has jaws similar to long-nosed pliers. The big feature of the tool is a ratchet-like catch incorporated between the handles, so that once that elusive 100-$\mu\mu$fd. mica has been caught in the jaws, the handles may be snapped together to hold the condenser fast. When so held, it can be maneuvered into soldering position with the Hemostat and kept rigid during the process. The fingers also are at a safe distance, and a better connection results in every way.

— *H. F. Shepherd, jr., W6QJW*

—•••—

WHEN you are stripping some gear and want to be able to use the parts again in another rig, damage to the fragile socket pins can be avoided easily by plugging an old tube in the socket while you unsolder the connections. The pressure of the tube pins against the socket terminals keeps them straight, and prevents bending and loosening.

— *David O. Finnell, W5LCL*

—•••—

ON THOSE hard-to-solder jobs, where the iron is too small for the job at hand, try preheating the metal parts to be soldered with an electric hot plate, toaster, or other source of heat. The iron will not then have to lose so much heat, and the operation can be performed successfully.

— *J. C. Nelson, W2FW*

HAM-MADE SOLDER FLUX

AN EXCELLENT noncorrosive soldering flux can be made by crushing rosin into a fine powder, then mixing it with methyl hydrate or rubbing alcohol until a syrup about the consistency of molasses is secured. This mixture should be kept corked when not in use. However, I have found that the alcohol does not evaporate rapidly when mixed with rosin. A 1-oz. bottle of this flux will last a long time, so it is very inexpensive.

— *Austin A. Smith*

SOLDERING-IRON CLEANER

SHOWN in Fig. 1-11 is a handy tip cleaner for your soldering iron. It is made from an empty solder spool, forming two "cups" by sawing it in half through the barrel of the spool. The cups are then filled with steel wool, and are fastened to the work bench by two screws that pass through the large flange. Just a poke and a twist of the iron into one of the cups will insure a clean, bright iron and greatly simplify the soldering job. In my own shop I found the vertical back of the bench the most useful spot for mounting these gadgets.

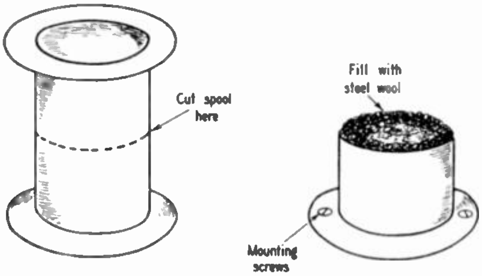


Fig. 1-11 — A neat soldering-iron cleaner made from an old solder spool.

— *Leon Baldwin, VE2TM*

SOLDERING IN CRAMPED QUARTERS

Recently having a soldered connection come loose deep inside a milliammeter, and not wishing to take time or risk further damage to the instrument by taking it apart, I resorted to the stunt illustrated in Fig. 1-12. It is a simple method that will prove helpful whenever it becomes necessary to make a soldered connection in a space too small for the point of the soldering iron to enter.

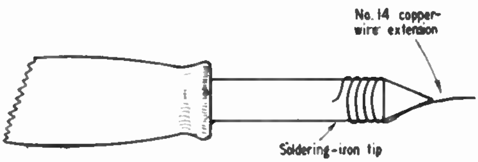


Fig. 1-12 — A handy "extension" for soldering in close quarters may be made of a short length of No. 14 copper wire, preferably pretinned.

A short length of No. 14 bare copper wire is wrapped about three turns around the tip of the iron, with an extension brought out as far as needed past the tip of the iron. The "extension" works best with pretinned copper wire, but any metal that will conduct the heat will do. Have the extension contact the tip of the iron along as much of its length as possible.

— *Jerry Morgan, W5ABQ*

GLYPTAL SOLVENTS

Cliff Erickson, W8DAE, finds ordinary paint remover a highly effective agent for loosening Glyptal-locked bolts and nuts. A more adventurous soul, Wayne R. Ayres, W9PAB, uses his XYL's fingernail-polish remover for doing the job!

— • • • —

Glyptal can be *temporarily* softened by the application of heat, a heavy-duty soldering iron being a good source. However, fast work is necessary once a setscrew or coupling has been freed in this manner, because the stuff "sets up" rapidly.

— *W4JWG*

HANDY FEED-THROUGHS

Excellent high-voltage feed-through grommets can easily be made by cutting wafer-shaped cross-sections of the vinylite dielectric used in coaxial cables.

W6EFH

EQUIPMENT NAMEPLATES FROM HAND-DRAWN NEGATIVES

White-on-black paper nameplates are suitable for use on transmitter, receiver, frequency-meter and other instrument panels. Obviously, they are best applied in the case of equipment having a black panel or cabinet.

A negative is made of tracing paper. The printing may be either typewritten or hand-lettered on the negative. If typewriting is to be used, the type should be cleaned with a small brush and carbon tetrachloride, and a dense and fairly new ribbon used. The tracing paper should be backed with a piece of carbon paper (carbon side facing tracing paper). Hand lettering should be done with black drawing ink. Border and other lines should be drawn with drawing ink and a ruling pen. Slightly sharper lines will result on the finished job if the lines are drawn on the reverse side of the negative — i.e., the side that will be next to the sensitized paper.

Photographic paper is then exposed through this negative, and developed and fixed in the usual way. A double-weight paper stock with a velvet surface is suggested and should be the "hardest" available; e.g., Azo No. 5. The time of exposure is not critical, and with an ordinary printing box, 10 seconds will be about correct.

Earl Schoenfeld

— • • • —

Of interest to amateurs who don't own photographic equipment is the following method of blueprinting nameplates, suggested by Charles F. McMorrow, W1KLN:

The nameplates are drawn with black drawing ink on pure white paper, then taken to a blue-print maker and photostated. Care must be taken in cleaning the original drawing since the photostat will show dirt marks as well as the drawing. These prints turn out very well and are glued right to the panel with any good grade of glue, or they can be glued to a thin sheet of brass to make the usual type of removable nameplate. The background of the print is more gray than black, and looks well on either gray or black panels. After the glue has dried, the surface of the print is given a coat of lacquer (clear fingernail polish), and when dry will remain new-looking for a long time.

A word about the cost. An $8\frac{1}{2} \times 11$-inch drawing will hold about 12 switchplates or about 70 small one-line nameplates ($1\frac{1}{2} \times \frac{1}{2}$ inch), and costs 30 cents to photostat.

It pays to *make* your own and have just the wording you want and any design you want. Of course your own labor comes cheap, and a bottle of glue will last a long time.

PADDING FOR 'SPEAKER CABINETS

In case you're in need of a suitable absorbent padding material to deaden a loudspeaker cabinet — especially the bass-reflex type — a satisfactory substitute will be found in "Chux," a disposable baby diaper, available at the corner drugstore in case you have no little harmonics at your house.

— *W5CVO/4*

DRILLING GLASS PANES

A simple way to drill a hole in a pane of glass is to use an old drill (that you have no further use for) and a high-speed electric drill. Place the glass on an absolutely flat surface, and turn on the drill, applying moderate pressure. After a time, the drill will become red hot, and then almost white hot. Suddenly it will fall right through as it melts the glass. Do not try to take the drill out while it is still turning, but turn it off, removing it from the hole before the glass has had a chance to cool. The drill will be no good for drilling metal, or even wood, after use in this fashion, but it may be used on glass again. There will be a slight burr around the edges of the hole when it hardens, but this is usually of small consequence, and can be covered by a beehive or other type feed-through insulator.

— *J. A. Felthouse, KL7ED*

ANOTHER GLASS-DRILLING HINT

Here's another way to drill glass, and it's probably the best way if you have access to a drill press. If you don't have a drill press, you will have to use another method.

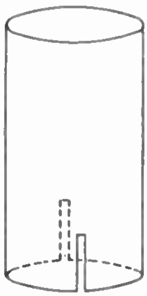


Fig. 1-13 — Method of notching tubing for use in drilling holes through panes of glass.

Determine what diameter hole you want and obtain a piece of thin-wall brass or copper tubing of the same outside diameter. With a suitable saw notch the tubing as shown in the diagram, and mount the tubing in the drill-press chuck. If the tubing is of a larger size than the chuck capacity it will be necessary to devise some sort of a holder. One way is to shape a wooden dowel of hard wood, one end of which will fit in the chuck and the other end of which will fit inside the tubing. A screw can be run through the tubing into the wood to hold it firmly in place. It is essential that the tubing run true on the axis of rotation, with no wobble or shifting.

The glass through which the hole is to be drilled should have a firm foundation on the drill-press bed. When drilling thick glass sheets a wood base is often used. However, for drilling such thin panes as window glass, it is strongly recommended that a layer of soft felt be placed under the glass.

A dam of putty or plaster of Paris is built up around the hole-to-be, and this is then filled with a mixture of water and Carborundum. Or, if no Carborundum is immediately available in the workshop, fine valve-grinding compound may be used.

Now you're all set to drill. The watchword is "take it easy." Don't use too much pressure, don't try to go too fast, don't try to force the operation. Use very light pressure, just enough so that the felt begins to give. After you've drilled through a couple of panes of glass (and have perhaps broken one) you'll get the "feel" of it. It is essential that the grinding compound stay moist and fluid. Some of the water will pass through the slots in the tubing to the inside of the spot being drilled, thus keeping that area cooled. If not, there'll be a hot spot, and a good chance that the glass will crack.

Keep plenty of water on the work and not too much pressure on the drill press, and you won't have any trouble. Coarse Carborundum will cut faster than fine powder or valve-grinding compound, but the hole won't be quite as smooth.

— *Richard L. Baldwin, W1IKE*

A BATTERY-SAVER

If you are like most amateurs, you probably run a big bill for batteries principally because you neglect to turn the switch off after some piece of incidental gear is used. By employing a timer switch made for gas-engine model aircraft, I really saved on batteries and cuss words. The switch can be adjusted for a 5- to 10-minute period, and then wired in series with the usual filament switch. The price is reasonable and the timer surely pays for itself in saving batteries, which come rather high these days.

— *B. E. Henry, W8QBJ*

GETTING AT THAT CRAMPED SPOT

Here's an old trick that still works . . . it might save *you* a bit of bother. Did you ever try to put a 6-32 nut into a spot where your fingers or your "long-noses" wouldn't go? Just take a short length of solder, flatten the end a bit, and force it part way into the nut threads. Bend the solder into the form necessary to get down to that inaccessible bolt, and there you have it. Now all you have to do is to get at the bolt head with a screwdriver! If you can't do that — you had better move the whole works.

— *R. O. Deck, jr., W9JVI*

USEFUL TOOL FOR TVI REDUCTION

When you start working on your rig to cut down harmonic radiation, you'll find the gadget illustrated in Fig. 1-14 a handy addition to your bag of tricks. It is a pick-up loop designed to permit easy and constant coupling to d.c. leads, feeders, tank coils, etc., to make your indicator a more useful and reliable device.

An 8-inch length of the new tubular 300-ohm Twin-Lead is used to form a hairpin loop. The wires at one end of the piece are joined, forming the loop, and a convenient length of 75- or 150-ohm Twin-Lead is connected to the other end, running to a single-turn loop that fits around the coil in your harmonic indicator. A ⅛-inch slot is cut through the side of the hollow Twin-Lead, as shown. The little notches near the ends of the slot permit you to clamp the lead you are checking within the "probe" so that the lead and the hairpin loop run parallel for several inches. This provides maximum coupling to the lead, and also insures that the degree of coupling will remain *constant* while you work on the rig to reduce the amplitude of the harmonic flowing in that lead. Thus you won't have to wonder whether the "reduction" in the harmonic was a result of the change you made, or of a difference in the degree of coupling from one measurement to another.

The bare wires exposed at the joints in the probe may be insulated by melting a little of the brown dielectric from a scrap of the Twin-Lead and flowing it over the joint, as is done in making up the center joint in Twin-Lead folded dipoles. You can then use the probe around fairly high voltages without fear of electrocution. It is also possible to push the probe through small openings in the shielding of your rig to determine how much of the harmonic is still left inside. In low-power transmitters it is even possible to place the pick-up probe right inside the tank coil.

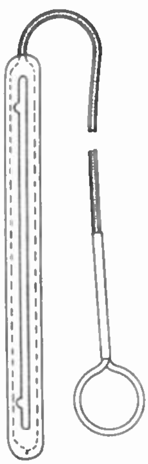


Fig. 1-14 — **Handy probe for use with a wavemeter in conducting tests to reduce TVI. The construction of the probe, which is made of the new tubular Twin-Lead, is discussed in the text.**

When using the slotted probe to check an open-wire feed line, bow one side of the feeder for about six inches of its length and clamp the bowed portion inside the probe. In this way you'll be able to check the effectiveness of your antenna coupler in knocking down the harmonic that gets out by way of the antenna.

The use of the pick-up loop discriminates against stray pick-up from the fundamental signal, and gives you a reading of the harmonic only. In addition, it permits you to place the indicator on the bench, freeing the hand that would otherwise hold it to make adjustments on the rig. If you've tried to maintain constant coupling to a given circuit and make adjustments on that circuit at the same time, you'll know what we mean! With this gadget it's easy.

— *Richard M. Smith, W1FTX*

TOOL FOR REPLACING METAL TUBES

A TOY "arrow" (wooden dowel with rubber suction cup at one end) is a handy gadget for replacing metal tubes in hard-to-get-at sockets. Toy stores have them at three for a dime.

— *Cliff Robinson, W1RQR*

ADAPTER FOR OCTAL-BASE RECTIFIER TUBES

HERE'S a handy idea for the workbench that permits interchange of any of the 5-volt octal-base rectifier tubes (5T4, 5U4G, 5V4G,

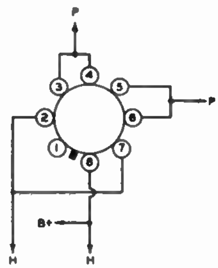


Fig. 1-15 — **Jumpers added to an octal tube socket to permit use of various types of 5-volt rectifiers.**

5W4, 5X4G, 5Y3G, 5Y4G or 5Z4). All that is needed is the addition of a few jumpers as shown in Fig. 1-15.

— *Ward T. Watson*

W. A. MIDCALF has tried the above hook-up and finds it most satisfactory. He cautions against the use of wafer-type sockets, which do not have the voltage-breakdown ratings of the molded bakelite or ceramic types. — *Ed.*

LIMITING DRILL TRAVEL

EVEN in the most careful designs, it is often necessary to drill an extra hole or two after some of the parts have been mounted. To keep from ventilating some of the parts with the drill, start the hole, then remove the drill and slip a metal tube or wood block of the correct size over it, as shown in Fig. 1-16, and resume drilling

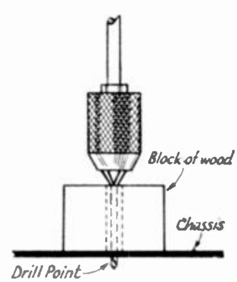


Fig. 1-16 — **Method of limiting the travel of a drill to prevent damage to parts which may have been mounted underneath the chassis.**

without danger of punching through. Unless an intermittent, low-resistance connection is specifically desired, it is advisable to remove the metal shavings after drilling. This is pretty hard to do unless some vaseline or cup grease to hold the chips has been spread over the point where the hole is drilled. The grease is wiped off after the drilling is complete.

— *John Alvin Weber, W5JJL*

PLUG-IN SHIELD CANS

WHILE building a new exciter, I found it necessary to shield one plug-in coil, but that meant a plug-in shield would be needed. After some thought the solution shown in Fig. 1-17 presented itself. It is passed along to others who may like to have good-looking gear but who can't afford the commercially-built refinements.

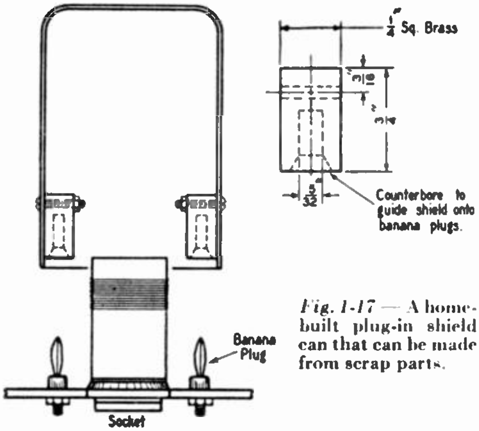


Fig. 1-17 — A home-built plug-in shield can that can be made from scrap parts.

The shield is a square aluminum coil shield from a defunct b.c. set. The two square brass pieces are drilled as shown, mounted inside the can, and the whole works then plugs onto a pair of banana pins mounted on the chassis.

— *Bill Wildenhein, W8YFB*

SHIELD FOR MINIATURE TUBES

Here is an efficient and easy-to-make tube shield for "peanut" or miniature glass tubes. As shown in Fig. 1-18, the shield is made from a short length of large-diameter copper shield braid.

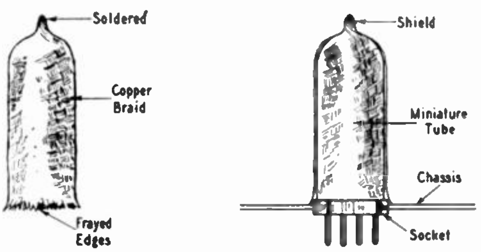


Fig. 1-18 — Improvised shield for miniature tubes.

The diameter and length of the braid are determined by the tube used, and should be chosen so as to form a tight fit over the glass envelope. Cut the length of braid about one-half inch longer than the tube, twist one end of the braid together, and solder. This makes the top of the shield. The bottom of the shield is left frayed so that there will be numerous contacts with the metal chassis. A ground wire could be added to assure permanent connection, if desired.

— *Harry Star, W1MWO*

BREADBOARD-CONSTRUCTION HINT

How to mount a toggle switch on a breadboard-construction job has been a problem that is hard to lick. They just aren't built to be mounted on a board. It can be done, however, by opening the "eye" of a ½-inch screw eye with a screwdriver blade, putting the barrel of the switch inside the eye, and then clamping it there with gas pliers. The lock nut on the switch barrel can be used to hold the switch firm, and the whole assembly can then be fastened to the breadboard by screwing the eye into the wood.

— *William J. Wright, W5KYK*

SHIELDING KINK

In some instances, such as in a high-gain audio amplifier, it is desirable to shield an individual component to reduce hum. A very effective shield can be made from the metal case of a discarded fluorescent-light "starter" by removing the glass tube and condenser found inside and mounting the component inside on the terminal lugs. The result is shown in Fig. 1-19.

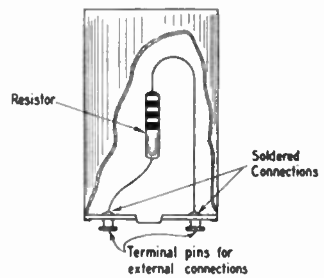


Fig. 1-19 — An effective method of shielding an individual component. The case of a burned-out fluorescent-light "starter" is used as shown.

The assembly can then be grounded to the amplifier chassis by means of a cable clamp, or by drilling a hole in the top of the can and mounting with a 6-32 screw. The outside connections can be made with shielded wire to insure complete isolation.

— *G. W. Jerguson, W4IJI*

CHASSIS-CUTTING TOOL

Aviation or "duck-bill" snips are the answer to the problem of cutting round or square holes in chassis. A ¼-inch hole is sufficient to get them started. With ordinary thicknesses of chassis material a square hole with practically no fillet can be cut easily. Likewise, round holes are a cinch. Because any size hole can be cut using this tool, it is well worth its price of approximately $4.75.

— *Lt. Cmdr. R. J. Slagle, USN, W3PD*

REMOVING GLASS FROM METER CASES

Oftentimes it becomes necessary to remove the glass face of a meter, either for repairs or for recalibrating the scale. A convenient way to do this is to bake the meter with an infrared heat lamp. This expands the bakelite or metal case but not the glass, allowing the latter to drop out "easy like."

— *Ed. A. Kirchhuber, W2KJY*

2. Hints and Kinks . . .

for the Receiver

AN UNTUNED PRESELECTOR

Although the old adage concerning the impossibility of "getting something for nothing" still holds, the addition of a simple untuned 6AC7 preselector has been found to add much to the sensitivity and selectivity of small communications receivers without a tuned r.f. stage ahead of the converter. For best results the preselector should be connected to the receiver with the antenna coil of the superhet directly in the plate circuit of the preselector, as shown in Fig. 2-1. This arrangement was found to be better than the choke-condenser coupling shown in Fig. 2-1B.

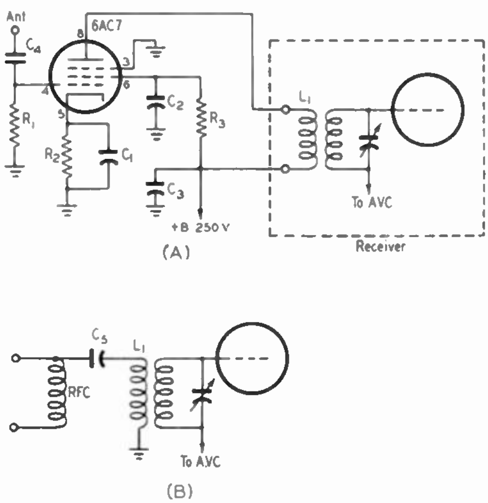


Fig. 2-1 — **This untuned preselector requires only a few components and a 6AC7, yet it will improve the performance of the ordinary variety of communications receivers having no preselection. An alternate method of coupling to the receiver is shown in B where an r.f. choke replaces L_1 in the circuit shown in A and is capacity coupled to the antenna winding of the receiver.**
C_1, C_5 — 0.01 μfd. paper.
C_2, C_3 — 0.1 μfd. paper.
C_4 — 47-μμfd. mica.
R_1 — 1 megohm.
R_2 — 220 ohms.
R_3 — 47,000 ohms.

In receivers with separate antenna coils (for use with doublet antennas) the connections are quite easily made, and even in those with internal grounds it is a simple job to unsolder the grounded end, and bring it out for use with the preselector. With such connections the reflected impedance in the plate circuit of the preselector is maximum at the frequency to which the mixer grid circuit is tuned, and therefore maximum gain is achieved at that frequency alone. The grid of the 6AC7 may be returned to the a.v.c. line if it is desired to make this additional change in receiver wiring, but it is not essential for smooth operation of the preselector.

— *Herbert L. Ley, jr.*

USING ONE RECEIVER TO CHECK I.F. OF ANOTHER

When a signal generator is not available, this simple means of lining up a receiver's i.f. amplifier may help.

The idea is to use a second receiver whose i.f. amplifier already is tuned to the desired i.f. The second receiver, used as a signal generator, is tuned to a station. The output signal then is taken from one of the i.f. stages and fed through a mica condenser to the i.f. amplifier of the first receiver. The first i.f. amplifier then can be lined up on this signal.

— *Kenneth S. Digre*

COMBINATION B.F.O. AND A.N.L. FOR THE SKY BUDDY

The combination b.f.o. and a.n.l. circuit used in the S-38 receiver can also be used in the Sky Buddy by substituting a 6SQ7 for the 76 b.f.o. tube originally used. The 76 and its socket are removed, and an octal socket for the 6SQ7 is installed in place. The circuit connections are shown in Fig. 2-2. The two diode plates are tied together and are connected to the control grid of the audio tube through a switch. The triode section of the tube is then wired as the b.f.o.

In operation no trouble has been experienced

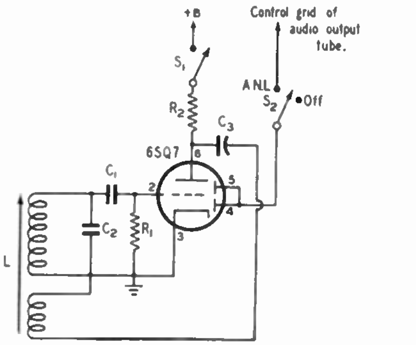


Fig. 2-2 — Circuit modifications required for the addition of a noise limiter to the Sky Buddy receiver.
C_1 — 100-μμfd. mica.
C_2 — 470-μμfd. mica.
C_3 — 0.01-μfd. 400-volt paper.
R_1, R_2 — 47,000 ohms, ½ watt.
L — B.f.o. coil.
S_1 — B.f.o. switch.
S_2 — S.p.s.t. toggle switch.

with the performance of the new b.f.o., and the limiter works very well. With the limiter switched into the circuit it is possible to hear signals plainly that were previously not even audible through the noise.

— *Fred R. Mumma, W3KEK*

A SHORT-WAVE LOOP ANTENNA

In an attempt to receive DX broadcasts originating in the U.S.A. and in London, I have been experimenting with antennas of various types in an effort to minimize interference from undesired stations operating on the same frequency. Since the local set-up makes it impossible to string up a terminated-rhombic antenna, I now use the old familiar loop, tuned to the desired short-wave band and rotated until one of the nulls is placed on the interfering station. While the performance of the loop does not compare with that of a rhombic, it does a better job of reducing interference than any other type of antenna for which space is available.

The frame consists of a wooden cross, 19 inches across by 25 inches high, on which are wound three turns of insulated No. 14 wire. The ends of the antenna are tied to the stator plates of a 35-μμfd. split-stator condenser. The condenser rotor and the center tap of the antenna are grounded to reduce hand capacity (and consequent change of tuning) to a minimum.

For coupling the antenna to the receiver I first tried a single turn, inductively coupled to the three-turn loop. When this turn was connected to the 600-ohm input of the receiver, the antenna tuning was affected by the tuning of the receiver. This was tried on the 9.5–11.75 Mc. short-wave broadcast band.

Next I removed the coupling loop and substituted a low-impedance match, tapping the antenna 14 inches from the center tap on each side and hooking the low-impedance leads to the receiver input. The loop was connected to about 4 feet of twisted line and mounted adjacent to the receiver.

The antenna tuning sharpened greatly and the signal strength came up to a level only one "S" point less than with a 75-foot antenna installed outside.

The results with this arrangement were startling. Tuning to London each evening on the 11.75- and 15.0-Mc. bands, I was able to keep them tuned in fine, and placing the null on the interference cut it down two or three "S" points on the receiver's meter.

— *Lt. Henry B. Plant, SC*

ANTENNA COUPLER FOR THE RECEIVER

Modern communications receivers possess different input-impedance characteristics, and receiving antennas, with their varying types of transmission lines, have different terminal impedances. Therefore it may be seen that the receiver transmission line should not necessarily be connected directly to the antenna binding posts on the receiver. An impedance mismatch will occur in many cases, and as a result, a lowered transfer of radio-frequency energy will exist between the transmission line and the receiver input circuit.

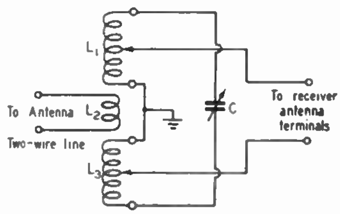


Fig. 2-3 — Antenna coupler for the receiver.
L_1, L_3 — 15 turns No. 22–24 wire, tapped, on 1-inch diameter form. See text.
L_2 — 3 turns wound between L_1 and L_3.
C — 50-μμfd. variable.

One of the simplest and most effective antenna impedance arrangements, known as the link antenna-coupling circuit, is illustrated in Fig. 2-3. The correct adjustment of the secondary coil is determined by the "cut and try" method. However, each tap must be adjusted the *same number of turns each side of the center tap on the coil.* Condenser tuning will give a sharper impedance match than would be possible with the tapped-coil arrangement alone.

— *Art Monsees, W6HJP*

REDUCING NO-CARRIER NOISE IN F.M. RECEIVERS

To kill noise in f.m. receivers when no carrier is being received, try adding fixed bias to the limiter tube. Sufficient bias should be used to cut the tube off, plus enough to keep the noise voltage from drawing limiter grid current.

— *Robert G. Hester*

IMPROVED "HETEROFIL" CIRCUIT

After experimenting with various suggested "Heterofil" circuits, I found that performance was greatly improved by the use of the three

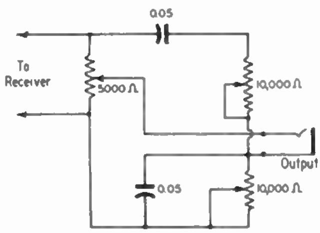


Fig. 2-4 — **Improved "Heterofil" circuit developed by W7ABF. The three variable controls are not ganged.**

variable controls in the circuit shown in Fig. 2-4. It is suggested that condensers of high quality be used as others will impair the operation.

— *Robert H. Flagler, W7ABF*

DIODE PEAK CLIPPER WITHOUT BIAS BATTERIES

In the course of trying several noise limiters, we attempted to use a pair of selenium rectifiers in place of the 1N34 germanium diodes called for in the *Handbook* circuit. We found that instead of clipping at the 3-volt level that was supposed to be established by the bias batteries, the unit clipped at 8 volts peak-to-peak. Apparently the 5-volt drop that is encountered in the selenium rectifiers holds even at low current levels.

The batteries were eliminated, therefore, resulting in the circuit shown in Fig. 2-5. The limiter clips at 5 volts, peak-to-peak, which has worked out well for high-impedance 'phones.

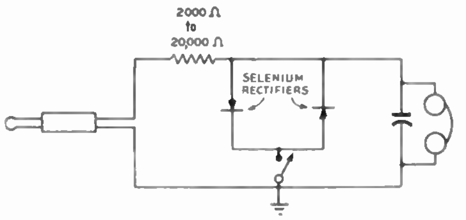


Fig. 2-5 — **A diode peak clipper that requires no bias batteries. Two selenium rectifiers are used instead of the usual germanium crystals.**

The great advantage of the selenium rectifiers in this unit is the elimination of the need for batteries. Any battery will wear out after a relatively short time, while the rectifiers used in this gadget will probably outlive your receiver.

— *Floyd Gardner, W9BQJ*

CAR RECEIVERS FOR MOBILE

If you are planning a mobile 3.9- or 14-Mc. 'phone station for your car but don't know what to do about a receiver/converter combination, W8MGQ reminds us that there are car radios built that include the broadcast band *and* short-wave. Some can stand a little bandspreading, but otherwise they should be a natural.

MINIATURE BASS-REFLEX CABINET

Whether it's a 3-, 4- or 5-inch 'speaker on your communications or midget broadcast receiver, the quality of reproduction will be greatly enhanced by mounting the 'speaker in a bass-reflex cabinet. A cost-free enclosure can be provided through the use of a cigar box obtained from your friend in the corner store. Cut a round hole of the proper size in the bottom of the box for the 'speaker as shown in Fig. 2-6. Then cut a rectangular aperture below the 'speaker hole. This should have an area approximately one-

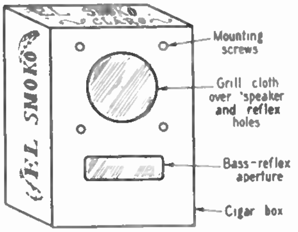


Fig. 2-6 — **Cigar-box bass-reflex cabinet for a small 'speaker. The holes may be covered with cloth.**

quarter that of the 'speaker opening. A small notch cut in the lid will permit the entrance of the leads. Then nail the lid tight. The improvement in quality will surprise you!

— *M. V. Winston, W2EZC*

A FORWARD-READING S-METER

Hams who build their own receivers often desire to include a carrier-level indicator in their sets. Unless one has a special meter whose normal needle position is at the right for zero current indication, the meter will read backward. This means that maximum deflection with signal applied will be to the left. In order to have the meter read to the *right* at maximum signal it is necessary to invert the instrument. This often spoils the finished appearance of the set.

The circuit shown in Fig. 2-7 overcomes this difficulty. It consists of a v.t.v.m. with a modified Wheatstone bridge in the plate circuit. Values of components may, of course, have to be altered to adapt the circuit to conditions encountered in different receivers. With the values shown the circuit will function correctly with a 250-volt d.c. plate supply and an a.v.c. system developing up to 10 volts.

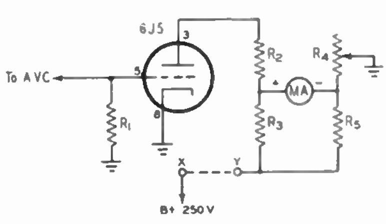


Fig. 2-7 — **Bridge-type forward-reading S-meter.**

R_1 — **1 megohm, ½ watt.**
R_2 — **22,000 ohms, ½ watt.**
R_3, R_5 — **47,000 ohms, ½ watt.**
R_4 — **0.1-megohm potentiometer.**
MA — **0-1 d.c. milliammeter.**

To adjust the range initially, ground the receiver a.v.c. circuit and set R_4 for zero meter reading. Then remove the ground and tune in a strong signal. Note the point of maximum deflection, which should be at nearly full scale on the meter. If it is not, the value of R_3 and R_5 may be changed. Both resistors must be changed an equal amount to sustain balance in the bridge. *Increase* the resistance if the meter reads too high; *decrease* it if the reading is too low. A second method of adjustment is to insert a variable resistor between points *X* and *Y*. This may be a wire-wound resistor with a slider or a wire-wound potentiometer or rheostat. The first method eliminates the extra control, and thus is preferable.

A higher-range meter may be used, but the full-scale value should not exceed the maximum rated plate current drawn by the tube with zero grid bias.

— *Kenneth M. Miller, W9NQT*

SIMPLIFIED DESIGN OF LOW-FREQUENCY DISCRIMINATOR TRANSFORMERS

The action of FCC in permitting n.f.m. on some of the lower-frequency bands has stimulated interested amateurs to build limiter-discriminator units to be added to their 455-kc. receiver i.f. amplifiers. At present, 455-kc. discriminator transformers are not available on the market, and the design of such a transformer without a great deal of laboratory equipment is quite difficult. Most standard 455-kc. i.f. transformers are not adaptable. The coupling between the primary and secondary windings is quite critical for correct bandwidth, and can be adjusted only by sliding the coils up and down the form, a most difficult operation. It is possible, however, to couple the primary and secondary windings capacitively, which makes the bandwidth adjustment merely a small trimmer condenser.

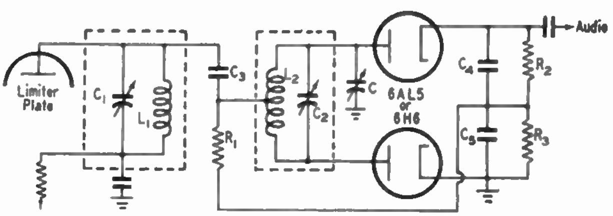


Fig. 2-8 — A method of overcoming the lack of low-frequency discriminator transformers. Two separate tuned circuits are coupled through a fixed capacitance. Bandwidth is then adjusted by means of a small mica trimmer, *C*.

C — 3–30 μμfd. trimmer.
C_1, C_2 — 100-μμfd. trimmer.
C_3 — 47-μμfd. mica.
C_4, C_5 — 100-μμfd. mica.
R_1, R_2, R_3 — 0.1 megohm, ½ watt.
L_1 — 1.5-mh. pie from 455-kc. i.f. transformer.
L_2 — Same as L_1, but center-tapped.

The circuit is shown in Fig. 2-8. Inductances L_1 and L_2 are pies from any replacement 455-kc. i.f. transformer. *C*, the bandwidth control, is a 3-30 μμfd. mica compression trimmer. The two coils have no magnetic coupling between them and are preferably mounted in separate shield cans. The unbalance provided by *C* causes current to flow in the secondary of the same phase which would be supplied by straight magnetic coupling. Thus, to change the bandwidth, merely adjust *C*, tune C_1 for maximum a.m. output, tune C_2 for minimum a.m. output, and the job is done. A few trials should give the desired bandwidth.

— *Harry R. Hyder, W3NVL*

CURE FOR UNTUNABLE SIGNALS

Are you hearing a miscellaneous jumble of untunable signals in the 28-Mc. band? If so, look to your antenna change-over relay and clean up its contacts. Oxidized silver is probably acting as a rectifier.

NO-KINK SCHEME FOR 'PHONE CORDS

Here is a kink destined to solve that ever-present problem of headphone leads getting in the op's way. Run an extension lead from the receiver up the wall and along the ceiling of the shack. Put a 'phone jack on the ceiling over the operator's position. By inverting the earpieces the cords go right up, completely out of the way.

— *J. C. Nelson, W2FW*

MOBILE RECEIVER FOR 75-METER 'PHONE

With 75-meter 'phone open to mobile operation, the question of a receiver can be solved easily by anyone who owns a BC-454 (3 to 5 Mc.) Command receiver, and who has a broadcast set installed in his car.

The BC-454 was found to be unsatisfactory when used alone, lacking both selectivity and audio output, but when its 1425-kc. i.f. circuits were used to introduce the hamband signals to the car receiver, in "Q5-er" fashion, both of these shortcomings were overcome. In fact, it is necessary to use only the first three tubes in the BC-454. This lowers the "B"-supply drain, and results in less "hash" than when the i.f. stages of the BC-454 are used.

A double-pole double-throw switch is used to switch the BC-454 receiver out of the circuit when it is desired to use the broadcast set for its original purpose.

— *Marion D. Conham*

DIODE NOISE LIMITER FOR CAR RECEIVERS

It is not necessary to have an extremely hot receiver for the mobile station, since noise is almost always the limiting factor, rather than receiver sensitivity. Even if you have your own car noise suppressed completely, the racket from other cars can give you plenty of trouble. A sim-

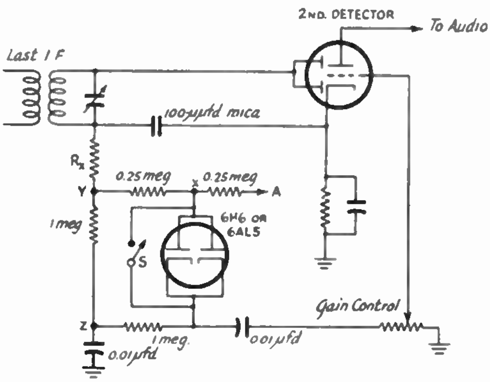


Fig. 2-9 — Schematic diagram of a simple diode noise limiter for use in a car radio receiver. If the a.v.c. voltage comes from the plate of the last i.f. tube, ignore the a.v.c. connection. If it comes from the second detector and does not use the same diode for both detection and a.v.c., change the circuit so it does. Try connecting the a.v.c. to points *X*, *Y*, and *Z*, in that order. Try connecting point *A* to cathode, or ground, whichever gives best results. Use a 6H6 as first choice, in preference to a 6AL5. Do not use a crystal diode. Resistor R_1 appears only in some receivers and may be left in the circuit.

ple and effective noise limiter is shown in Fig. 2-9. It works only with diode tubes; don't try a crystal diode — it won't work. Use a 6H6 in preference to the 6AL5. Avoid the use of a limiter which requires a knob adjustment. The one shown is the automatic-level type, and it does a nice job.

— *R. V. Anderson, W3NL*

COUPLING 500-OHM 'PHONES TO THE RECEIVER

With tube-to-500-ohm-line transformers still scarce, many amateurs are faced with the problem of using 500-ohm 'phones with their receivers without burning out the output tube, its

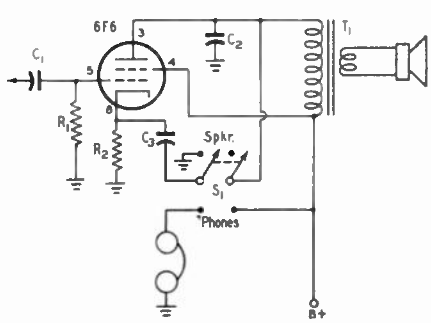


Fig. 2-10 — Proper operation of the output stage of the receiver when 500-ohm 'phones are used is provided by the connection of a d.p.d.t. switch, as shown. All other parts shown in the diagram are those usually found in the receiver.

C_1 — 0.01-μfd. 600-volt paper.
C_2 — 0.005-μfd. 600-volt paper.
C_3 — 10-μfd. 25-volt electrolytic.
R_1 — 0.47-megohm, ½ watt.
R_2 — 470 ohms, 2 watts.
S_1 — D.p.d.t. toggle switch.
T_1 — Tube-to-voice-coil transformer.

plate by-pass condenser, the output transformer, or all three, because of high peak voltages developed as a result of operating the tube with improper load on the voice-coil winding.

Operating the output tube as a cathode follower, as shown in Fig. 2-10, solves all of these problems with the additional advantage of producing excellent frequency response and very low distortion. By the addition of a double-pole double-throw toggle switch as shown, and a little rewiring of the components that are already in the receiver, proper operating conditions under both 'phone and 'speaker loads can be easily achieved.

— *Robert C. Potter, VE3TO*

A NOISE LIMITER USING GERMANIUM CRYSTALS

Many stations are bothered by ignition and other noises, often to the point of spoiling what would be a good QSO. As a result of the war, there has been developed a diode that has char-

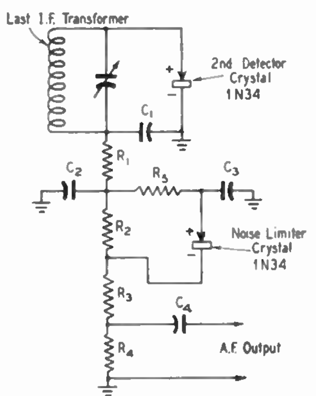


Fig. 2-11 — A second-detector-and-noise-limiter circuit utilizing germanium crystal rectifiers instead of tubes.

C_1, C_2 — 47-μμfd. mica.
C_3, C_4 — 0.1-μfd. paper.
R_1 — 47,000 ohms.
R_2 — 0.27 megohm.
R_3 — 0.1 megohm.
R_4 — 0.33 megohm.
R_5 — 1 megohm.

acteristics such that a remarkable noise limiter can be built into most communication receivers with a minimum of change. The diode is the 1N34 Sylvania germanium crystal which exhibits polarized nonlinear current-voltage characteristics. This diode starts to work with much less signal than the typical vacuum-tube diode and has less electrostatic capacity, making it more suitable for use in a high-frequency i.f. amplifier. The circuit shown in Fig. 2-11 is in use by the writer. A brief description follows.

In the schematic the diode load resistor is the series combination of R_1 through R_4. C_1 and C_2 in combination with R_1 make up the r.f. decoupling network.

Resistor R_2 is where the noise is dissipated. As can be seen, the 1N34 germanium diode is connected in shunt across the resistor after first being connected through a 0.1-second time-constant *RC* network. R_3 is an audio decoupling resistor before the audio output network, R_4 plus C_4.

This limiter is remarkably effective on noise or pulses of steep wave front and short duration such as are emitted by automobile and aircraft ignition systems.

— *Wm. F. Frankart, W9KPD*

AN "INTERCOM," "PHONO-AMP" AND RECEIVER COMBINATION

This combination intercommunication system, phono-amplifier and conventional receiver arrangement may prove handy in a ham shack or club room.

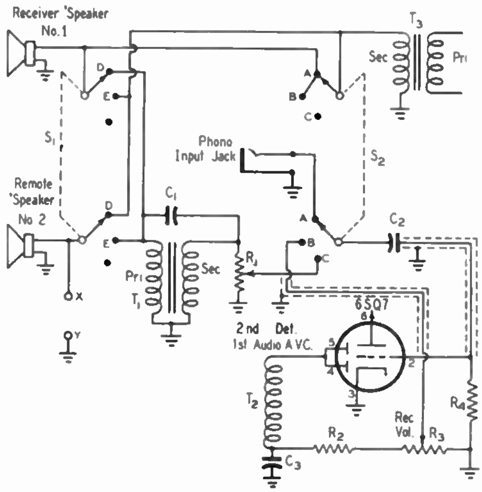


Fig. 2-12 — **Combination radio, phono-amplifier, and intercommunication circuit using a standard receiver.**
C_1, C_2 — 0.01 μfd.
C_3 — In receiver.
R_1 — 1-megohm "inter-com" gain control.
R_2 — In receiver.
R_3 — In receiver, volume control.
R_4 — 2 megohms.
S_1, S_2 — 2-gang single-pole 3-position switch.
T_1 — Microphone transformer.
T_2 — I.f. transformer secondary, in receiver.
T_3 — 'Speaker output transformer.

Fig. 2-12 shows the output circuit of my superheterodyne receiver and the modifications and additions necessary to permit this flexible operation.

With S_2 in position B, and S_1 in position E, the detector circuit of the receiver is connected to the triode section of the second detector and the receiver 'speaker is connected to the output transformer, T_3, in a normal manner.

With S_1 in position E and S_2 at C, the triode section of the 6SQ7 amplifies speech from 'speaker No. 2 (used as a microphone) through the microphone transformer, T_1. 'Speaker No. 1 is still connected to the output transformer, T_3, and receives the "output" of 'speaker No. 2. Push-to-talk operation, with control at the receiver end of the circuit, is possible by placing S_1 at D. Phono-amplification is obtained with S_2 at A.

With S_2 at either A or B, on either phono-amplifier or radio, 'speaker No. 1 may be used alone, if S_1 is at E. However, if S_1 is at D, both speakers are operated in parallel.

In the present installation, we have our remote 'speaker (No. 2) located in the movie-projection booth. By connecting the primary of a second microphone transformer to terminals X and Y, and the secondary to the phono-jack in the movie sound amplifier, we are able to pipe radio programs or music from records into the movie hall, or to use either 'speaker for announcement purposes.

— *Lyman H. Howe*

IMPROVED OSCILLATOR-MIXER COUPLING

Anyone who has been aggravated by that troublesome interaction between mixer and h.f.-oscillator circuits known as "pulling" will find the use of an untuned buffer stage interposed between the oscillator and the mixer an effective means of reducing the trouble. This method is an improvement over the usual pentagrid-converter arrangement, in that while the former provides good isolation, it does so at the expense of lowered sensitivity, because the conversion transconductance of the tube is comparatively low.

In order to achieve freedom from pulling, and at the same time maintain mixer sensitivity, an untuned triode may be used as a buffer, as shown in Fig. 2-13. This takes advantage of the fact that although the control grid has a large influence on the plate circuit of a tube, the influence of the plate on the control grid is negligible. We have, then, a one-way affair that does not allow the mixer tuning to "back up" into the oscillator.

The grid of the triode is coupled to the tuned circuit of the oscillator, and the plate of the triode is, in turn, coupled to the tuned circuit of the mixer, the connection being made by a tap on the tuning coil of the mixer only a turn or two above ground. This permits the use of a high-sensitivity tube such as the 6AC7/1852 or 6SK7 as a mixer.

It should be noted that poor interstage shield-

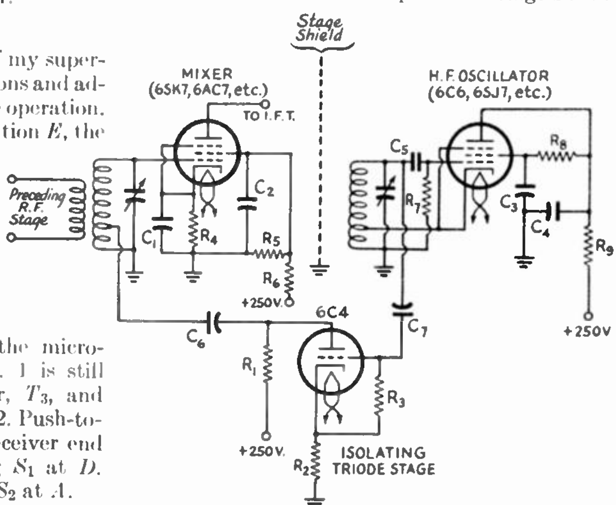


Fig. 2-13 — **An untuned buffer stage used to provide maximum isolation of the h.f. oscillator and mixer circuits to reduce "pulling."**

C_1, C_2, C_3, C_4 — 0.01-μfd. paper.
C_5 — 220-μμfd. mica.
C_6, C_7 — 0.005-μfd. paper.
R_1, R_6 — 0.1 megohm.
R_2 — 2200 ohms.
R_3 — 0.47 megohm.
R_4 — 22,000 ohms.
R_5, R_8, R_9 — 47,000 ohms.
R_7 — 10,000 ohms.

ing or injudicious placement of parts will tend to undo the benefits of the isolating triode. Conversely, any measure designed to prevent the oscillator and mixer from coupling by means other than through the triode buffer stage will make the arrangement more successful.

Choice of a 6C4 miniature triode is favored because the tube is small, its power drain almost negligible, and it seems to give results equal to those obtained with pentodes, in spite of expectations to the contrary.

The results have been something more than encouraging. Over all amateur frequencies up to 30 Mc., sharp tuning peaks in the mixer stage are regained without disturbing the oscillator frequency, and the receiver can be peaked for maximum sensitivity with decidedly less need for readjustment. In addition, the buffer presents a constant load to the oscillator, eliminating the trouble encountered in some receivers of oscillator failure in certain parts of the tuning range. No longer are dead spots encountered as the receiver is tuned through its range.

No doubt there is room for more experimentation on this subject, and it is hoped that others will be stimulated to make similar investigations along this line.

— *Clyde P. Brockett*

TELETYPE RECEPTION WITH MAKE-BREAK KEYING

Amateurs who are now using teletype machines for communications work may be interested in a system that was developed and tested by the writer in 1946 [and described in detail in June, 1949, *QST* — *Ed.*]. As at that early date there seemed to be no amateur interest in this form of communication, the work was dropped. This system uses off-on keying and gets around the necessity for using two-tone modulation or frequency-shift keying. It has a very substantial capability of discrimination against noise.

A loop circuit was set up between locations in downtown and midtown New York over a 5-mile path. The 11- and 2-meter bands were used. Both teletype machines were located downtown. Transmission north was accomplished with a surplus 144-Mc. crystal-controlled transceiver with one-watt output. The signal was received on a similar unit and retransmitted south by a 10-watt 11-meter transmitter. The signal was picked up on an SX-28 and fed into the receiving teletype machine.

This location was extremely noisy — the S-meter readings averaged around S7 on building noises of all types. Haywire antennas were employed so the signal never boosted the S-meter reading much beyond S9. Despite this severe handicap, the system worked very well. Amateur-teletype fans should obtain excellent results as they will rarely, if ever, encounter such poor receiving conditions.

The receiver circuit is shown in Fig. 2-14. A reverse-diode r.f. noise limiter is used in conjunction with a blocking-oscillator "tone-noise generator." The audio amplifier of the receiver can be followed by an audio filter, if desired, or the output can be fed directly into the rectifier. The rectified audio output of an SX-28 is sufficient to operate the teletype relay directly. The low-current teletype relay generally used in radioteletype work will reduce the audio output requirements.

The blocking oscillator shown in the diagram operates at the receiver's intermediate frequency. The repetition rate can be adjusted to any convenient frequency; between 400 and 600 cycles is a good choice. The output level of this oscillator is not important because the noise limiter clips the peaks. When the carrier is "on," the limiter operates and the locally-generated noise of the blocking oscillator is squelched. The carrier "on" condition thus becomes the teletype "space" position. The carrier "off" condition permits the blocking oscillator and any received noise to make the "mark" signal.

The system will operate successfully until the signal drops below the level of limiting or until local noise becomes so continuous that it keeps the receiver squelched all the time. The random nature of most received noise makes this an extremely unlikely occurrence.

— *Dana A. Griffin, W2AOE*

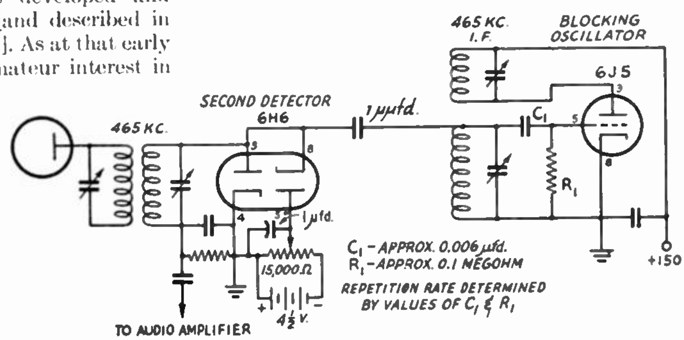


Fig. 2-14 — Circuit diagram of the second-detector circuit used with a standard communications receiver. The blocking oscillator provides noise pulses for the "mark" teletype signal.

MODIFYING THE HQ-129-X FOR N.F.M. RECEPTION

Comparing Figs. 2-15A and 2-15B will acquaint the reader with the circuit modifications made in a well-known communications receiver, the HQ-129-X, to convert it into an a.m.-n.f.m. receiver. It will be seen that a ratio detector is used. The output on n.f.m. will be somewhat less than on a.m. because R_1, which is a rather heavy load, is across the total output of the two diodes in the n.f.m. position. If desired, this resistor could be left in the circuit at all times, thus equalizing the a.m. and f.m. audio outputs. A crystal diode was substituted into the noise-limiter circuit so that the detector would be more or less balanced.

The only disadvantage in using this circuit lies in choosing a proper value for R_1. Although the value given works satisfactorily, the exact value should be determined experimentally, using a 100,000-ohm potentiometer in each receiver set-up for maximum results. The lower the value of resistor R_1, the better the performance from the standpoint of independence of amplitude variations. On the other hand, raising the value of R_1 increases the sensitivity. The optimum value of this resistor depends on the selectivity curve of the i.f. amplifier and the characteristics of the detector transformer, and hence must be determined experimentally in each installation.

Alignment of the ratio detector is similar to the alignment of a discriminator. However, in the absence of instruments the following procedure can be used: First, tune in an unmodulated carrier and adjust the transformer primary tuning for maximum output, as indicated on the S-meter. To adjust the secondary, tune in an *amplitude*-modulated signal and adjust the secondary tuning for *minimum* audio output. The

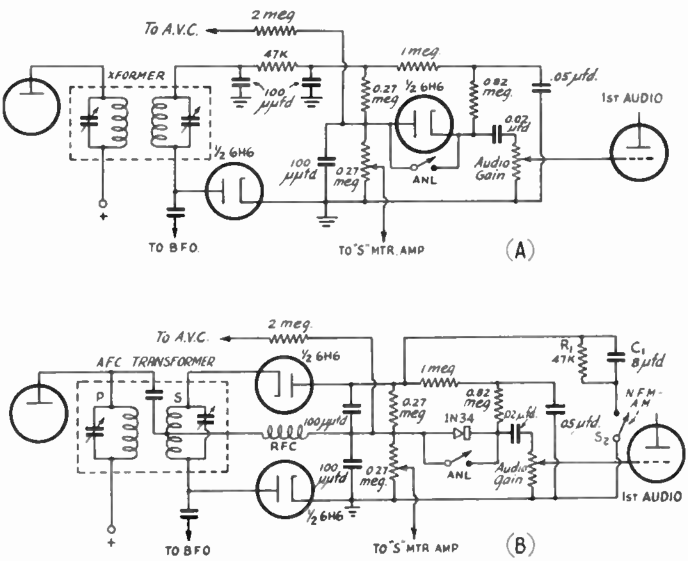


Fig. 2-15 — A — **HQ-129-X second-detector circuit; B — circuit revisions necessary to provide alternative a.m.-f.m. reception.**

a.m. carrier should be kept "on the nose" of the i.f. in this adjustment. A final check on a narrow-band f.m. signal will show whether or not the system is reasonably well balanced. When the detector is working properly the speech from a good n.f.m. signal will sound undistorted and the audio volume will not change when the manual r.f. gain control is varied over a considerable portion of its range.

Application of the ratio detector to other types of receivers will, of course, differ in detail depending upon the particular type of second-detector circuit employed. If the fundamental circuit is kept in mind, however, it should not be difficult to arrive at a modification that will work in whatever type of receiver you may happen to have.

— L. H. Allen, W4IZH

MODERNIZING THE PREWAR HRO

After extended use at W8GZ the writer believes that the following suggested conversion represents a worth-while improvement in any prewar HRO. What the author has done is to apply to the HRO the improved circuit of the HRO-7, with certain minor modifications dictated by simplicity.

Conversion of the H.F. Oscillator

Conversion of the high-frequency oscillator consists of substituting a 6C4 and associated 0A2 regulator tube in place of the 6C6 or equivalent oscillator and the adding of a temperature-compensating condenser across the oscillator bandspread trimmer condenser. Circuit details are given in Fig. 2-16.

Remove the present h.f. oscillator tube and socket from the chassis. With a hack-saw blade or similar tool enlarge the present tube-socket hole into a rectangular hole approximately 1¼ by 2 inches. Cut a piece of sheet aluminum into a rectangle approximately 2⅜ inches by 2⅝ inches. On this piece of aluminum mount the sockets for the 6C4 and 0A2 tubes. Space these sockets approximately 1¼ inches between centers. This socket assembly is now centered over the rectangular hole in the chassis and fastened in place by means of small bolts or rivets in each corner of the aluminum sheet. The 6C4 tube must be located toward the front. Connect the 6C4 and 0A2 as shown in the wiring diagram of Fig. 2-16.

Temperature Compensation

Temperature compensation is obtained by connecting a 10-μμfd. ceramic condenser, with a coefficient of − 0.00077 μμfd./μμfd./°C, across the oscillator bandspread trimmer condenser. This temperature compensation is used on the 28-, 14- and 7-Mc. coils. It cannot be used on the 3.5-Mc. coils without modifying the coil-assembly components, which is hardly worth while.

Remove the h.f. oscillator brush board (the bar with four contact fingers in the right-hand coil slot) and add a fifth contact arm to this brush board, by using a piece of spring brass or any other similar material. The brush board is already drilled and slotted for the fifth contact. All that is necessary is to fashion the arm out of suitable metal and fasten it on the board with a small bolt or rivet. If you desire, a new 5-contact brush board can be purchased very cheaply directly from the National Company, Malden, Mass.

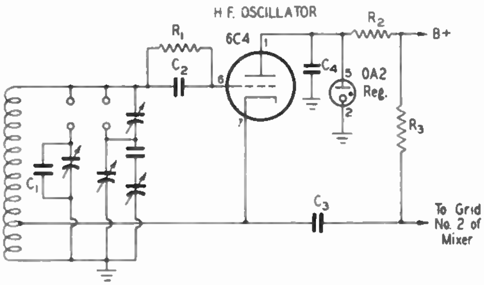


Fig. 2-16 — Revisions in the high-frequency oscillator circuit.

C_1 — 10-μμfd. ceramic, −0.00077 μμfd./μμfd./°C (see text).
C_2 — 100-μμfd. ceramic.
C_3 — 0.01-μfd. mica, 600 volts.
C_4 — 0.1-μfd. 100-volt paper.
R_1 — 22,000 ohms, ½ watt.
R_2 — 5000 ohms, 10 watts.
R_3 — 0.1 megohm, ½ watt.

Connect the temperature-compensating condenser from this new contact arm to ground. Be sure to leave the condenser leads long enough so that the compensating condenser can be pressed against the 6C4 oscillator tube. Use a small ceramic stand-off insulator to support this condenser and give it mechanical rigidity.

Next remove the 28-Mc. h.f. oscillator coil can from the plug-in rack and remove the coil assembly from its shield can. Solder a connection from Contact 1 (it is plainly marked and was previously unused) to the stator connection of the bandspread trimmer condenser. Make it short and stiff for mechanical rigidity. Replace into the shield can and back onto the rack. Repeat the operation for the 14- and 7-Mc. coils. Leave the 3.5-Mc. coils untouched.

Warm up the receiver and realign the bandspread trimmer on the h.f. oscillator coils for 28, 14 and 7 Mc. This is Adjustment 7 in the HRO instruction manual. A slight decrease in capacity is necessary, because you have added 10 μμfd. across this trimmer. Remember that the h.f. oscillator should always be on the high-frequency side of the signal, so if your oscillator tunes at two points the counterclockwise one is the correct point. See page 8, HRO instruction manual. Check your bandspread. On the 28-Mc. coil, 28.0 Mc. should come at 50 on the dial and 29.7 Mc. should come at 450 on the dial. Similarly, the band limits for the 14- and 7-Mc. coils should come at 50 and 450. If the bandspread is out, realign as outlined on pages 8 and 9 of the manual.

Exact temperature compensation is secured by pressing the compensating condenser closer to or farther away from the 6C4 oscillator tube. In the writer's receiver the correct point is approximately ⅛ inch from the center of the side of the 6C4 tube. At W8GZ this adjustment gives a maximum drift at 29.7 Mc. of plus or minus one (1) dial division, starting with an absolutely cold receiver.

If the oscillator "sqegs," or operates at several frequencies simultaneously, reduce the grid leak to around 18,000 ohms or else use a grid condenser of lower capacity. Do *not* change the oscillator coil!

A final point on temperature compensation. Remember that a cold coil plugged into a hot receiver will have some drift in spite of your compensation. You can correct this by keeping the extra coils on top of the receiver or any other place where their temperature will be substantially the same as that of the receiver. If you desire, you can introduce additional temperature compensation directly into the plug-in coils by removing the coils from their shield cans and soldering a small negative-coefficient condenser from Terminal 1 to Terminal 4 on the 28-, 14- and 7-Mc. coils. The exact size of this condenser will depend upon your own particular HRO. After adding the condenser you must still be able to "zero" the oscillator with the bandspread trimmer condenser. The writer's experience has been that condensers of from 3 to 5 μμfd., with a coefficient of −0.00077/μμfd./μμfd./°C, are about the maximum usable capacities. A little trial and error will give you the best possible combination. However, unless you do a lot of coil shifting this coil compensation is hardly necessary.

Noise Limiter

At W8GZ one of the rhombic antennas parallels a state highway for nearly 1000 feet. The ignition interference is terrific! After much cut-and-try, the writer settled upon the circuit shown in Fig. 2-17 as giving the best results with a minimum of change in the HRO.

The first step is to take your HRO "as is" (either with or without the h.f. oscillator conversion). Connect a signal generator or some source of definitely fixed and unvarying signal to the antenna terminals and feed a 28- or 14-Mc. signal into the receiver. The exact frequency is unimportant. Tune in this signal very carefully and make a note of the S-meter reading. You are now ready to begin work.

Remove the 6B7 second detector and its socket from the chassis and replace with a 6H6 socket and tube. Connect it as shown in Fig. 2-17. Mount the 6H6 noise limiter and 6SJ7 first audio into the chassis directly behind the S-meter, the 6H6 noise limiter to the front. The noise-limiter control is mounted to the lower right of the headphone jack. Connect as in Fig. 2-17. Both 6H6 tubes use 4.3-ohm 2-watt resistors in series with the heaters to reduce the voltage at the sockets to 5.0 volts.

The noise-limiter control may be either a 0.5-megohm potentiometer with a tap at 20,000 to

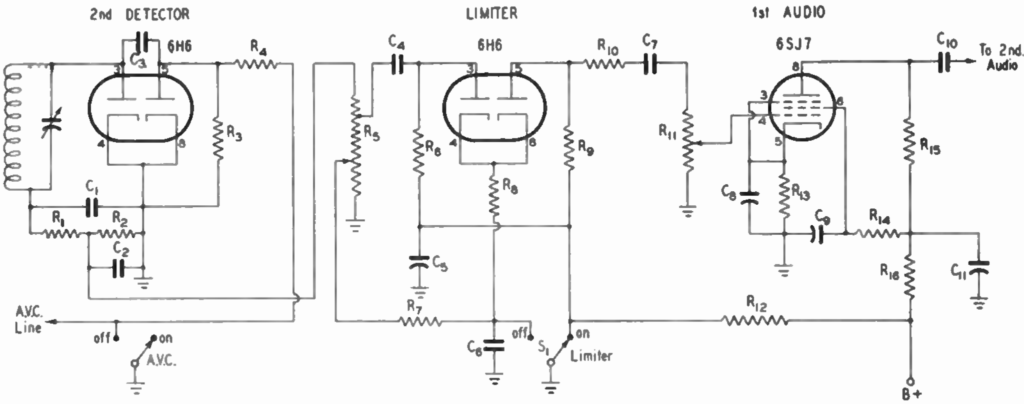


Fig. 2-17 — The revised second detector and first audio, and the new limiter, are from the circuit of the HRO-7.

C_1 — 270-μμfd. mica or ceramic.
C_2, C_3 — 100-μμfd. mica or ceramic.
C_4, C_5, C_6, C_9, C_{10}, C_{11} — 0.1-μfd. 400-volt paper.
C_7 — 0.01-μfd. 600-volt paper.
C_8 — 25-μfd. 50-volt electrolytic.
R_1, R_{16} — 47,000 ohms.
R_2, R_9 — 0.47 megohm.
R_3, R_4 — 1.5 megohms.
R_5 — 0.5-megohm potentiometer tapped at 22,000 ohms (IRC Type D17-133X) or as in Fig. 2-18.
R_6, R_7, R_8, R_{10} — 0.22 megohm.
R_{11} — 0.5-megohm volume control.
R_{12}, R_{14} — 0.82 megohm.
R_{13} — 2200 ohms.
R_{15} — 0.1 megohm.
All resistors half-watt.
S_1 — Switch mounted on R_5 (IRC No. 43).

25,000 ohms (Fig. 2-17) as is used at W8GZ, or it may consist of a 0.5-megohm potentiometer shunting a 22,000-ohm and a 0.47-megohm resistor (Fig. 2-18) as in the HRO-7.

After completing the wiring realign the 6H6 second detector for maximum output. (Refer to Adjustment 13 and 14, HRO instruction manual.)

Reconnect the signal generator or signal source and again tune the signal in carefully as before.

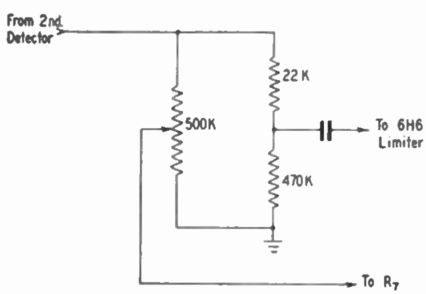


Fig. 2-18 — A substitute circuit for R_5 of Fig. 2-17.

The S-meter reading will now be somewhat lower than it was before adding the noise limiter. Using a long screwdriver or similar tool *very carefully* increase the capacity of the crystal-filter output coupling condenser by turning clockwise (Adjustment 9, HRO instruction manual) until the S-meter reads the same as before installing the limiter. Do *not* go beyond this point or you will lose selectivity.

Your conversion is now complete. The S-meter should operate exactly as it did before conversion. You have a receiver with an extremely stable oscillator and an excellent noise limiter — and last but not least the over-all gain of your receiver is slightly higher than it was before you started work. While you are at it hadn't you better check your tubes and then touch up the alignment of the entire receiver in accordance with the procedure outlined in the instruction manual?

— *Loren G. Windom, W8GZ*

[Editor's Note: Owners of early-model HROs are referred to another conversion article on this receiver, "'Souping Up' a War-Surplus HRO," by Paul D. Rockwell, W3AFM, in February, 1949, *QST*.]

SELECTIVITY . . . AND MORE SELECTIVITY

Apparently you have to hear the W9AEH receiver ("A Super-Selective C.W. Receiver," August, 1948, *QST*) before you really wake up to this selectivity business. Harold Leighton, W9LM, writes to tell what he did after listening to the receiver on several occasions. He was so impressed that he wanted something like it. He had a McLaughlin Selectable-Sideband Adapter (April, 1948, *QST*) on the tail end of his HQ-129, but it wasn't good enough on c.w., so he added a little additional selectivity. He took six Hammarlund SS-50 transformers (special low-frequency transformers available for the McLaughlin system) and increased the separation between pots by ⅜ inches, to loosen the coupling. He then built an i.f. amplifier using two of these transformers between each stage, and patterned the detector circuit after the McLaughlin design. For a 50-kc. b.f.o. he used the coil from a BC-453 surplus unit, padded with micas and tuned by a 100-μμfd. variable.

To give him the various degrees of selectivity he wants, a 4-position switch is used. The first gives straight audio output from the HQ-129, with the crystal filter in Position 4. In the second position, the headphone output is taken from the selectable-sideband adapter. Position No. 3 gives the receiver selectivity plus the selectable-sideband adapter selectivity plus the six loose-coupled SS-50s selectivity, and No. 4 uses all this plus an audio filter! A beat note of about 375 cycles is generally used, and in Positions 3 and 4, no signal has ever been heard on the other side of zero beat, and practically all signals are gone by the time the beat reaches 800 cycles on the high side. Plates have been removed from the band-spread condenser in the 129, and only 150 kc. is covered on 14 and 28 Mc., and on 3.5 and 7 Mc. only 30 kc.! The main bandset condenser is reset to cover the band. On 40 and 80 meters, all of the selectivity can be used practically all of the time. The most trouble with drift comes from the HQ-129 b.f.o., which is used only in Position 1 and so is of little importance. Fine tuning is available on the 50-kc. b.f.o., however, and a handy gimmick is the pair of pencil marks on the panel that permits flipping the b.f.o. from one spot to another that gives exactly the same beat note on the other side of the signal.

SOURCES OF "SHARP" LOW-FREQUENCY I.F. TRANSFORMERS

Amateurs interested in the construction of their own Q5-er strips will be interested in the following letters bearing on the surplus sources of hard-to-find low-frequency i.f. transformers:

From George Goldstone, W8MGQ: "The CFI unit from an ART-13 transmitter has some coils that might be used in sharp low-frequency transformers. The little unit marked 'Z-2201' (there are two in a CFI) contains a 50- and a 200-kc. tuned circuit. Both inductors are slug-tuned in powdered-iron pots, and they are mounted side by side in a bakelite housing inside a shield can. By removing the 200-kc. coil and substituting the 50-kc. coil from another unit, it should be possible to make a fair transformer. On the Q-meter, the 50-kc. coil shows a Q of 80 at 85 kc., just twice that of the coils in the 85-kc. transformers used in the BC-453. Some stores have the Z-2201 units for 25 cents — a CFI unit for about $1.50 has two Z-2201 units."

From A. E. Pugh, VE5AP: "The Bendix MN-26 radio-compass receiver, available in surplus, contains a total of 22 powdered-iron pots and cores, with various coils mounted in the pots. Many of them tune to around 110 kc., so they are in the range and might be useful. The receiver has a wealth of condensers and resistors, a 5-gang tuning condenser and a 24-volt dynamotor."

ELIMINATING TIRE STATIC

Mobile enthusiasts who have had their reception disturbed by a noise similar to leaky power-line interference will do well to look to their cars' tires. This form of interference is caused by friction between the inner tube and tire casing, and can be remedied by introducing one of the new "tire powders" — such as Chevrolet part No. 986035 — into the tubes.

— *Harold G. Price*

A "HOT" FRONT END FOR THE RME-69

After having heard the performances of some of the new receivers, the author was rather discouraged with the one in his ham shack. Regardless of the fact that ten years ago it performed along with others in the same general price bracket, it just didn't have the "sock" of the newer ones. Furthermore, images on ten and twenty meters were sometimes bothersome. Consequently, the "old friend," which had done its job in an excellent fashion all these years, had fallen into disrepute. A new receiver was out of the question, so it was decided to find out just what might be done in the way of improving the performance of the old. It might be well to mention here that the receiver concerned is an RME-69, but it is felt that the improvements to be described are not peculiar to this particular receiver and may be duplicated in others. The original r.f. amplifier circuit is shown in Fig. 2-19.

In looking over the field, no major improvements in circuits could be found on newer receivers outside of such things as noise suppressors, etc. Fundamentally, the new receivers remain superheterodynes and the improvements in sensitivity and selectivity have been brought about mainly by the use of better components and tubes.

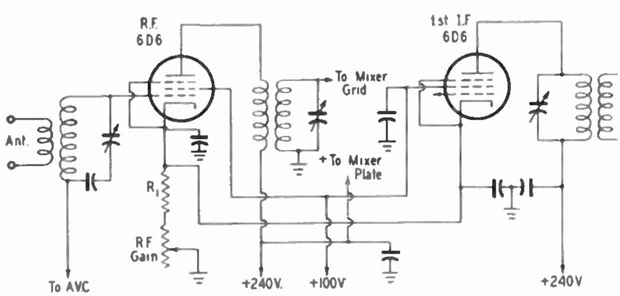


Fig. 2-19 — Circuit of the original r.f. amplifier in the author's RME-69 receiver. The band-change switch and meter circuit are not shown. R_1 is 150 ohms.

In surveying the newer tubes, it became apparent that the 6AK5 was by all means the tube to use in the r.f. amplifier of a receiver. Its input admittance is fairly low at 28 Mc. and, in addition, its transconductance is in the order of 5100 compared to around 1500 for tubes such as the 6K7, 6D6, etc. What could be simpler? An adapter was made from an old 6-prong tube base and a 6AK5 was substituted for the 6D6 in the r.f. stage of the RME-69. The results were far from startling; in fact, the only improvement noticeable was at frequencies lower than about 10 Mc.

In view of the fact that the 6AK5 and 6D6 are not designed to operate at the same values of bias, screen and plate voltages, the failure of the experiment was attributed to this. The receiver was taken out of the cabinet and by the use of several resistors and associated by-pass condensers, voltages were adjusted to those rated for the new tube. The other components in the r.f. amplifier stage were left as found. An immediate improvement in gain was measured on all frequencies, varying from 18 db. at 2 Mc. to 4 db. at 30 Mc., with several frequencies showing gains in the order of 25 db. The resulting increase in gain was so startling to the author, and the receiver had so much "sock," that it was left in this condition for several weeks, and once again it seemed like a new receiver rested on the operating desk.

However, being a true ham, and considering that in spite of the improved gain at the lower frequencies there had been relatively little increase in gain and image rejection on ten meters, it was decided to carry the investigation further.

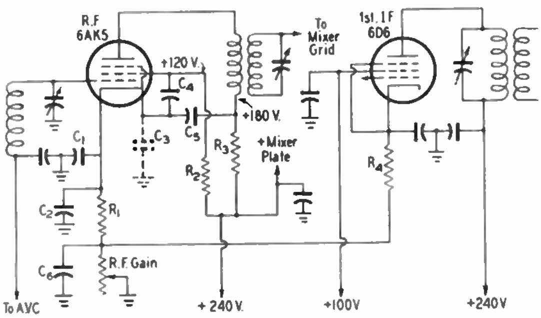


Fig. 2-20 — **Modified r.f. circuit for the 6AK5 r.f. amplifier.**

C_1, C_2, C_4, C_5, C_6 — 0.1-μfd. paper.
C_3 — 470-μμfd. mica.
R_1 — 220 ohms.
R_2 — 47,000 ohms.
R_3 — 6800 ohms.
R_4 — 330 ohms.

In attempting to bring up the gain at 30 Mc., it was considered possible that degeneration was entering into the picture — that the length of the cathode lead external to the tube, in particular, was introducing inductive reactance at the higher frequencies, thereby reducing the gain at 30 Mc. Accordingly, it was decided to discontinue use of the adapter and install the miniature socket in place of the old 6D6 socket, thus shortening the leads considerably. Furthermore, upon studying the receiver, it was found that grid, screen, and plate by-passes were brought to the chassis rather than to the cathode terminal of the socket. The control-grid ground return could not be connected to this terminal because the tuning-condenser rotor was grounded. Since lifting the condenser from ground would have involved a major construction job, it was left as originally installed. All other by-passes were returned to the 6AK5 cathode terminals. This tube has two such terminals, one for grid returns and the other for plate returns. The decision to alter these by-pass connections ultimately made the r.f. stage work.

Immediate improvement in gain at 30 Mc. was noted, amounting to some 12 db. over that obtained before work on the receiver was started. Simultaneously the signal-to-image ratio was increased to better than 30 db. Since this is considerably greater than would be expected from the tuned circuits even if there were no loading, it seems evident that regeneration contributes to this sort of performance; in fact, the stage had a tendency to oscillate at certain spots within the two higher-frequency ranges. This instability was eliminated completely by the use of C_3 as shown in Fig. 2-20.

A comparison of the original of Fig. 2-19 and the modified circuit of Fig. 2-20 will show the change in the original by-passing. Some of the condensers were originally located several inches away from the r.f. tube socket and were common to either the mixer or the first-i.f. amplifier tubes. The two 0.1-μfd. cathode by-pass condensers shown are actually there. One goes from the cathode to the ground terminal in the middle of the socket and the other goes from the cathode to the ground terminal of the a.v.c. circuit by-pass at the ground end of the r.f. tank coil.

— *William L. North, W7BHE*

MOUNTING METERS IN CRAMPED QUARTERS

When there is not room to mount an S-meter on a panel because of lack of room behind the panel, as is often the case with war-surplus receivers, the idea shown in Fig. 2-21 may solve the problem. Remove the meter from the case, and grind down the entire flange of the case, as shown. This may be done with a grinding wheel, smoothing the corner with a file. After grinding the flange away, sandpaper the rest of the outside of the case to give it a finish that will match the crackle finish of the panel. Wash out the inside of the case with soap and water, and reassemble.

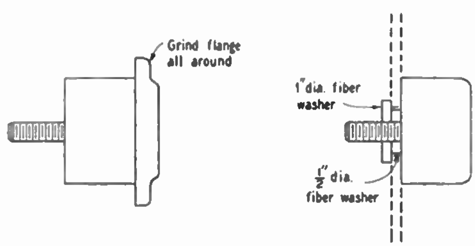


Fig. 2-21 — **Method of mounting meters on the outside of a receiver panel.**

The meter is then mounted on the panel by drilling two ½-inch diameter holes and using fiber washers to insulate the meter terminals from the panel. It will be necessary to remove all of the nuts from the terminal bolts to bring the back of the meter flat against the front of the panel. No damage will result if care is taken not to drive the bolts back into the case. The finished result makes a very neat-looking job.

— *Gordon V. N. Wiley, W1AUN*

3. Hints and Kinks . . .

for the Transmitter

CURING UNBALANCE IN PUSH-PULL AMPLIFIERS

In many instances it seems difficult to obtain exact balance in both tubes of a push-pull r.f. amplifier. One tube will show color while the other runs cool. A simple rearrangement of the wiring of the filament circuits will sometimes effect the desired balance when nothing else seems to do the job. The arrangement used at W2MFS and W2HFS to correct unbalance in push-pull 810 stages is shown in Fig. 3-1.

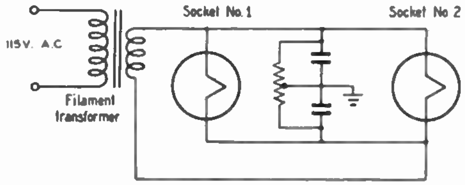


Fig. 3-1 — **A filament-wiring "kink" to correct unbalance in push-pull amplifiers.**

An *exact*-center-tap-and-by-pass arrangement is used, with the by-pass condensers located midway between the two sockets. A center-tapped resistor is used rather than the usual center-tapped filament transformer. In addition, the filament leads are wired from opposite ends, as shown. In this manner any possible voltage drop in the wires themselves is equalized so that both tubes will operate at identical filament voltage.

— *Herb Spohn, W2GMM*

INDUCTIVE NEUTRALIZATION OF THE 813

After many hours of trying in vain to neutralize a pair 813s by conventional methods and never knowing whether I had too much or too little capacity, I finally decided to try inductive neutralization. A one-turn link was wound around the center of the grid coil with "bell" wire and brought over to the center of the plate coil with 70-ohm Twin-Lead where another one-turn link was constructed. With grid drive on and plate power off, the final grid and plate tanks were tuned to resonance. A 60-ma. bulb coupled to the plate tank almost burned out. The swinging link neutralizer was then slowly pushed into the center of the plate tank, and the bulb grew brighter so the 70-ohm Twin-Lead connections to the link were reversed and presto! the bulb grew dimmer. The swinging link was pushed in a little at a time until the 60-ma. bulb went out completely even though it was tightly coupled to the plate tank. The whole operation from start to finish took only a few minutes. With 700 watts input and 100% modulation, the 813s were really stable for the first time.

Homemade swinging links for the neutralizing leads were constructed and installed in the 10-meter final and also in the 20- and the 75-meter finals. All three have been working for over a year and much more satisfactorily than any other method yet tried here.

— *Philip Rand, W1DBM*

BALANCING PUSH-PULL DRIVE

It is well worth while reminding those who build push-pull amplifiers of the importance of balancing the drive to the two tubes. This becomes even more important when using tubes like 807s, since underdriving of one tube can combine with the harmful effects of overdriving the other to give some pretty discouraging performance. In the capacitance-coupled push-pull amplifier with which we were working, provision for balance, as shown at C_1 in Fig. 3-2, was included. The output capacitance of the driver tube was looked up in the tube data and the balancing condenser, C_1, was set to what was estimated roughly by eye to be an equivalent capacitance. The amplifier performed very poorly. The output was considerably below the rated value and the dip in plate current at resonance was negligible when the amplifier was loaded to rated input. Finally, it was noticed that one plate was showing some coloring. A check of the individual screen currents (a convenient indication of balance in a push-pull amplifier, since the tank circuits don't have to be opened up for the meter) showed that one tube was drawing almost no screen current, while the screen current of the other was considerably in excess of its rating. It was found that a very careful adjustment was necessary to bring the two screen currents to the same value. The difference in performance after accurate balancing was remarkable. Good efficiency was obtained and off-resonance plate current increased to between 350 and 400 ma., giving a very pronounced dip to the rated 200

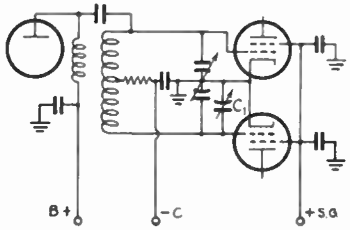


Fig. 3-2 — The excitation to push-pull tubes can be balanced by use of a balancing condenser, C_1, in the input circuit. Its value should be the same as the output capacitance of the driver tube.

ma. at full rated load — and this with the screens supplied from a dropping resistor. Apparently, before balancing, one tube had been doing almost all of the work. With one tube loaded up to nearly 200 ma. it isn't surprising that the plate-current dip was negligible!

Let us repeat, too, another reminder. Hold the grid current of 807s and other beam tubes to the rated value at the recommended operating bias. Overdriving spoils the performance of tetrodes by running the screen current up unnecessarily. With a series resistor, this drives the screen voltage down, making it difficult to load the amplifier properly.

— *Don Mix, W1TS*

PROTECTING SCREEN-GRID TUBES

A SIMPLE method of protecting the large screen-grid tube against failure has been described in the past for the case where the screen current is supplied to the tube through a series dropping resistor from the plate supply ("A Medium-Power Bandswitching Transmitter," Smith, *QST*, October, 1946). A different and more serious problem is introduced when the screen current is supplied from a low-voltage source of comparatively good regulation, such as the exciter power supply. In this instance, loss of plate or bias voltage is almost always fatal to the amplifier tube if the full screen potential is still applied.

The circuit shown in Fig. 3-3 offers a simple method for protecting the tube against failure of the plate supply, and at the same time eliminates the need for fixed bias. First consider the circuit with the amplifier tube V_3 operating under normal conditions. The negative grid bias developed across R_1 is applied to the grid of V_1, thereby cutting off its plate current, so for the moment this tube may be disregarded. R_3 and R_4 act as a voltage divider across the plate supply of the amplifier tube. Their values are such that the voltage at their junction point is approximately equal to the desired operating voltage for the screen of the amplifier tube.

If a sufficiently-high voltage is applied to the plate of V_2, it will conduct, and the potential applied to the plate of V_2 (less tube drop) will appear at its cathode, serving as the screen voltage of V_3. This in turn is controlled by the grid voltage of V_2, which is determined by R_3R_4. If, however, the plate voltage of V_3 is removed, the grid of V_2 falls to ground potential, approximately, tending to reduce sharply the conductivity of V_2, thus reducing the screen potential on the amplifier tube. Thus V_2 serves to protect the tube against failure of the plate supply while excitation and screen voltage are applied.

The function of V_1 is to protect the amplifier tube against failure of excitation while plate and screen voltages are still applied. If the excitation is removed from the grid of the amplifier tube, V_3, the grid of V_1 returns to zero, and plate current is drawn through R_4. This reduces the voltage on the grid of V_2, causing its conductivity to be decreased, thus lowering the screen voltage on the amplifier tube to a point where plate and screen dissipation are not excessive.

For a practical case, assume that the desired amplifier screen voltage is of the order of 300 to 400 volts. A 6J5 tube may be used for V_1, and a

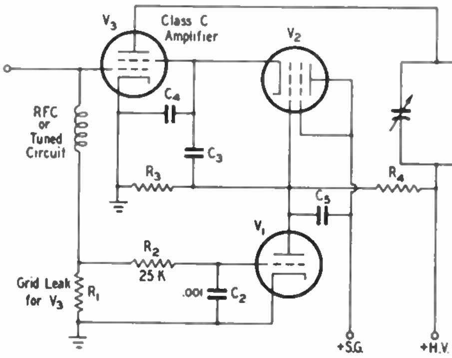


Fig. 3-3 — Protective circuit for screen-grid tubes when a separate screen supply is used. The "protective-tube" idea is applied through a series tube to reduce screen voltage automatically whenever excitation or plate voltage is removed

6L6G, with the screen and plate tied together, may be used for V_2. If the screen current in the amplifier tube is about 30 or 40 ma., the drop across V_2 will be 75 to 100 volts. Thus the screen supply will have to furnish this extra voltage. R_3 and R_4 should be about 500 ohms per volt. Since the current through them is small, they may be made up of a number of 2-watt carbon resistors in series, the value of each resistor being 0.25 megohm or less. A separate filament transformer is required for V_2. If the screen current supplied to V_3 is modulated, C_3 and C_5 must be large enough to pass the modulation frequencies.

— *W. B. Bernard, W1QUR*

W2ASB HAS A REAL SEND-RECEIVE SWITCH

Tom Garretson, W2ASB, changed the s.p.s.t. toggle switch in his receiver to a d.p.d.t. and connected the new elements of the switch in series with an outlet from which he obtained the 115-volt supply for his transmitter. Now when he throws the switch from *receive* to *send* — he does!

AUTOMATIC HIGH-LOW RANGE METER SWITCHING

It is often desirable to cut an amplifier's plate power input to a fraction of its original value. Such may be the case with a 1-kw. rig operating in a local net, in which it is desired to run less than 100 watts. The plate meter, usually 1000 ma. in such a rig, is difficult to read below 100 ma. One could more easily tune to resonance, with no load on the amplifier, using a 100-ma. scale, were it not for the danger of damaging the meter by accidental overloads.

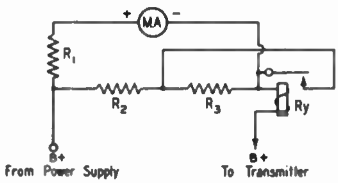


Fig. 3-4 — Automatic meter switching to read high or low currents. *Ry* operates when 200 to 250 ma. is drawn through its winding, thus shorting out R_3 and changing the full-scale reading from 100 to 1000 ma. when the resistances are used as shown below. The relay winding must pass 1000 ma. maximum current.
MA — 1-ma. meter.
R_1 — 1000 ohms, minus the meter resistance.
R_2 — 1 ohm, 2 watts.
R_3 — 3 ohms, 5 watts.
Ry — D.c. relay, designed to operate at 200–250 ma.

An automatic meter switch can be provided by the addition of a relay and a pair of resistors to the usual 1-ma. meter circuit. The relay, one of the type that operates when 200 or 250 ma. flows through its winding, automatically shifts the meter shunt from high to low as the current increases. The circuit is shown in Fig. 3-4.

This type of switching does not rely on the human element, and will provide protection for the meter and greatest ease in adjustment of the circuit. Through the use of different values of resistors, other current ratings may be obtained.

— *Kenneth M. Miller*

MAKING THE MOST OF 'PHONE JACKS IN THE SMALL RIG

Fig. 3-5 shows a method for using two closed-circuit 'phone jacks to provide an inexpensive keying and metering system for a small two-stage transmitter. With the circuit wired as shown the following may be accomplished: A meter may be inserted to read oscillator cathode current, amplifier current, or the total of both. Either the amplifier alone, or the entire transmitter, may be keyed.

To read oscillator current, plug the key into J_2 and the meter in J_1. To read amplifier current, plug the meter in J_2. To key both stages simultaneously, plug the key in J_1.

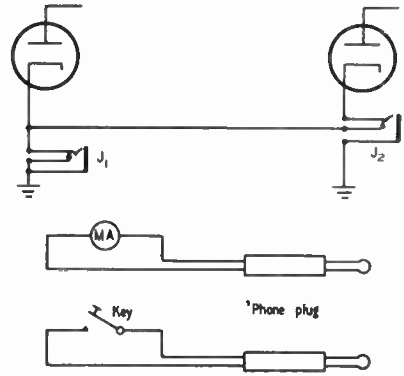


Fig. 3-5 — Simple arrangement of 'phone jacks to provide a flexible keying and metering set-up for a small transmitter.
J_1, J_2 — Closed-circuit jack.
MA — Plate milliammeter of suitable range.

An open-circuited 'phone plug may be used to turn off the oscillator during periods of reception when the amplifier alone is being keyed. The dummy plug is pushed into J_1 to kill the oscillator.

— *Harold Held, W9OCK*

SAFETY FIRST WHEN USING 'PHONE JACKS

Oftentimes a 'phone jack is wired in the cathode circuit of an r.f. amplifier to allow external metering of the stage. One side of the jack is placed at ground potential; therefore it is thought that all is safe — a most dangerous assumption. If the amateur uses a portable test meter everything is OK so long as the external circuit is kept closed. However, most test meters have small pin jacks for different ranges. If the amateur decided to change the range, what happens? He opens the external circuit and in so doing has carelessly placed the full plate voltage of the amplifier in his hands.

Moral — Shunt the jack with a 50-ohm resistor. This will not upset the meter reading yet it will protect the operator. Of course, this arrangement prevents keying of the stage. But who would be so foolish as to key directly the cathode circuit of a high-power amplifier?

— *Martha M. McVay, W7KCU*

SIX OSCILLATOR INPUT CIRCUITS ON ONE SOCKET

This circuit permits the first tube in a transmitter (such as a 6F6 or 807) to be used with equal convenience as an oscillator or as a buffer-amplifier. The circuit shown in Fig. 3-6 has been built into several transmitters during the past three years and has proved entirely satisfactory.

The cathode bias resistor and condenser are sometimes at a moderate r.f. voltage above ground, therefore they should be insulated accordingly. The value of cathode resistance is just sufficient to limit the plate current (zero signal) to a safe value. Since the cathode resistance used will vary with the type of oscillator tube and other circuit conditions, no value for *R* has been specified.

The plugs are old six-prong tube bases. The Tri-tet coil was wound on a homemade fiber bobbin, which was cemented in a tube base. The components for the grid-plate oscillator circuit were made to go into a tube base by using a very small size mica condenser and a single-pie r.f. choke. All of the tube bases were covered with thin bakelite discs cemented in place.

Although a coaxial-cable connector is provided, the tube may be driven by plugging an exciter output cable directly into the crystal socket, and providing a plug with suitable jumpers. If the

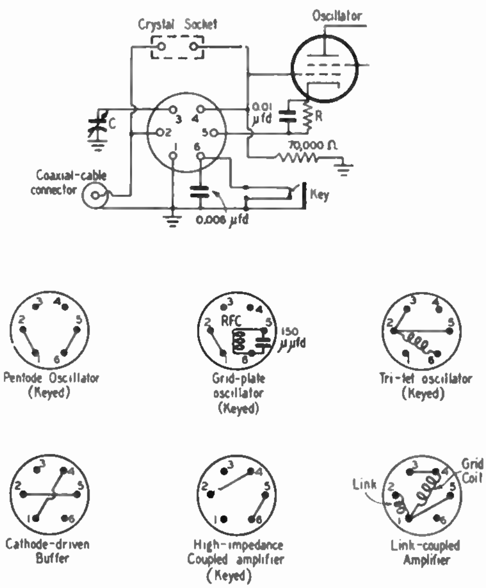


Fig. 3-6 — **Six different oscillator-circuit arrangements are available in this versatile oscillator socket layout. Variable condenser *C* must be large enough (100 to 250 µµfd.) to resonate the Tri-tet coil or the link-coupled amplifier grid coil. The value of *R* will vary with various tubes and should be the normal cathode resistor for the tube selected.**

coaxial-cable connector can be insulated from ground, it might be better to return the outer-shield connection to Pin 6 (the key jack) rather than to ground. This would permit using the tube as a cathode-keyed buffer or doubler.

— *Henry L. Cox, jr.*

DEVICE FOR BREAKING ARCS IN TRANSMITTERS

Fig. 3-7 shows the circuit of a device used to stop instantaneously any arc-over that occurs in the final-amplifier tank circuit of a 'phone transmitter. The coil of a relay that will "throw" when passing slightly more current than that drawn by the final amplifier under normal operating condi-

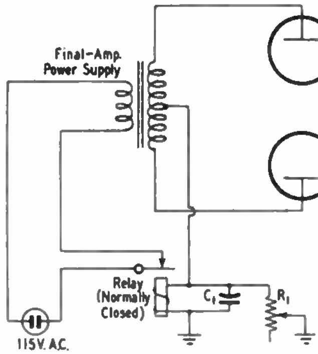


Fig. 3-7 — **A fast-operating circuit that takes the rig off the air and puts it back on again in no time flat when an arc-over starts.**
C_1 — 8-µfd. 150-volt electrolytic.
R_1 — 25-ohm wire-wound variable resistor.
R_y — 6-volt d.c. relay, s.p.s.t., normally-closed contacts (Guardian 200 series).

tions is inserted between the center-tap of the high-voltage transformer and ground. The contacts of the relay (normally closed) are arranged to break the primary circuit of the transformer when the relay is energized.

Once the relay has tripped, it resets itself automatically and closes the primary circuit. The entire break-and-make cycle takes only an instant, thus maintaining continuity of the transmitted signal except for an instant so brief that the receiving station often will not even know that an arc-over has taken place. Should there be a permanent short-circuit, the relay will oscillate with a buzzing sound that will be a sure tip-off to the operator to pull switches before the power transformer burns out.

The condenser shown in the diagram will absorb brief surges that do not result in an arc, and the variable resistor R_1 is used to set the point at which the relay will operate. A setting that causes it to operate at any overload 50 ma. in excess of the normal current drain will be satisfactory in most cases.

— *Eldon L. Kanago, W0UHC*

UNIFREQUENCY TRANSMISSION AND RECEPTION

This system was in use at prewar W5CAT and should appeal particularly to the many 'phone boys who have a receiver containing a crystal filter which is seldom used. The crystal is removed from the receiver and, as shown in the block diagram of Fig. 3-8, built into the exciter stages of the transmitter. A conventional mixer stage follows and produces a carrier frequency of exactly the frequency to which the receiver is tuned, the necessary heterodyning frequency being obtained by a simple pick-up loop coupled to the local oscillator in the receiver. The resultant frequency is continuously variable, following the receiver automatically up and down the band.

The advantages are obvious; when calling CQ, the operator simply searches for a clear channel on the receiver and when the transmitter is turned on it occupies that channel. Sometimes when making a radical shift in frequency it is necessary to touch up the transmitter amplifier stages but that is to be expected in any VFO system. In answering a CQ the transmitter automatically comes squarely on the calling station's channel and the chances of making a contact are enhanced, especially if the calling station is also using this system.

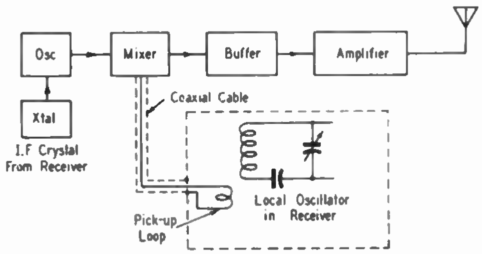


Fig. 3-8 — W5CAT utilizes the i.f. crystal from his receiver in a transmitter frequency-controlling oscillator.

It is conceivable that interference might be greatly reduced in all bands if this system was used widely, since stations in contact with each other would necessarily be using the same channel.

— *Cecil R. Gray, W5CAT*

HOMEBUILT MULTIPLE CRYSTAL HOLDER

An easy-to-build gadget that will permit a crystal-switching system to be installed in almost any existing transmitter is shown in Fig. 3-9. Construction details are self-evident from the drawing. The plug-in base is obtained from a National type PB-10 base-and-shield-can assembly. The top, on which six ceramic crystal holders are mounted, is a sheet of transparent insulating material. (Plexiglas, lucite or polystyrene will do.) It is held in position by four threaded brass rods, which are bolted to the 5-prong plug-in base as shown. The selector switch is mounted on another piece of similar material. This piece has

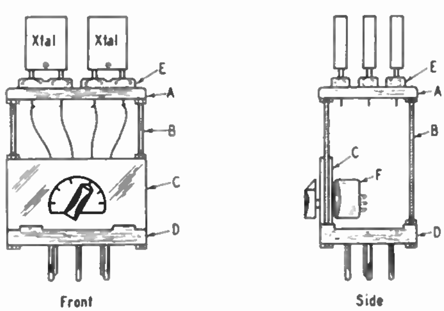


Fig. 3-9 — Constructional details of a simple multiple crystal holder. The unit makes use of a 5-prong plug-in-coil base, and will hold up to six of the small-size crystal holders. *A*, *C* — sheet of ¼-inch transparent insulating material; *B* — 6/32 threaded brass welding rod; *D* — 5-prong coil base (National PB-10); *E* — ceramic crystal socket; *F* — six-position selector switch.

grooved ends which slide in between the brass rods. The grooving is done with a small rat-tail file, and eliminates the need for drilling through the sheet edgewise.

The ceramic crystal sockets used are of the model that accommodates the new Type FT-243 crystal holders. Six of these fit into the upper "deck" without crowding. If desired, one of the sockets could be of the type that takes the old-style holder. By extending the brass rods, another deck may be added to permit use of twelve crystals. In this case, however, the shield can that comes with the unit cannot be used.

— *Bill Roper, W7DPK*

THREE-WAY CRYSTAL SOCKET

In many ways adapters for fitting the new small-size crystal holders into standard UY 5-prong sockets are not the ultimate solution to the problem of how to use three styles of crystal holders in the same rig without using three sockets. The homemade socket shown in Fig. 3-10 handles all three of the currently-popular holders without requiring adapters, and does it without any forcing, pinching, or binding. Its construction is simple, and the parts required can usually be found in the junk box.

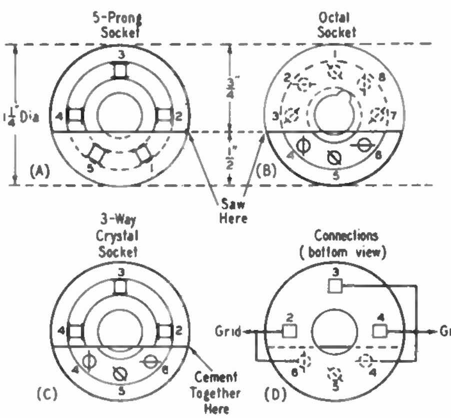


Fig. 3-10 — Method of constructing a 3-way crystal socket from portions of a 5-prong socket and an octal socket. The two are cut as shown in A and B, and are cemented together as shown in C. The socket connections to permit use of any of the three popular sizes of crystal holders are shown in D.

In this gadget, a portion of a 5-prong socket and a matching portion of an octal socket are cemented together to form a composite affair. The resulting pin spacings and contact diameters permit the use of the prewar "standard" crystal holders (0.125-inch diameter pins spaced ¾ inch), the FT-243 holder (0.089-inch pins spaced ½ inch), and the CR-1A/AR holder (0.125-inch pins spaced ½ inch). The old-type holder plugs into Pins 2 and 4 of the 5-prong socket, the FT-243 goes into Pins 4 and 6 of the octal portion, and the CR-1A/AR into Pins 2 and 3 of the 5-prong portion.

To make the socket, remove the locking ring and mounting plate from the sockets. Needless to say, the sockets should both be of the same diameter and general type. Amphenol types S-5 and S-8 fill this requirement nicely. Saw the two as shown in the sketch, being careful to keep the cut square. If you want to be extra cautious about it, leave a little extra portion on each one and finish it smooth with a file. This will assure a good fit, and will permit the surfaces to be squared up in the event that the hack-saw cut wasn't quite true. Cement the portions together as shown in the sketch, and reassemble them in the mounting plate. If the two "halves" match well, the locking ring will hold them securely in place, and the socket can then be mounted in the chassis as any other socket would be. If you are extra careful to get a perfect fit, the mounting plate may be eliminated and the assembly can be mounted in a 1 11/64-inch hole with the locking ring alone.

Ceramic sockets cannot be used in this gadget because they are impossible to saw. If, however, low-loss mica-filled bakelite sockets are used, the losses should be low enough to make the unit entirely satisfactory. It makes about the only satisfactory three-way crystal socket seen here to date.

— *Basil C. Barbee, W5FPJ*

TWO CRYSTAL-HOLDER SOCKETS

The increased use of FT-243 crystal holders brought forth these two sockets. In Fig. 3-11A I used clips taken from a Millen crystal socket to

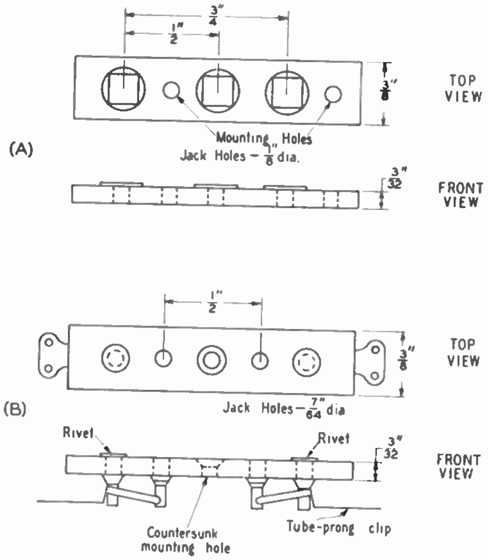


Fig. 3-11 — Two crystal-holder sockets fabricated by W1LIG. In A, clips from a Millen crystal socket are spaced for both amateur standard and FT-243 holders. Another style, for FT-243 holders only, is shown in B and utilizes clips from a tube socket riveted in place.

make up a socket that will accept both amateur standard and FT-243 holders. Fig. 3-11B takes only the FT-243 holder and is made from two tube-prong clips riveted in place.

— *Dr. J. E. Greenbaum, W1LIG*

ELIMINATING STAND-BY DRIFT IN A VFO

Some of the drift in a VFO can be avoided by permitting the oscillator tube to run continuously. However, in spot-frequency operation, even the weak signal from the oscillator is not desired and must be removed. Cutting the plate

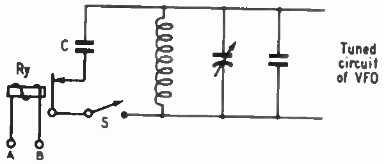


Fig. 3-12 — Elimination of drift during VFO stand-by. The relay (operated by a source of power available when the transmitter is on) removes the padding condenser *C* from across the VFO which then returns to the desired operating frequency. When the transmitter is turned off the relay closes and the padder lowers the VFO frequency sufficiently to move it out of the way of the incoming signal in the receiver.

This method of moving the VFO frequency is *not recommended* for keying the oscillator, as the contact capacity of the relay will make signal chirp or "yoop."

voltage allows the tube to cool and when turned on again, the output may be on a different frequency. The scheme shown in Fig. 3-12 eliminates this drift. After the oscillator has reached normal operating temperature its frequency may be shifted off the band by closing *S*, thus placing the condenser *C* across the tuned circuit. This capacity should be enough to move the oscillator frequency out of the band being worked. When the transmitter is on, the relay opens this padder circuit and the oscillator returns to the desired transmitting frequency. When the transmitter is switched off, the relay operates and connects the padder back into the circuit and the operating frequency is clear for reception. This scheme keeps the oscillator plate current constant.

The circuit may be modified to cut some portion of the oscillator tank capacitance in and out, in which case the relay would normally be open and would close the circuit on transmit, thus placing the stand-by signal higher than the operating frequency.

Such a device will not work as a method of keying as the opening and closing of relay contacts will make "yoops" in the oscillator signal.

A suitable d.c. relay can be connected in series with the cathode of a buffer or amplifier tube. An a.c. relay should be connected in parallel with the antenna relay or across some other circuit that is energized when transmitting.

— *J. W. Brannin, W6OVK*

A SIMPLE METHOD OF COUPLING BETWEEN VFO AND AMPLIFIER

I have found that the output of my VFO (a Signal Shifter) is sufficient to drive an 807 buffer or doubler without employing a tuned circuit in the grid of the 807 stage, although the ECO unit is on the operating table several feet from the transmitter. The method of connection

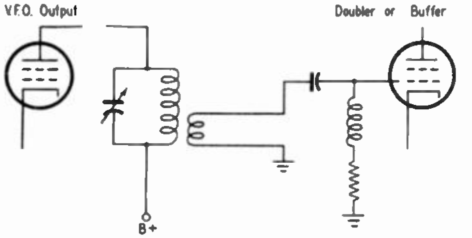


Fig. 3-13 — Remote-coupling method for VFO or exciter.

shown in Fig. 3-13 is, admittedly, an inefficient way to transfer power; but maximum efficiency is unimportant, so long as the stage receives sufficient drive. The ease with which this 807 is driven indicates that a higher-powered stage, employing an 813 or similar tube, could be operated by the same method.

— *John P. Isaacs, W6PZV*

VARIABLE END-LINKED COILS

When high-power tetrodes are used in a single-ended amplifier circuit, it seems wasteful to use a split-stator tank system to obtain a variable link. Since no variable end-link coils were available, one was made in the following manner:

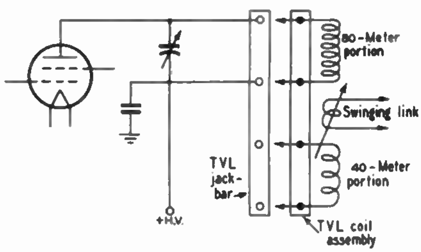


Fig. 3-14 — Method of obtaining variable-link coupling with single-ended circuits. Two bands are covered with a single coil assembly, as described in the text.

A standard B & W 500-watt TVL jack bar was used to hold the plug-in coils. The associated split-center TVL coils were altered by removing one of the two identical windings on the 80-meter coil, and substituting in its place one of the windings from the 40TVL coil. The result is a coil that can be used on 80 meters when it is plugged in one way, or on 40 meters when it is plugged in after 180° rotation. A 20–10 meter coil was made in like manner from the 20- and 10-meter TVL coils.

Fig. 3-14 shows the circuit connections necessary to permit this arrangement. The inoperative portion of the coil assembly has no effect on the performance of the amplifier, as it is not connected to the circuit in any way, and is isolated from the operative portion by the swinging link. [In rare instances, the "floating" coil might be self-resonant at the operating frequency, resulting in a wavetrap action, but if this is the case, it can be detuned with a condenser or shorted to ground to eliminate the trouble. — *Ed.*]

This arrangement is not applicable to single-ended triode stages where a balanced circuit is needed for neutralization.

— *Walter Zuckerman, W2LBF*

COUPLING NETWORK FOR WORKING SEVERAL BANDS ON ONE ANTENNA

For several years at W2LIW I used a pi-section network, sometimes called a "Collins coupler," because of the ease with which it enabled me to work over a wide range of frequencies in several bands with one antenna. The antenna was a 66-foot end-fed Hertz, with a number of bends.

The transmitter was located in the attic, about 35 feet above the ground. When operated at 3.5 Mc. it was being fed near a current loop, with large currents flowing to ground. As the 35 feet of steam pipe, electrical conduit, etc., which comprised the lead to actual ground, represented a considerable fraction of a wavelength, the transmitter in the attic was quite a few volts above ground. As a result the r.f. got into a number of places where it had no business — in the lighting system, for example. Since the power supply delivered only 30 watts to begin with, I resented a

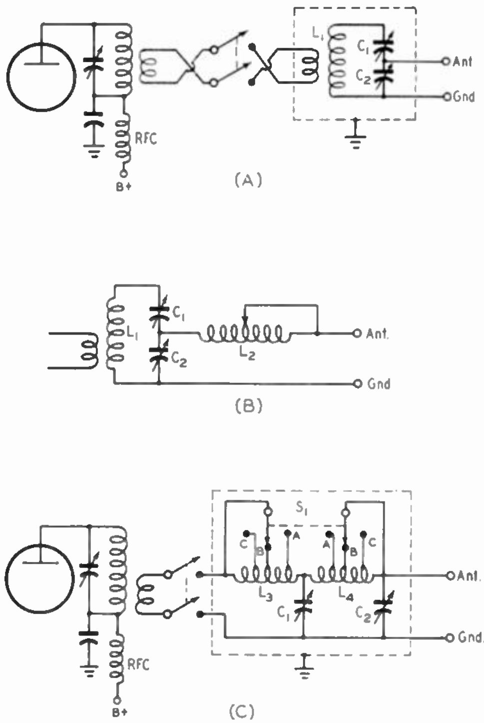


Fig. 3-15 — (A) Wide-range antenna coupling network. (B) Loading coil used with above coupler for working a very short antenna on a very low frequency. (C) Tapped antenna coupler for a bandswitching transmitter.
C_1 — 250-$\mu\mu$fd. variable, widely spaced.
C_2 — 500-$\mu\mu$fd. variable, widely spaced.
L_1 — To resonate at desired band with low capacity.
L_2 — 30 turns, 2½ inches diameter.
L_3 — 30 turns, 2½ inches diameter, tapped.
L_4 — 40 turns, 3 inches diameter, tapped.
S_1 — Double-pole 4-position tap switch.

large portion of this being wasted in illuminating bulbs in various parts of the house, particularly since the orange glow produced was useless for practical purposes.

After a good bit of experimentation the system shown in Fig. 3-15A was evolved. The important thing is to see to it that the coupler itself is completely insulated from the transmitter ground (chassis) and link-coupled to the transmitter. Then the ground lead from the coupler is carried to an actual ground (in my case the water main in the cellar) and carefully insulated all along its length. No. 14 wire supported on stand-offs is suitable. Absolutely nothing else is to be connected to this ground lead. Links on both the final tank and the antenna coupler may be permanently coupled closely, as all variations in loading are taken care of by C_2, the 500-$\mu\mu$fd. variable output condenser. The other condenser, C_1, is a 250-$\mu\mu$fd. variable.

The coupler tank coil, L_1, is cut so that it will resonate in the desired band with very low tuning capacity. The entire unit is placed in a shield can which is grounded to the transmitter chassis, while the coupler is carefully insulated from the shield.

The tuning process is the same as with any other form of pi network. The transmitter first should be tuned up with the d.p.s.t. switch in the link open. After that the transmitter is not touched. Loading is adjusted by means of C_2, a surprisingly easy process. Resonance is achieved by varying C_1. Then the power is going to the right place, as can be observed easily by placing an r.f. meter in the antenna lead.

A variation which is useful when working, say, a very short antenna system on a very low frequency, is by the addition of a loading coil, L_2, as shown in Fig. 3-15B. If mechanically feasible, this loading coil might be placed at the open end of the antenna. This would move the current loop, the point of maximum radiation, farther out in the clear, a definite improvement in design.

The arrangement shown in Fig. 3-15C is excellent for a band-switching transmitter. The two switch sections comprising S_1 may be ganged after the optimum position for the taps has been found by experiment. What has already been said concerning insulation still applies, and the tuning process is the same.

At W2LIW, one coupler was used from 1.8 to 14 Mc. For 28 Mc. a v.h.f. version was constructed, using two 50-$\mu\mu$fd. midget condensers and an air-wound coil. All leads were made very short. Excellent results were obtained.

— *Harry R. Hyder, W3NVL*

THE TEN-DOLLAR WONDER — A TRANSFORMERLESS VFO

IT WAS GREAT to be back on the air again, but with the choice of only a few prewar crystals I often felt the lack of a VFO.

But where was I going to scare up half-a-hundred bucks for a commercially-built unit? QRM grew worse so the time came to analyze the contents of the junk box. It revealed some midget variable condensers, tube bases — and best of all, a 70L7GT and a 6G6G. Some old aluminum-base 16-inch transcriptions supplied stock for the chassis. (All there is to cleaning them is to dip them in very hot water and then peel off the acetate coating with a knife, starting at the edge.)

It was thought that by using a transformerless power supply, fair regulation might be obtained without the use of voltage regulators. This proved true in spite of line voltage changes from 95 to 115. This arrangement also simplified the power-supply problem from the standpoint of economy, stability and size. The whole unit, shown in the photographs, measures 6 by 6 by 3 inches.

The 75-ohm resistor, R_5, and the 150-ma. bulb were added to protect the rectifier section of the 70L7GT because high current is encountered in charging the filter. Capacitor C_{10} is required to reduce hum and should not be omitted. (See Fig. 3-16.)

No screen-dropping resistors are required and no cathode bias resistor is used for the 70L7GT

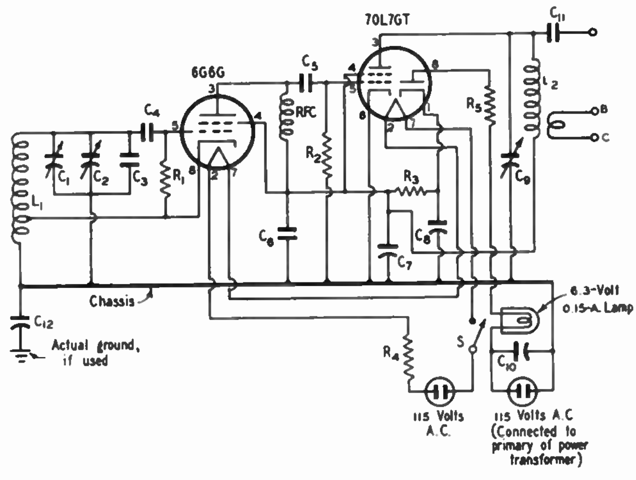


Fig. 3-16 — Schematic diagram of the low-cost transformerless VFO. The heavy line denotes the chassis. The unit is actually grounded only through the protective condenser, C_{12}. High-impedance output is taken from C_{11}. A low-impedance link may be connected to *B* and *C*.

C_1 — 50-$\mu\mu$fd. variable.
C_2 — 140-$\mu\mu$fd. variable.
C_3 — 600-$\mu\mu$fd. mica.
C_4, C_5, C_{11} — 100-$\mu\mu$fd. mica.
C_6 — 0.01-μfd. mica.
C_7 — 40-μfd. electrolytic.
C_8 — 20-μfd. electrolytic.
C_9 — 100-$\mu\mu$fd. variable.
C_{10}, C_{12} — 0.05-μfd. paper.
R_1 — 47,000 ohms, ½ watt.
R_2 — 100,000-ohm ½-watt 70L7GT grid leak.
R_3 — 1000-ohm 10-watt B + filter resistor.
R_4 — 250-ohm line-cord resistor.
R_5 — 75 ohms, ½ watt.
L_1 — 19 turns, tapped at 4 turns. (1.8 Mc.)
L_2 — 25 turns. Link — 2 turns (3.5 Mc.). Both L_1 and L_2 are wound on the tube bases with No. 20 wire.
S — S.p.s.t. "on-off" switch.

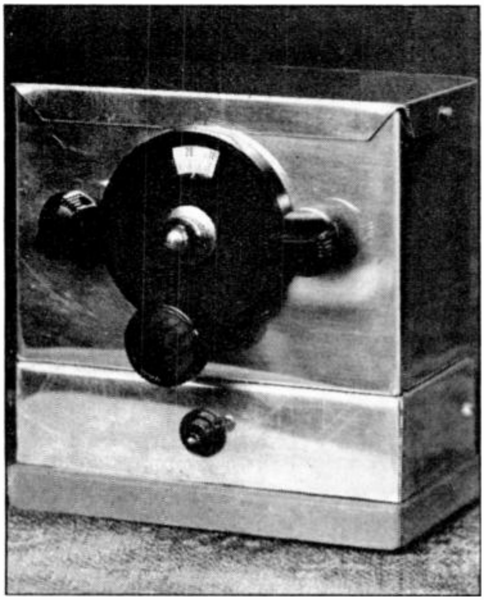


Fig. 3-17 — Front view of the ten-dollar VFO.

because it gets sufficient bias from the grid leak. The two coils are mounted at the back of the chassis so that there is no chance for them to be warmed by the tubes. The oscillator coil is unshielded. The unit sits on a wooden desk and no metal comes near the back of it.

With the condenser combination as shown it is just possible to cover the entire 160-meter band. The 6G6G is an excellent oscillator and

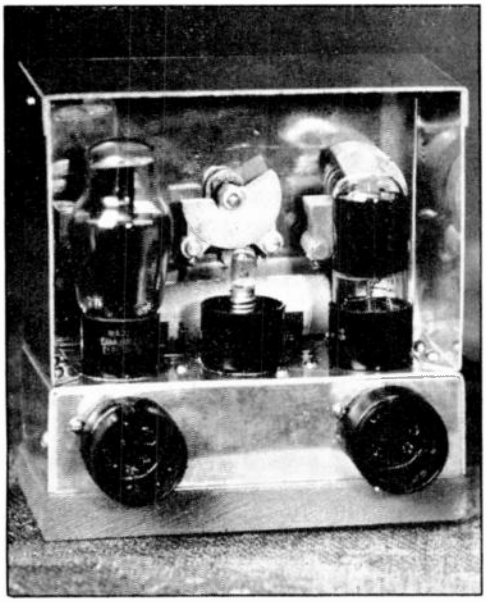


Fig. 3-18 — Rear view of the VFO shows its compact arrangement. The coils are mounted on the rear of the chassis which must be kept clear of other units on the operating desk when in use.

runs cool. The 70L7GT doubles to 80 meters with over a watt output, sufficient to take the place of a crystal. I connected it to the grid of the regular 6L6 oscillator through C_{11} without even a ground return, and with an unshielded three-foot lead at that. The 6L6 stage then quadruples to "20" as if it were a Tri-tet.

We thought this design too good to keep to ourselves, after news of this compact and stable VFO was received with unusual enthusiasm by others to whom we described its features. The cost of this unit was in the neighborhood of ten dollars. I like that neighborhood.

— *Don Langbell*

SOME NOTES ON THE CLAPP OSCILLATOR

The following notes on the Clapp series-tuned oscillator (see "A High-Stability Oscillator Circuit," May, 1948, *QST*) are a result of the author's experience in building a VFO using this circuit. It is hoped that they will be useful to others.

The circuit used is shown in Fig. 3-19. Values are conventional, but only high-quality components were used.

Greatly-improved isolation between the oscillator and succeeding buffers may be accomplished with the circuit as shown. One half of a double triode (12AU7 or 6SN7) is used as the oscillator and the other section operates as a cathode follower. The low output impedance of the cathode follower makes the voltage and frequency less sensitive to load changes. W2FBA has used a cathode follower to isolate other VFOs, but the Clapp oscillator lends itself very simply to this circuit. If the oscillator is not keyed, the follower grid may be directly coupled to the oscillator cathode, since little or no d.c. voltage exists at this point. If the oscillator is keyed in the cathode circuit, capacity coupling should be used to prevent the open-circuit cathode voltage from appearing on the follower grid.

It was found that an r.f. choke in the cathode circuit of the follower improved the output. The output is somewhat less than that from the oscillator alone, although neither is very large. In this installation about 3 volts output was obtained, enough to drive a 6AC7 Class A. The 6AC7 was found to be superior to the 6AG7 in cases where the grid drive is small. This is to be expected from the high perveance of the 6AC7. In addition, it was desired to keep power dissipation to a minimum, and the 6AC7 gives more output at lower current. A 2E26 may be driven to full output with the 6AC7 operating Class A from the cathode follower.

The mechanical construction used with this type of oscillator must be considerably more rugged than with the usual high-C VFO. The junction between the tuning capacitor and the coil is very hot and any change in stray capacitance at this point will spoil the stability. The coil and condenser should be firmly mounted so that no relative motion can occur between these components or between them and the shield.

Available ceramic coil forms did not give Qs which came up to expectations. An air-wound coil similar to the B&W type, having a length about equal to its diameter, was selected as having the best Q. The coil was clamped on one side

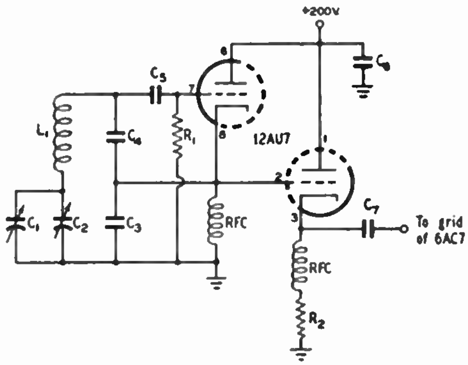


Fig. 3-19 — Series-tuned oscillator with cathode follower stage.

C_1 — 50-μμfd. variable.
C_2 — 15-μμfd. variable.
C_3, C_4 — 0.001-μfd. silver mica.
C_5, C_7 — 100-μμfd. mica.
C_6 — 0.01-μfd. mica.
R_1 — 0.1 megohm, ½ watt.
R_2 — 15,000 ohms, ½ watt.
L_1 — 45 turns No. 18, 2¼-inch diam., 2¼ inches long. (See text.)
RFC — 2.5-mh. choke.

in a polystyrene bracket. The Q of this coil without a shield was measured as 275 at 3.5 Mc. It should be realized that placing a shield around a coil will reduce its Q. The coil should be spaced from all sides of the shield by a distance at least equal to the coil diameter to lessen the reduction in Q by the shield.

The usual precautions as to condenser bearings should be observed. The small amount of tuning capacitance used in this circuit makes the frequency more dependent upon strays and minimum capacitance of the condenser. Condensers in which spacing can be changed with longitudinal pressure on the shaft should be avoided.

The keying properties of the circuit were investigated only as a matter of academic interest. A barely-discernible chirp seems to be present with the usual filter arrangements. Previous experience with the critical tastes of the FCC in the matter of key clicks made it desirable to eliminate them from this unit. In any keyed oscillator the frequency will change as the applied voltage builds up; the Clapp oscillator is no exception, although it is considerably better than others. If the rise in the keyed voltage is sharp the chirp will appear as a click, and many cases of clicks may be traced to this effect. Wishing to have none of these difficulties, it was decided to allow the oscillator to run continuously and to take advantage of the mechanical construction to accomplish the necessary shielding. This proved to be a practical solution; no trace of the oscillator can be heard on anything but the fundamental (3.5 Mc.) and this is not objectionable. The unit is keyed in the Class A 6AC7 following the oscillator.

No measurements have been taken on the stability of the VFO. After a warm-up period of 15 to 20 minutes the oscillator will stay in zero beat with a 100-kc. crystal for long periods of time. The main source of drift seems to be the expansion of the inductance. This could be compensated for by negative temperature-coefficient capacitance.

The Clapp oscillator is most certainly superior to previously-used types. It is not a cure-all for VFO troubles, though, and considerable care must be used in construction to realize its capabilities.

— *Richard G. Talpey, W2PUD*

TUBULAR CONDENSER FOR ANTI-TVI APPLICATIONS

Fig. 3-20 gives in cross-section the details of a tubular capacitor for effectively by-passing v.h.f. r.f. currents between the plate and cathode of an amplifier tube, thereby eliminating v.h.f. parasitics which contribute to TVI. The condenser is especially adapted for tubes

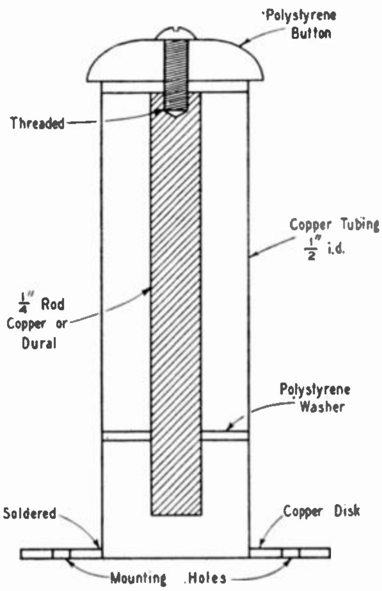


Fig. 3-20 — Homemade tubular condenser for providing short r.f. path between plate and cathode, for tubes having the plate connection at the top. A condenser 4 inches long has a capacitance in the vicinity of 10 μμfd.

having the plate connection at the top, because it can be mounted vertically alongside the tube.

As shown in the sketch, the unit is mounted over a hole in the chassis near the grounded connection of the amplifier-tube cathode, for shortest r.f. path; the plate is connected to the screw at the top. Homemade condensers of this type have relatively low capacity — 10 to 15 μμfd. — depending on the length and spacing of the tubing sections.

4. Hints and Kinks . . .

for the 'Phone Rig

MINIMIZING HUM IN SPEECH AMPLIFIERS

An extremely simple yet effective way to minimize hum is apparently overlooked by or unknown to most amateurs. If you have an audio unit plagued by 60-cycle hum, place approximately 10 volts positive bias on the heater or filament circuit. This can be accomplished in the following typical manner:

Across the 300-volt d.c. plate supply place a 0.3-megohm ½-watt resistor in series with a 10,000-ohm ½-watt resistor as shown in Fig. 4-1.

Where the resistors join, the potential is 10 volts positive. Connect this point to either side of the filament circuit after making certain that neither side of this circuit nor the center tap of the filament transformer is grounded. Larger resistors than ½-watt are not needed because the current drain through the bleeder is slight.

If it is desirable to tap across a d.c. source of different voltage than that used in the example

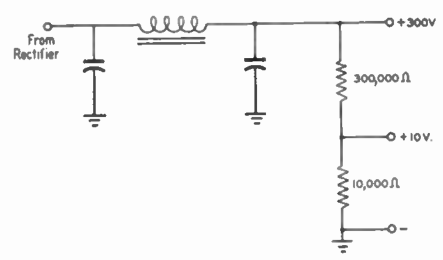


Fig. 4-1 — Method of obtaining a small positive bias for use in hum reduction.

above, merely keep the ratio of resistance values so that from 10 to 12 volts positive results at their junction.

In several cases this simple and inexpensive method completely solved the hum problem after all other means had failed.

— *Karl Dreher, WØWO;*
Charles Murray, WØNWU

INEXPENSIVE RELAY FOR PUSH-TO-TALK CIRCUITS

A useful adaptation of an automobile part to ham radio is the use of a double headlight relay in a push-to-talk system. I bought my relay from one of the automotive chain stores for $1.19 and it works swell!

— *M. E. Dahl*

DIRECT-COUPLED AUDIO AMPLIFIER

Fig. 4-2 shows a direct-coupled audio amplifier that I found simple to construct. It has a flat response from 30 to about 800 cycles with about

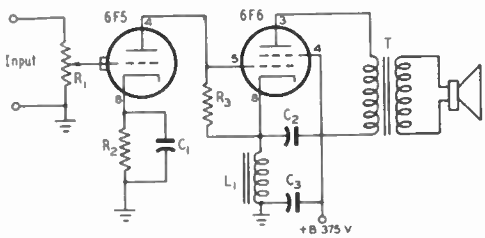


Fig. 4-2 — Direct-coupled amplifier requiring a minimum of parts.
C_1, C_2, C_3 — 8 μfd.
R_1 — 0.5 megohm, variable.
R_2 — 15,000 ohms.
R_3 — 0.47 megohm.
L_1 — 2500-ohm 'speaker field, or 2500-ohm 10-watt resistor.
T — Output transformer, plate to voice coil.

a 3- or 4-watt undistorted output. With a 6SJ7 ahead of the 6F5 it will make a good microphone amplifier, with a performance exceeding that of many other low-power jobs I have seen.

— *H. B. Ford*

BALANCING PHASE-INVERTER CIRCUITS

The arrangement shown in Fig. 4-3 provides a most convenient means of balancing phase-inverter circuits. It requires little equipment, and is perhaps more accurate than other more involved methods.

The primary of a plate transformer is temporarily connected in the B+ lead to the center tap of the output transformer. Headphones are connected across the secondary as shown. Signal input is then applied to the phase inverter, and the balancing potentiometer is adjusted until minimum signal, mostly distortion products, is

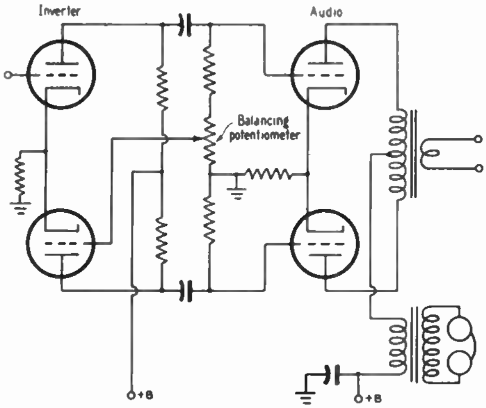


Fig. 4-3 — Arrangement used for balancing phase-inverter circuits without the use of elaborate test equipment.

heard in the 'phones. This point is very critical, and indicates balance of the inverter circuit. Slight variations introduced when replacing tubes can be offset by readjustment using the same method.

— *H. G. Brower, W2FQP*

PUSH-PULL CLASS-A WITHOUT A PHASE INVERTER

Shown in Fig. 4-4 is a push-pull Class A amplifier that some of the fellows might like to try. This circuit was borrowed from the sweep circuit of one of the Du Mont oscilloscopes. However, I found that it may also be used as an audio amplifier. I constructed such an audio system with 6L6s in the output and found that I had no trouble at all in obtaining 15 watts of undistorted power output.

The beauty of this hook-up appears in the fact that there is no need to use a phase inverter stage or push-pull input transformer. Because the cathode resistor is not by-passed, a slight

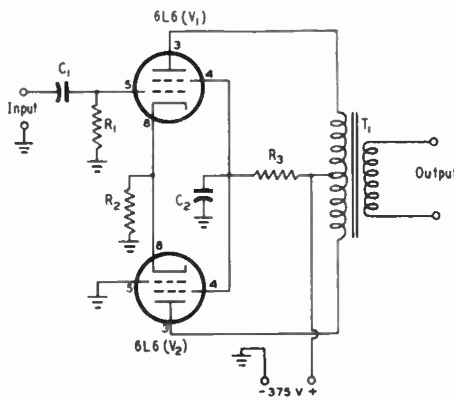


Fig. 4-4 — Push-pull Class A amplifier without a phase inverter.
C_1, C_2 — 0.05-μfd. 600-volt paper.
R_1 — 0.22 megohm, ½ watt.
R_2 — 300 ohms, 10 watts, wire-wound.
R_3 — 220 ohms, 1 watt.

amount of inverse feed-back is induced which tends to cancel out the small amount of distortion, if any.

In order to picture the mode of operation more clearly, follow through one cycle of the input excitation voltage. Beginning with the positive swing of excitation, as the voltage on the grid of V_1 goes positive it causes the plate current in V_1 to increase. The increase of current flowing through R_2 (the cathode resistor) causes the voltage drop across R_2 to increase with the grounded side of R_2 becoming increasingly negative. (This change is instantaneous since R_2 is un-bypassed.) This voltage also exists between the cathode of V_2 and its grid since the two cathodes are connected together and the grid of V_2 is grounded. Therefore the over-all effect on V_2 is the same as though a negative voltage was being applied on its grid from an external source. The remainder of the cycle may be traced out and in all cases as the grid voltage on V_1 varies the effective grid (bias) voltage on V_2 will vary 180 degrees out of phase with it. This gives true push-pull operation which cannot become unbalanced unless Class A operation is exceeded and V_1 allowed to draw grid current.

— *George H. Taylor, W7ITL*

INEXPENSIVE BCI CURE

Having about 75 midget a.c.-d.c. "cracker-box" sets in the immediate vicinity of my 250-watt 10- and 20-meter 'phone rig, I had to do something about the resulting BCI. It had to be inexpensive, yet effective. I found that by-passing one side of the heater of the combination detector/first-audio tube (usually a 12SQ7 or its equivalent) with a 0.001-μfd. mica condenser cured about 95 per cent of all cases when the trouble was caused by power-line pick-up.

— *Ted Wilds, W4GVD*

LOCK-ON FOR THE T-17B HAND MICROPHONE

I have noticed on several occasions when in contact with a station using a T-17B microphone that the audio is frequently interrupted. This is caused by the fact that it takes a lot of pressure to hold the switch button closed, and after a few moments the hand gets cramped. A simple solution to the problem requires only that a ¾-inch piece of No. 18 wire be soldered under the edge of the metal mounting washer that is found beneath the bakelite switch button. After reassembling, it will be possible to lock the switch in the "on" position with a slight twist of the button.

— *R. A. Cohagen, W8NBM*

BUILT-IN OSCILLOSCOPE FOR MODULATION MONITORING

The availability of 3-inch cathode-ray tubes (3AP1, 3BP1, etc.) and 8016 high-voltage rectifier tubes on the surplus market makes it possible for every amateur who operates 'phone to equip his transmitter with a built-in 'scope for modulation monitoring.

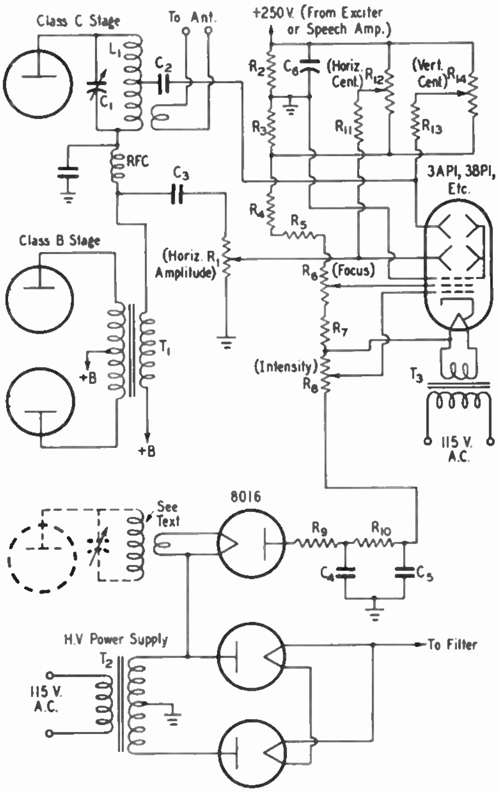


Fig. 4-5 — Circuit diagram of a built-in 'scope that costs little, utilizes the transmitter power supply, and can be added to any medium- or high-power 'phone transmitter.

C_1 — Final-amplifier tuning condenser.
C_2 — 50-μμfd. 5000-volt mica.
C_3 — 0.01-μfd. high-voltage mica or paper (oil-filled).
C_4, C_5 — 0.05-μfd. 1500-volt paper.
C_6 — 1.0 μfd. 600-volt paper.
R_1 — 1-megohm potentiometer.
R_2, R_3 — 2.7 megohms, 1 watt.
R_4, R_5 — 1.8 megohms, 1 watt.
R_6 — 2-megohm potentiometer.
R_7 — 1 megohm, 1 watt.
R_8 — 0.5-megohm potentiometer.
R_9 — 47,000 ohms, 1 watt.
R_{10} — 0.15 megohm, 1 watt.
R_{11}, R_{13} — 1 megohm, ½ watt.
R_{12}, R_{14} — 3-megohm potentiometer.
L_1 — Final-amplifier tank coil.
RFC — Final-amplifier r.f. choke.
T_1 — Modulation transformer.
T_2 — Power transformer (about 100 volts each side c.t.).
T_3 — Filament transformer (depends upon type of 'scope tube used).

The circuit shown in Fig. 4-5 has two novel features. Accelerating voltage for the cathode-ray tube is obtained from one of the high-voltage supplies in the transmitter, eliminating the need for a separate supply. The filament voltage for the 8016 rectifier is obtained by link coupling it to the tank coil of a low-power r.f. stage. Thus during stand-by periods the 'scope tube is inoperative, eliminating the danger of burning the screen.

Since the 8016 operates at only 1.25 volts and is easily damaged by overloads, it is suggested that the initial adjustment of the link be made using a No. 112 flashlight lamp across the link in place of the 8016 filament. Use a one-turn link and start with very loose coupling. Increase the coupling until the lamp reaches full brilliance. *Caution!* The lead from the high-voltage transformer to the link must be opened during this adjustment, because otherwise the link would be at the full plate potential! All wiring associated with the 8016 filament should be insulated for several thousand volts.

Should a more conventional filament circuit be desired, any of the high-voltage rectifiers (2X2, 2V3-G, etc.) may be used with a well-insulated filament transformer. A modification of this type is shown in Fig. 4-6.

In operation, this modulation indicator produces the familiar trapezoidal pattern (in many ways superior to any other for this purpose). Should a "leaning" pattern appear, it is probable that some r.f. voltage is appearing at the horizontal-deflection plates of the tube. This effect can be minimized by insertion of a 2.5-mh. r.f. choke in the lead to the rotor arm of R_1.

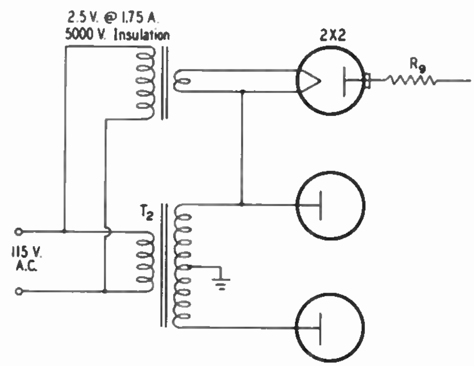


Fig. 4-6 — Alternate connections for the built-in oscilloscope when using a 2X2 high-voltage rectifier with transformer for filament supply.

General information on the adjustment and operation of cathode-ray tubes, and on the interpretation of the trapezoidal patterns obtained, may be found in *The Radio Amateur's Handbook*.

— *John V. Ellison, W4MID*

PLATE-MODULATING THE 807

In an attempt to obtain better audio response, the screen resistor in an 807 amplifier was by-passed, as shown in Fig. 4-7. The result was a very bad low-frequency parasitic that caused splatter and severe BCI. With the aid of a sensitive wavemeter similar to the one described in recent editions of the *Radio Amateur's Handbook*, the trouble-causing circuit was found to be the plate r.f. choke resonating with C_1, C_2 and C_3, building up something like the old Colpitts, with the screen acting as the control grid. The parasitic circuit is shown in heavy lines.

By-passing the lower end of the plate choke eliminated the parasitic, but the capacity

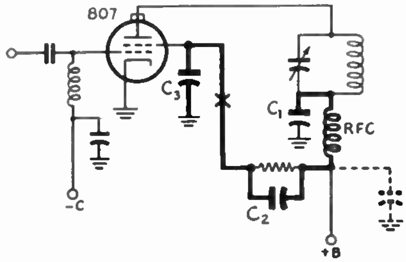


Fig. 4-7 — A plate-modulated 807 amplifier stage that was troubled with parasitics. The low-frequency parasitic circuit is shown in heavy lines. The method by which the trouble was cured is described in the text.

(dotted) had to be so large that it also by-passed enough of the audio to impair speech quality. The final solution was the insertion of a 1000-ohm resistor at the point marked "X."

— *Harold Bernhardt, OE-341, ex-LY1HB*

UNIVERSAL OUTPUT TRANSFORMERS USED IN MODULATOR

About the most common, and yet one of the more inefficient methods of plate modulating an oscillator or power amplifier, is the Heising or choke modulation system. Many amateurs seem to have overlooked the possibilities of transformer modulation utilizing replacement-type output transformers.

The usual circuit for transformer modulation of an oscillator or amplifier, when both r.f. and a.f. tubes are supplied from the same power source, is shown in Fig. 4-8A. Here, T_1 is equivalent to an autotransformer of the proper ratio, with the plate voltage fed in at the tap and the modulator and amplifier plates taken off at opposite ends.

For low-power use, advantage can be taken of universal replacement push-pull output transformers, which will satisfactorily handle the low power, in transceivers or transmitter-receivers, since a 'speaker winding is also supplied. Thus one transformer, by a judicious choice of values, can be made to take the place of two with greater output efficiency.

For example, consider a 12-watt oscillator, say a 6V6, modulated by a single Class A 6V6, with a plate-supply voltage of 300 in a circuit as shown in Fig. 4-8B. The plate current of the oscillator will be $I = W/E = 12/300 = 0.04$ ampere (40 ma.) and the equivalent resistance of the Class C circuit will be $R = E/I = 300/0.04 = 7500$ ohms. The recommended load impedance of the 6V6 modulator for 300-volt operation is 8500 ohms. This mismatch is permissible. However, in tube combinations where a 2-to-1 or 3-to-1 mismatch occurs, a compromise must be made since the most generally available transformers have symmetrical primaries. It is preferable to put the higher load resistance across the modulator, which will give less distortion than the lower value, and accept slightly less audio-power transfer to the load, since this will help guard against overmodulation.

— *Alan Sobel*

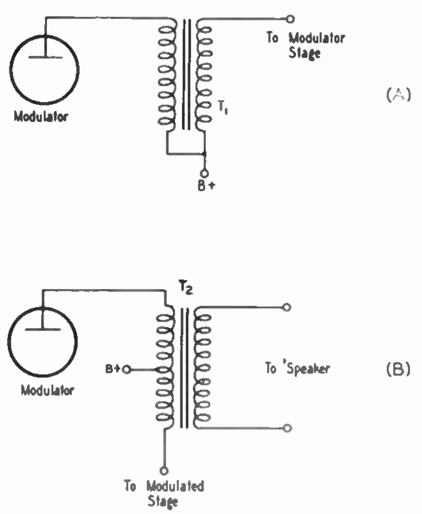


Fig. 4-8 — (A) Transformer modulation using a conventional modulation transformer. (B) Transformer modulation using a replacement-type push-pull output transformer.

LINK-COUPLED MODULATOR

Modulation transformers are quite expensive, but 'speaker output transformers of the universal type are readily available, and at low prices. Many low-power transmitters use filter chokes in the Heising circuit; others use the split primary of a 'speaker output transformer for a modulation transformer. Both of these systems have the disadvantage of having to use a common power supply for both transmitter and modulator, and permit no adjustment for proper impedance match. Also, push-pull modulator tubes cannot be used. The following scheme is superior in both respects.

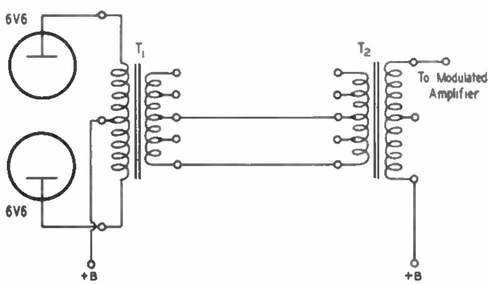


Fig. 4-9 — Universal-type output transformers connected back-to-back to obtain control over a wide range of impedances.

Use two universal 'speaker output transformers connected back-to-back, as shown in Fig. 4-9. By utilizing the voice-coil taps, a wide range of impedances can be matched; step-up or step-down, single-ended or push-pull, Class A, AB, or B. Merely determine the impedance transformation ratio for the various voice-coil taps from the data sheet supplied with the transformers. Then, by using the ratios as a step-down from the modulator and as a step-up to the transmitter, a perfect match can be had. As an example: Push-pull Class AB 6V6s are to be used to modulate an 807 running at 400 volts and 60 ma. The recommended load resistance for 6V6s, Class AB, is 8000 ohms. The modulated amplifier represents a load of 400/0.06, or 6666 ohms. From the data sheet we find the secondary tap that will match 8000 ohms to, say, a 6-ohm voice coil. Then all that has to be done is to find from the same data sheet a tap which will match approximately 6666 ohms to a 6-ohm voice coil, the two secondaries are linked together, and the job is done with a "link-coupled" modulator at a fraction of the cost of a regular modulation transformer.

— *Harry R. Hyder, W3NVL; Joseph Vitko, W1BEA*

IMPROVED CIRCUIT FOR PREVENTING NEGATIVE-PEAK SPLATTER

Clipping is the only method that allows full modulation of the carrier at all times without negative-peak splatter. Only high-level clipping will be discussed, because it is the *only* method of clipping that is a sure preventative of negative-peak splatter. No maladjustment is possible because the operation is entirely automatic.

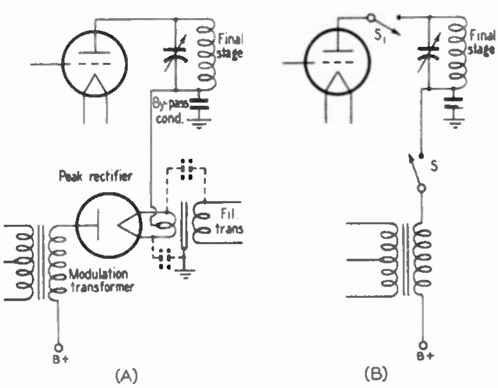


Fig. 4-10 — The usual type of high-level negative-peak clipper is shown at A. On negative peaks, the peak rectifier does not conduct, and the circuit is opened as though by S in B. With no plate voltage, the output tube is disconnected from the circuit, as though by S_1. The net effect is that the final tank circuit is hit by a negative square wave, and damped waves are generated as in a spark transmitter.

Any increase in gain after the low-level clipper, or any decrease in input to the modulated stage, can result in overmodulation. Most low-level clippers limit both the positive and negative peaks, but since the negative peak is the only troublemaker, some extension of the positive peaks is desirable, provided the modulator is capable of supplying the necessary undistorted power.

Fig. 4-10A shows the typical high-level clipper. To understand its operation consider first what causes negative-peak splatter. Under normal modulation conditions, the final tube may be considered as a stable generator and the plate tank circuit and antenna as a resonant load. At all modulation percentages below 100, the final tube as the stable generator retains control of the tank circuit and the resulting signal is sharp. When overmodulation occurs, and the plate voltage drops to zero or goes negative, the final tube loses control of the tank and load circuits, just as though it were disconnected by switch S_1 in Fig. 4-10B. At this instant we have, for all practical purposes, an old-fashioned spark transmitter consisting of an antenna, a tank circuit, and a voltage source (which in this case is the modulator). The voltage applied to the tank circuit during these periods produces damped waves, the duration of which will be proportional to the circuit Q. The spectrum occupied by these waves will be determined by the L and C of the circuit.

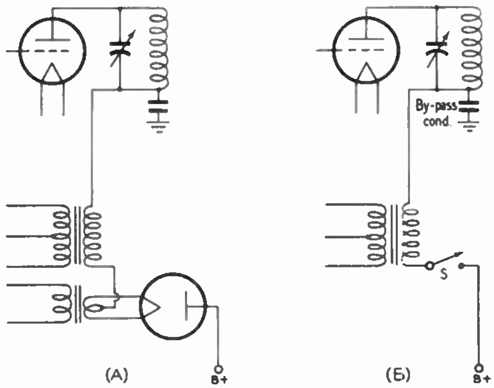


Fig. 4-11 — The new type of high-level negative-peak clipper moves the clipper tube to the other side of the modulation-transformer secondary, as shown at A. This has the action of a switch at S in B. In combination with the clipper-tube filament transformer, the inductance of the modulation-transformer secondary, and the plate by-pass condenser, a low-pass filter is formed, and no sharp negative square waves reach the modulated stage. (See Fig. 4-12.)

In operation, the clipper tube behaves the same as the final tube when the plate voltage reaches zero. It is represented by switch S in Fig. 4-10B. Thus, for all practical purposes, the tank and antenna circuits are completely disconnected from the rest of the transmitter during negative overmodulation peaks.

High-level negative-peak clipping has the following disadvantages:

1) Because of the square-wave trigger characteristics of the rectifier tube (especially the mercury-vapor type) [see following H. & K. by W6BCX — *Ed.*] high frequencies are generated which produce broad sidebands, unless the clipper is followed by a low-pass filter.

2) The filament transformer for the clipper tube must be capable of withstanding the peak modulation voltage without insulation breakdown to core or primary.

3) Capacitance of the filament-transformer secondary across the audio results in excessive by-passing.

These three disadvantages were overcome by connecting the clipper tube as in Fig. 4-11A. The effect is as shown in Fig. 4-11B. Switch S will still disable the modulator, as in Fig. 4-10B, but with the following advantages:

1) The capacitance of the filament transformer is no longer a part of the plate by-pass circuit.

2) The voltage insulation of the filament transformer needs only to withstand the plate voltage.

3) Since the clipper tube is the generator of the undesirable high frequencies, the combination of the filament-transformer secondary capacitance, the inductance of the modulation-transformer secondary, and the final plate by-pass condenser forms a low-pass filter (refer to Fig. 4-12A).

This combination forms a constant-K π-section low-pass filter, as in Fig. 4-12B. The cut-off frequency of this filter is unimportant, so long as it is below the highest speech frequency it is desired to pass, because it attenuates only the high-order frequencies produced by the clipper tube. Similarly, the insertion loss because of the impedance characteristics of the filter is of no consequence, since the pass frequency is zero.

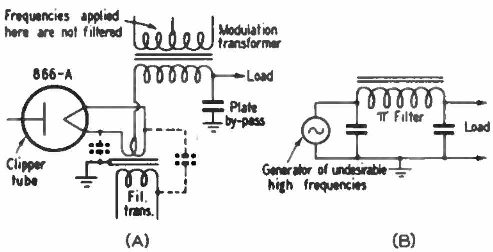


Fig. 4-12 — The circuit of Fig. 4-11A redrawn to show the filter action. The equivalent diagram is shown in B.

Assuming an inductance of 20 henrys in the modulation-transformer secondary, a capacitance of 0.002 μfd. in the filament transformer and a 0.004-μfd. plate by-pass condenser, the cut-off frequency would be approximately 900 cycles.

It must be remembered that the filter in this case need only pass direct current and attenuate frequencies below about 3000 cycles, and this allows considerable latitude. Because the cut-off frequency is well below 3000 cycles, the sloping characteristic of the constant-K configuration is of no disadvantage, for the attenuation is ample in the upper voice range and above. This eliminates the necessity for using any M-derived sections.

After the clipper has been installed, a check with the oscilloscope will prove its value. It is impossible to put a tail on the trapezoid pattern, provided that the audio applied to the horizontal plates is taken from the load side of the clipper. One of the checks used at W7NU with this clipper was to set the gain for 100-per-cent modulation with 600 watts input, and then to drop the input to 300 watts and shout into the microphone! Checks with the oscilloscope and with hams a few blocks away revealed no splatter, even with this severe test.

— *Howard W. Johnson, W7NU*

THE 836 AS A HIGH-LEVEL SPEECH CLIPPER

In the article "More on Speech Clipping" in the March, 1947, issue of *QST*, the writer showed an 866 used as a high-level speech clipper and stated that ". . . careful checks indicate that the performance is as good (with the 866) as with a high-vacuum rectifier." The 866 was used principally because it was inexpensive and could be used with a standard filament transformer.

Further investigation has shown that the high-vacuum type is more desirable, because under certain unfavorable conditions, such as location of the clipper tube in a stray r.f. field or in a region of high ambient temperature, there is a considerable slowing-up of the deionization time in the gaseous rectifier which impairs its performance. The splatter suppression is still noticeable, but is not nearly as effective as when a high-vacuum rectifier is used. Also, the transients that sometimes result under conditions of retarded deionization may, during moderately heavy clipping, cause the voice quality to sound much more "unnatural" than would otherwise be the case.

An ideal high-level clipper tube for medium or high power is the 836. This high-vacuum rectifier is not subject to the difficulties encountered with the 866 mercury-vapor type, and is available at even lower cost in the surplus market.

One 836 will handle 250 ma. input to the Class C amplifier stage; two in parallel can be used for currents up to 500 ma. Unlike the 866, no special precautions need be taken when using 836s in parallel. The voltage drop through an 836 is approximately 20 volts per 100 ma., or about 10 volts per 100 ma. for a pair.

— *W. W. Smith, W6BCX*

SIMPLE BUILT-IN NEGATIVE-PEAK OVERMODULATION INDICATOR

Here is a negative-peak overmodulation indicator suited to the needs of the laziest 'phone man. This little gimmick is so easy to build into the average 'phone rig that it is well worth the effort just to *know* that you are not filling the band with buckshot and monkey-chatter caused by overmodulation.

As shown in Fig. 4-13, the basic components required are a 1B3-GT/8016 half-wave high-vacuum rectifier and a NE-51 neon bulb. The rectifier has a filament that can be heated from almost any source, provided that about 200 ma. is available. In this unit it is heated by placing it in series with the high-voltage lead to the Class C stage, shunted by a small resistance. The value of R, somewhere in the neighborhood of 50 ohms, may be selected by measuring the voltage across the rectifier filament ab with the transmitter operating at normal load. *Careful!* The filament is at the full plate voltage used in the transmitter! Assuming that you run at least 180 ma. plate current to your final, the value of R should be adjusted until the drop across the rectifier filament is approximately 1.2 volts d.c.

The filament of the 1B3-GT/8016 has an appreciable thermal lag, so it will not be damaged by *momentary* overloads, but a good fast-acting overload relay should be used to take power off the rig in the event of a flash-over or short in the Class C stage. Resistor *R* also serves to insure a continuous load for the modulator stage even if the rectifier filament does burn out. The wattage rating of the resistor used should be large enough to handle a considerable overload. If you don't have at least 180 ma. available, the gadget won't work, because you won't be able to heat the filament.

A small positive bias is placed on the neon tube from almost any source that is available. The value of resistors R_2 and R_4, and of potentiometer R_3, should be adjusted so that about 60 volts positive appears at the point indicated in the diagram. The potentiometer may then be used to set the flashing level to any desired percentage of modulation using an oscilloscope or other modulation indicator. Since the current drain on the bias source is low, even batteries may be used.

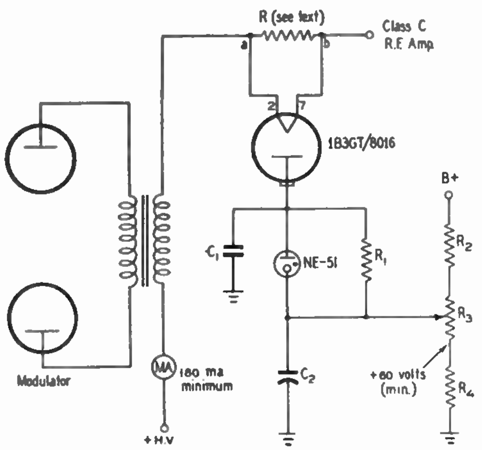


Fig. 4-13 — A simple neon-flasher modulation indicator. The circuit may be adjusted by R_3 to flash at any desired level of modulation.
C_1 — 100-μμfd. mica.
C_2 — 0.01-μfd. paper.
R_1 — 0.22 megohm, ½ watt.
R_2, R_3, R_4 — Bleeder for positive biasing NE-51. See text.

In operation, once the desired flashing level has been set by R_3, the neon tube will flash every time you exceed that level. To be on the safe side, it should be set to flash before the 100 per cent level is reached.

— *R. Page Burr, W2KQP*

[Editor's Note: A more elaborate overmodulation indicator is described in Chapter Eight.]

PROTECTIVE SYSTEM FOR 807 MODULATORS

The system shown in Fig. 4-14 was worked out to give double protection to a pair of 807s used as modulators. The circuit prevents screen voltage from being applied unless plate voltage is also on, and prevents the tubes from delivering output until the output transformer is loaded.

A high-resistance relay, Ry_1, is connected so that it is actuated by the 807 plate voltage. Thus,

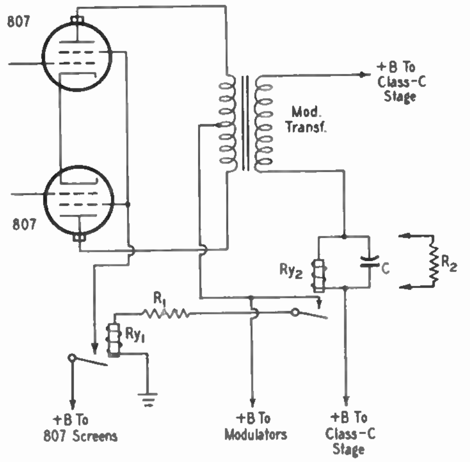


Fig. 4-14 — Protective system for 807 modulators. Two relays are used to prevent application of screen voltage before plate voltage and to kill the entire modulator if the output transformer is unloaded.
C — 8-μfd. 150-volt electrolytic.
R_1 — 0.47 megohm, 1 watt.
R_2 — See text.
Ry_1 — High-resistance relay (10,000-ohm coil).
Ry_2 — Low-resistance relay (12- or 24-volt coil).

screen voltage cannot be applied until Ry_1 closes after plate voltage is applied. The second relay is of the low-resistance type (12 or 24 volts), and is actuated by the d.c. flowing through the secondary of the modulation transformer. Thus if for some reason the plate supply to the Class C stage fails, it becomes impossible to apply power to the modulator, thus saving the modulation transformer which might break down if operated with an unloaded secondary.

If the voltage drop across Ry_2 is too great, it can be shunted as shown in the diagram. Several values should be tried until the one that produces the lowest drop while still permitting the relay to close is found.

— *Howard K. Van Jepmond, W9TJC*

A SIMPLE VOLUME COMPRESSOR

Nowadays it is becoming standard practice to include a compressor circuit in the speech amplifier of a rig. If you haven't already done so, a few hours of work and an investment of less than five dollars will give you the indisputable advantages of volume compression.

The circuit shown in Fig. 4-15 uses a triode-connected 6AB7 as the compressor tube. This 6AB7 should be located somewhere along the line in your speech amplifier, preferably ahead of the driver or the amplifier's output stage. It is shown as it would be connected in a resistance-coupled circuit, but it should be possible to substitute transformer coupling instead of R_2 and C_3, inasmuch as the 6AB7 is connected as a triode. At W3FPD, the lead marked "From output of speech amplifier" is connected to the hot side of the 500-ohm line connecting the speech amplifier to the modulator. If your arrangement is different, you can bridge a low-impedance tap of your modulation or output transformer with a plate-to-line transformer (its quality is unimportant, but the insulation must be adequate).

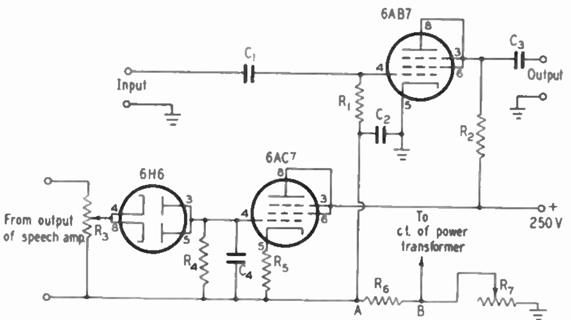


Fig. 4-15 — Wiring diagram of the simple audio volume compressor.

C_1, C_3 — 0.1-μfd. 400-volt paper.
C_2, C_4 — 0.25-μfd. 400-volt paper.
R_1, R_4 — 0.22 megohm.
R_2 — 22,000 ohms.
R_3 — 50,000-ohm potentiometer.
R_5 — 470 ohms.
R_6 — 10,000-ohm 10-watt wire-wound.
R_7 — 1000-ohm 10-watt adjustable wire-wound.

A potential of roughly 3 to 5 volts is needed at R_3 for control.

When there is no audio voltage at the output of the amplifier, the triode-connected 6AC7 bias generator has a small amount of self-bias developed across R_5. When audio voltage appears across R_3 (from the output of the speech amplifier), it is rectified by the 6H6 and applied to the grid of the 6AC7 across R_4. It appears as a negative voltage that increases with the speech-amplifier output. Hence the 6AC7 cathode current will decrease, depending upon the developed bias and the 6AC7 characteristic. Thus far we have a positive voltage with respect to ground appearing at point A, and this voltage will decrease as the output of the speech amplifier increases. But there is a (practically) constant negative voltage to ground at B developed by the steady bleed current through R_7. This voltage should always be higher than the voltage developed across R_6 by the 6AC7 current. A strong audio voltage appearing across R_3 will reduce the 6AC7 cathode current and hence the net voltage at A becomes more negative. This negative voltage, applied to the 6AB7 grid through resistor R_1, decreases the gain through the speech amplifier. The decrease in amplifier gain is proportional to the speech-amplifier output, and the desired volume-compressor action is readily accomplished.

The triode-connected 6AB7 retains the remote cut-off characteristic to a degree that is satisfactory for this application. The time delay of the circuit is determined by the combination C_4 and R_4. Capacitor C_2 should be located close to the grid of the 6AB7, to minimize coupling by the loop to extraneous noise and fields. It was also found advisable to locate the input circuit of the 6AC7 close to its source of audio drive. By observing these simple precautions, no difficulty should be experienced in adapting this device to a 'phone transmitter.

The required fixed negative bias appearing from point B to ground is obtained conveniently by inserting the variable resistor, R_7, between ground and the high-voltage center tap of the power transformer. It is assumed that the amplifier's total plate-current drain is at least 60 ma. or so. The "B"-supply voltage available to the plate circuits of the amplifier will be reduced by an amount equal to the drop across R_7. This decrease can usually be tolerated in a speech-input amplifier.

Only two simple adjustments are required. They are semipermanent and not critical to obtain. Potentiometer R_3 determines the degree of compression which the circuit will provide. A maximum power compression of at least 27 db. should be available with but a few volts of driving voltage. Thus the modulation level will be increased about 22 times.

The second adjustment should be made with no signal input into the amplifier. Simply adjust R_7 until the voltage at A with respect to ground is −3 volts. This voltage will increase to about −55 volts when the 6AC7 is driven to cut-off. Compression in the order of 27 db. will be obtained when the bias to the 6AB7 is −25 volts. If the audio power tubes of your amplifier operate Class AB instead of Class A even more compression should result.

A 50-volt d.c. voltmeter connected from point A to ground will indicate the degree of compression which the amplifier undergoes. This meter could then also serve as a modulation indicator. The slight complication of delayed a.v.c. was not considered necessary for ham use.

Practically all compressor circuits introduce some distortion, the distortion increasing with the amount of compression. Logically, for least distortion the compressor stage should be located at the front end of the speech amplifier, where the signal voltage (grid swing) is small and consequently the distortion would be minimum. However, a compromise must be made, since the tendency toward motorboating increases with the gain (number of stages) between the compressor tube and the source of the biasing voltage.

Measuring the distortion of the speech amplifier alone at 400 cycles, it was found to be 3.3 per cent at 8 watts output. With 27 db. compression the distortion was only 3.7 per cent. This small amount of distortion is negligible for all practical work, and the 27 db. of compression is a range wide enough to take care of almost any condition.

— *Jules Deitz, W3FPD*

5. Hints and Kinks . . .

for the Power Supply

OBTAINING HIGHER VOLTAGE FROM DUAL-VOLTAGE TRANSFORMERS

MANY transformers have a tapped secondary to permit the simultaneous delivery of a high and a low voltage from the same unit. A circuit that permits the output voltage to equal the *sum* of the original intended d.c. voltages and has the advantage over a bridge circuit of permitting the full current rating of the high-voltage portion to be used is shown in Fig. 5-1.

With this circuit, it is possible to obtain both plate and screen voltages for a transmitting pentode or tetrode from a single supply without the use of dropping resistors, because it also furnishes power from the original low-voltage taps. The current rating of the low-voltage winding is *decreased* by the amount of current drawn from the high-voltage taps. Thus, if the simultaneous secondary rating is 300 ma., and 250 ma. is being taken from the high-voltage tap, 50 ma. is available from the low-voltage tap. The main consideration is that at no time should the primary current rating of the transformer as a whole be exceeded.

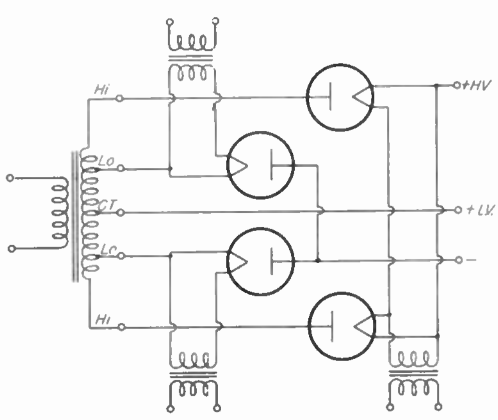


Fig. 5-1 — Novel rectifier circuit used to boost the voltage normally available from dual-tap power transformers and permitting both high and low voltages to be obtained simultaneously.

The use of three separate well-insulated filament windings is a must if fireworks are to be avoided!

— *Albert R. Orsinger, W6HUJ*

A FULL-WAVE TRANSFORMERLESS LOW-VOLTAGE SUPPLY

THE 117Z6GT, a full-wave rectifier, may be used without a transformer in a low-voltage power supply, as shown in Fig. 5-2. The output of

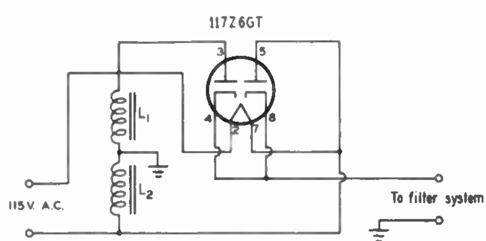


Fig. 5-2 — Low-voltage power supply requiring no transformer. L_1 and L_2 should be 10 to 20 henrys.

this arrangement has a 120-cycle ripple, thus reducing the amount of filter required. The chokes L_1 and L_2 are connected across the 115-volt line and must also carry the output current. A value of from 10 to 20 henrys is suggested for these chokes.

— *W. M. Nunn, jr.*

UTILITY POWER SUPPLY

IN these days of surplus gear, miniature low-voltage tubes, d.c. relays, and gadgets requiring all sorts of odd values of plate voltage, a utility power pack for the experimenter really has to be versatile. The unit shown in Fig. 5-3 has filled the bill nicely in my shack, and I don't doubt that it will be found useful in others. It can supply a variable d.c. potential anywhere between 50 and 350 volts, 6.3 volts a.c. and 12 volts a.c.

The potentiometer, R_1, is used to set the d.c. output to whatever value is required between the limits stated above. The primary of an old 6-volt vibrator transformer is used as an autotransformer working off the 6.3-volt winding of the regular replacement-type transformer to obtain the 12 volts a.c. required for the filaments of so many of the surplus gadgets. A separate 6.3-volt transformer is included to supply the filaments of the 6V6 and any other gadgets requiring it.

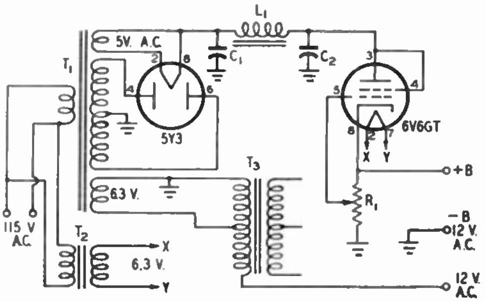


Fig. 5-3 — Circuit diagram of a handy utility power pack for the ham workbench.

C_1, C_2 — 10-μfd. 450-volt electrolytic.

R_1 — 0.25-megohm potentiometer.

L_1 — 100-ma. filter choke.

T_1 — 350-0-350-volt replacement-type power transformer with 6.3- and 5-volt a.c. windings.

T_2 — 6.3-volt filament transformer.

T_3 — Vibrator power transformer (secondary leads taped, half of primary used as shown).

The whole thing can be constructed from junk-box parts, thus keeping cost low, and it can be kept on the work bench where it will be ready to give almost any gadget you can think of a workout.

— *Ralph C. Renfro, W0KUZ*

POWER SUPPLY FOR 24-VOLT SURPLUS GEAR

Much of the gear that has been offered on the surplus market was originally designed for operation from a 24-volt source. This has proved to be a headache in many respects, because hams in general have set up their stations for operation from 115 volts a.c., using 6.3-volt tubes almost exclusively. Shown in Fig. 5-4 is a small power supply that will do a very satisfactory job in furnishing plate and heater power to many of the small receivers such as the ARC-5 (SCR 274N) series, in which 12-volt tubes are used with a 24-volt supply.

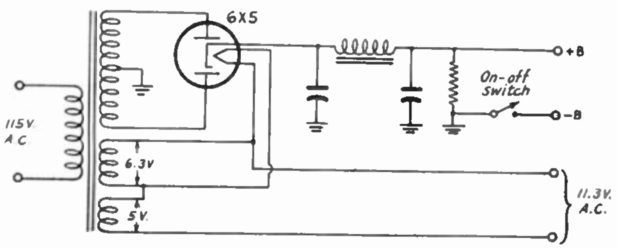


Fig. 5-4 — A simple power supply designed to be used with receivers requiring 12-volt heater supply. The filter components are standard, the only unusual feature being the use of a cathode-type rectifier to permit series connection of the two filament windings.

A standard replacement-type transformer is used with a cathode-type rectifier to permit series connection of the 5-volt rectifier filament winding and the normal 6.3-volt winding. When the plate voltage required is low, of the order of 200 or 300 volts, the hook-up shown in the diagram will be usable. It is not safe for higher voltages, however, because the cathode-to-heater potential-difference rating of the 6X5 is only 400 volts. If an on-off switch is used, it should be installed in the negative lead to the receiver rather than in the high-voltage center tap to avoid the possibility of break-down from cathode to heater in the 6X5 rectifier.

The series-connected filament windings add to 11.3 volts (when the windings are properly phased), and it is usually a simple matter to rearrange the heater wiring within the receivers to operate from the lower voltage. If rewiring is impossible, or undesirable, the 6-volt equivalent of the 12-volt tubes supplied with the receivers may be used.

— *J. Richard Kearns*

HIGH-VOLTAGE WARNING BLINKER

In line with the slogan "Switch to Safety," some form of warning indicator light for the high-voltage supply was needed on the transmitter at W6GM. While indicator lights are useful, one is apt to become accustomed to a steady pilot lamp and make the wrong move

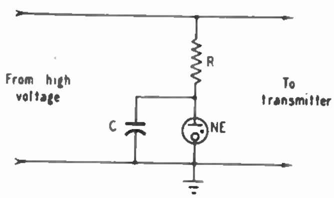


Fig. 5-5 — A neon blinker for addition to the transmitter as a high-voltage warning. The rate at which the neon tube blinks may be set by the value of the resistor used.

C — 0.5-μfd. 400-volt paper.

R — 30 megohms (three 10-megohm ½-watt units in series).

NE — ¼-watt neon lamp (G.E. NE-45).

anyway. A blinker lamp does a much more effective job of keeping one's subconscious informed that the high voltage is on.

A very simple neon blinker can be made as shown in Fig. 5-5. The value of resistance shown is about right for a 1200-volt supply, and produces a blinking rate of about one per second. This resistance must be adjusted according to the voltage of the power supply and the desired rate. If the neon light glows steadily, the resistance is too low. A clear-glass jewel should be used instead of a colored one to permit maximum effectiveness of the neon glow.

— *George W. Ewing, W6GM*

GETTING THE MOST OUT OF YOUR MOBILE POWER SUPPLY

Fig. 5-6 shows a method of getting the most out of a mobile power supply with the least battery drain. A 250-volt vibrator supply is used to power the oscillator and the speech amplifier, and a 500-volt dynamotor (not shown in the drawing) supplies the r.f. amplifier and the modulator.

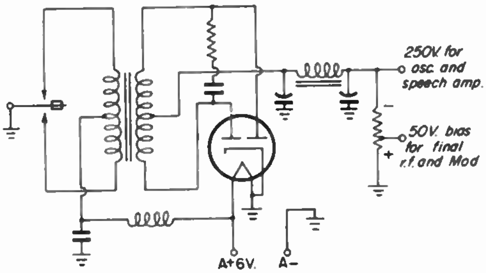


Fig. 5-6 — **Method of wiring the vibrator power supply to obtain both plate and bias voltages with maximum economy of power.**

The novelty of the circuit is that the *positive* terminal of the vibrator *output* is grounded instead of the negative. In this way, the low-voltage supply may be used as a source of bias voltage as well as a supply for the oscillator and speech amplifier.

The advantages of the system are numerous. The bias voltage does not subtract from the supply voltage, as it would in cases where the bias is obtained from a tapped grounded bleeder. The oscillator plate condenser may be grounded without requiring parallel feed, since the positive is grounded. Fixed bias may be used, without requiring batteries, eliminating the need for cathode bias. This results in a saving in the power usually lost in the cathode resistor, and permits the final amplifier to operate at the full supply voltage.

— *Zoltan T. Bogar, W3CJM*

TWO-WIRE CONNECTION FOR BIAS PACK

Two wires can be connected to the power plug of the transformerless bias pack shown in the ARRL *Handbook* without fear of a short-circuit if a s.p.d.t. switch and 115-volt lamp are connected in the circuit as shown in Fig. 5-7.

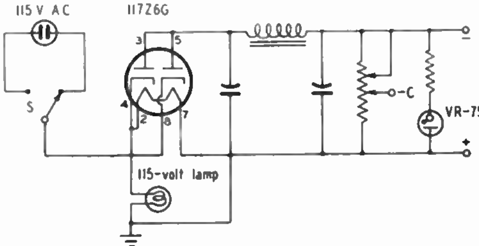


Fig. 5-7 — **By the addition of a switch and an ordinary lamp bulb, the possibility of short-circuiting the 115-volt line in the *Handbook* transformerless bias supply is eliminated.**

The switch should be thrown to the lamp position for "on" operation and the lamp will light unless the plug is incorrectly placed in the socket.

— *Walter Zuckerman, W2LBF*

FILAMENT TRANSFORMERS AS PLATE TRANSFORMERS IN BIAS SUPPLIES

It was desired to provide fixed bias on the 35T used in the final in the rig at W3FDJ, so that the plate current could be cut off during periods of no excitation while in c.w. operation. The transformerless bias supply in the *Handbook* looked good at first, but since the rig here connects to the a.c. line with the garden variety of plug, we were afraid of blowing the fuses too often because of getting the plug in the socket the wrong way, since one side of the a.c. goes directly to ground with this type supply.

To avoid this we looked for a transformer having a secondary of about 100 volts, but being unable to find one, the thought came to use a filament transformer *backward;* that is, to connect its low-voltage winding as a primary across an existing filament voltage to the 35T, and to use the normal primary for plate supply to a half-wave rectifier.

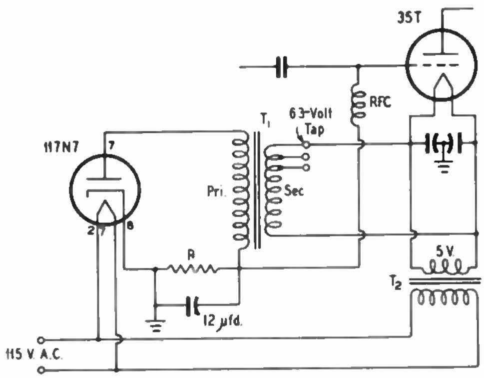


Fig. 5-8 — **A filament transformer is connected to supply grid-bias voltage through half-wave rectification. T_1 is a filament transformer with multiple taps on the secondary. T_2 is the 5-volt filament-heating transformer for the 35T. *R*, the 35T grid resistor, and a 12-μfd. condenser supply the filter action for the grid bias.**

Worked into the circuit shown in Fig. 5-8, T_1, a Thordarson T61F85 (which has a secondary tapped for 2.5, 5, and 6.3 volts at 2.5 amp.) has the secondary connected across the 5-volt supply of the 35T filament. The 6.3-volt tap is used to produce a secondary voltage of 5/6.3 times 115, or 91 volts; after half-wave rectification, this giving an output voltage across the grid resistor of about 50 to 60 volts. This was sufficient to reduce the plate current of the 35T (at 1300 volts) to about 5 or 10 ma. The rectifier section of a 117N7 was used in the bias supply, that type being on hand (we're still trying to figure out a use for the amplifier section). A 12-μfd. condenser seems to provide enough filtering. All parts are mounted on the r.f. chassis and bias voltage is available as soon as filament voltage is applied.

Using different combinations of filament voltages and windings of transformers, various output voltages in the neighborhood of 50 to 150 volts may be obtained. Naturally, the transformer supplying the source voltage must have a rating slightly in excess of the filament current taken by the r.f. tubes.

— *William Hoos, W8FDJ*

A "SELF-POWERED" BIAS SUPPLY

SHOWN in Fig. 5-9 is a novel circuit that has been used successfully for quite some time. It eliminates the need for a fixed bias supply, yet provides fixed bias!

The VR tube is initially lighted by the grid driving voltage, and a charge is thus placed on the condenser. When excitation is removed, as when the key is up, the VR tube goes out, and the charge that remains in the condenser keeps the amplifier tube cut off.

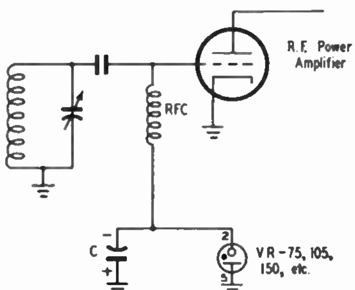


Fig. 5-9 — **A "self-powered" fixed-bias circuit that requires neither batteries nor power supplies. The charge on a large condenser is used as a holding bias to do the job. *C* is a 20-μfd. electrolytic condenser of suitable voltage rating.**

The leakage resistance of most electrolytic condensers is high enough so that the charge will not leak off for a matter of a couple of hours, so that the next time the rig is used, drive should be applied (to charge the condenser) before power is applied to the final amplifier. This is the normal procedure in tuning a transmitter anyway, so using this system should cause no inconvenience.

— *Herb Shear, W6WVQ*

A SIMPLE BIAS ISOLATOR

A COMMON trouble encountered when using bias supplies is the rise in voltage as the rectified grid current flows to ground through the bias-supply bleeder. The circuit shown in Fig. 5-10 in effect disconnects the bias supply when bias due to rectified grid current reaches a value equal to or higher than that supplied by the bias rectifier.

When excitation is applied additional voltage is developed across the grid leak, R_1. When this voltage reaches or exceeds that of the bias supply the rectifier stops conducting, no current flows in the circuit *CB*, and bias to the r.f. stage is supplied solely from the voltage developed by the flow of rectified grid current through R_1.

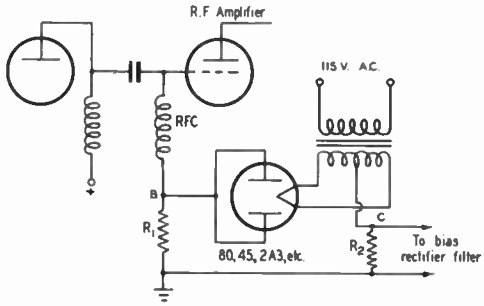


Fig. 5-10 — **Easy-to-install bias isolating circuit.**

The rectifier may be any nongaseous tube having low *Rp*. An 80 is ideal, but 45s, 2A3s, etc. may be used with grid and plate connected together. Pentodes and tetrodes may be used by tying all grids to the plate.

A single-ended r.f. amplifier stage is shown, but the system works equally well with push-pull. Additional stages may be supplied by connecting the bias-isolator cathodes to point *C*.

— *Wesley M. Bell, W9FEG*

SELENIUM RECTIFIERS AS A BIAS SOURCE

WITH several manufacturers including midget selenium rectifiers in their postwar lines, the amateur now has a means of obtaining protective bias for his rig without having to build separate bulky supplies. The compactness of these new units makes it entirely practical for one to be used at the base of the tube requiring the bias. The 813 amplifier in use at this station has a grid circuit as shown in Fig. 5-11. A small selenium rectifier is used in a half-wave circuit, filtered by C_1, C_2 and *L*. Values are dependent, of course, on the particular application, but for the 813 the values shown below the diagram have worked out very nicely. About 80 volts of fixed bias is always present at the grid of the tube, and the additional few volts required for operating bias are obtained by the series grid leak, R_1. In my case, bias increases to about 130 volts when ex-

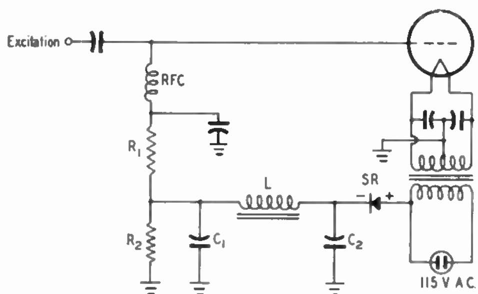


Fig. 5-11 — **Bias system for an 813 amplifier using one of the new midget selenium rectifiers.**
C_1 — Dual 8-μfd. electrolytic.
C_2 — Section of C_1.
R_1 — 2500 ohms, 2 watts.
R_2 — 5000 ohms, 10 watts.
L — 30-hy. 30-ma. filter choke.
SR — Federal Tel. & Radio Type 403D2625.

citation is present, varying, of course, with the amount of grid current flowing at the time.

Since only one side of the a.c. line is tapped, a good earth ground to the transmitter chassis is a requirement, and the power plug should be polarized to assure that the bias lead will always be the hot lead.

— *R. D. Althaus, W3KGD*

SELENIUM RECTIFIER HINTS

The following will be helpful in prolonging the life of the new midget selenium rectifiers:

The rectifiers should be mounted with their "fins" vertical to prevent heat from the lower sections causing destruction of the upper section.

The use of a current-limiting resistor of 50 ohms or so immediately after the rectifier will limit the initial surge into the large input filter capacitor usually used with such gadgets.

— *Laurence Geis, WØOKF*

RELAY-COIL TRANSIENT REDUCTION

After I installed a Model 750 Advance overload relay in series with a ground return from my final amplifier, I found that when I adjusted it to kick out at 320 ma., under steady-state conditions, it would not handle the transients attributable to normal turning on and off of the plate power supply. If I adjusted the threshold so that it would withstand the transient voltages, then it would not kick out, except under extreme conditions of steady overload. Since the d.c. resistance of the relay coil was only 6 ohms, I was afraid that I might have trouble slowing down the transient, especially since I did not know what the waveform of the transient looked like. To be on the safe side, I shunted the field coil with a 3000-μfd. 10-volt Mallory condenser, and found that the transient was completely tamed. It is quite possible that a lower value of capacitance would do the same trick.

— *D. W. Atchley, jr., W1HKK*

COMBINATION BIAS SUPPLY AND STATION CONTROL SYSTEM

The circuit shown in Fig. 5-12 makes use of several 24-volt d.c.-operated relays and a transformerless bias supply in an arrangement suitable for use with a low-power transmitter that uses 6L6s or 807s in the final amplifier. The relays are currently available at small cost in the surplus market.

As shown in the diagram, the coils of the relays are connected in series, and are used as a tapped bleeder across the bias supply. A 2500-ohm resistor is used to reduce the current through the coils to a point below that required for them to throw. A toggle switch shorts this resistance, causing the relays to throw to turn the transmitter on. The voltage drop across each relay coil may be used as a source of bias voltage in cases where the grid-current requirements of the transmitter are low. The voltages indicated in the diagram are typical of those obtained. When the switch is thrown to the receive position, the bias voltage increases above these figures, because the drain on the rectifier is then reduced.

Since the relay coils are connected in series, damage to the transmitter in case of bias failure is prevented, as the relays will not close. Similarly, if the coil of one relay opens, power cannot be applied to one part of the transmitter while it is not applied to another.

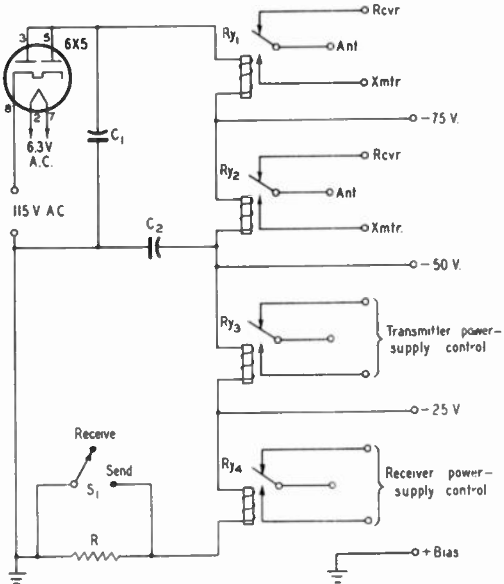


Fig. 5-12 — A novel method of using surplus low-voltage relays in a bias and station control circuit for the low-power rig.
C_1, C_2 — 20-μfd 150-volt electrolytic.
R — 2500 ohms, 10 watts.
Ry_1, Ry_2, Ry_3, Ry_4 — See text.
S_1 — S.p.s.t. toggle switch.

With the transformerless supply shown, a polarized a.c. plug must be used. There is no reason why the series-connected relay idea cannot be used with the standard transformer-type supply, however.

— *Rod Grant*

A SIMPLE TIME-DELAY CIRCUIT

The time-delay arrangement shown in Fig. 5-13 depends for its operation on the time required for a heater-type rectifier tube to reach

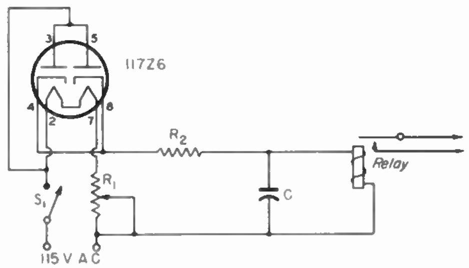


Fig. 5-13 — A simple variable time-delay system.

operating temperature. A 117Z6 is shown, but a 50L6, with grids and plate tied together, also worked satisfactorily.

A 400-ohm 10-watt potentiometer, R_1, is connected in series with the rectifier heater, to control the time delay, which is variable between 15 seconds and about one minute. R_2 is used to limit the current through the relay to the rated value. I found that 10,000 ohms was right for the relay I had on hand, as it allowed 8 ma. to flow through the relay at full operating temperature. The relay closed at 6 ma. The relay should have a d.c. resistance of from 1000 to 2000 ohms. The condenser is a 30-μfd. filter, used to prevent relay chatter.

— *James D. Matthews*

After trying the above-mentioned kink, H. H. Cross, W1OOP, writes: "I found that substituting a 5Z4 for a 5U4G in the bias supply of my transmitter (using bias interlock) gave me 30 seconds' protective delay in case the regular time-delay relay failed.

"The up-to-temperature time of heater-type rectifiers is increased by poor regulation of the heater supply but the tubes furnish the same emission when hot. Heaters have low resistance when cold and heat more slowly in a constant-current circuit.

"A 25Z5, with its heater in series with a 350-ohm resistor, will take 40 seconds to reach 90 per cent emission. I use an 8-μfd. condenser input and run 60 ma. through the relay. It'll work every time and the tube will last much longer than a 117-volt type."

AN UNUSUAL RECTIFIER CIRCUIT

The rectifier circuit to be described was originated at W1NVH and used successfully for nearly two years prior to the war. Other amateurs who have seen and used it have been so enthusiastic that it is presented here for general circulation.

The most interesting of the new circuit's many advantages and possibilities is that it offers the amateur a chance to obtain a selection of more-desirable voltages with the power-supply equipment already at hand. No longer need he be stuck with, for example, 1750 volts, when a full 2000 volts is desired. In such a case it is only necessary to add a relatively inexpensive transformer to make up the voltage deficit. The same circuit also provides for easy selection of several reduced voltages by steps, for use while tuning the transmitter and communicating over short distances.

The complete circuit is a combination of the conventional full-wave center-tap rectifier circuit and another one which at first appears unorthodox. It is shown later in Fig. 5-16, being first developed by stages for easier understanding.

In order to establish symbols and to facilitate explanation, the part of the circuit which is the conventional rectifier circuit is reproduced here in Fig. 5-14. A technical description of its operation can be found in *The Radio Amateur's Handbook* as well as numerous other radio texts.

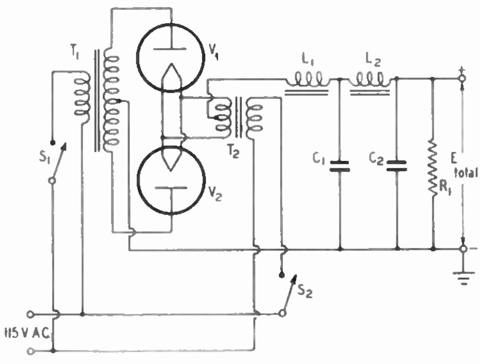


Fig. 5-14 — The conventional center-tap rectifier circuit, with choke-input two-section filter and bleeder.

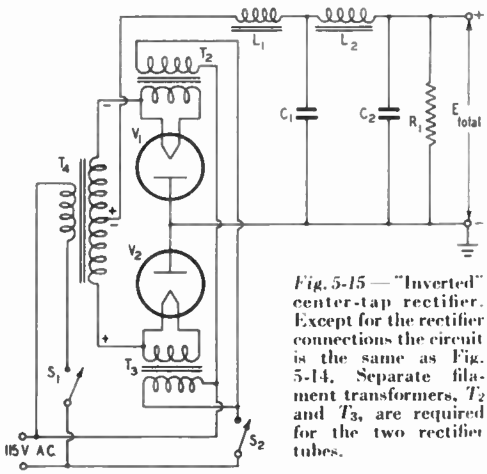


Fig. 5-15 — "Inverted" center-tap rectifier. Except for the rectifier connections the circuit is the same as Fig. 5-14. Separate filament transformers, T_2 and T_3, are required for the two rectifier tubes.

The part of the circuit which appears to be unorthodox is shown in Fig. 5-15. Don't worry, it works! In fact, it is frequently used in synchronous-vibrator power supplies, although infrequently employed with tube rectifiers. The symbols are the same as in Fig. 5-14 except that the high-voltage transformer is marked T_4. T_2 and T_3 must be *separate* filament windings because the entire secondary voltage of T_4 is between them.

It can be seen upon examination that this circuit is simply an inversion of the more conventional one of Fig. 5-14. It can be used alone and possesses a number of advantages over the standard one, such as:

a) It reduces hazards because the plate caps on such rectifier tubes as 866s and 872s can be at or near ground potential. The number of exposed high-tension leads is minimized.

b) Ripple voltage in the output has always been found to be less. If T_2 and T_3 are not center-tapped, experimentally connect the secondary of T_4 to either side of these individual windings

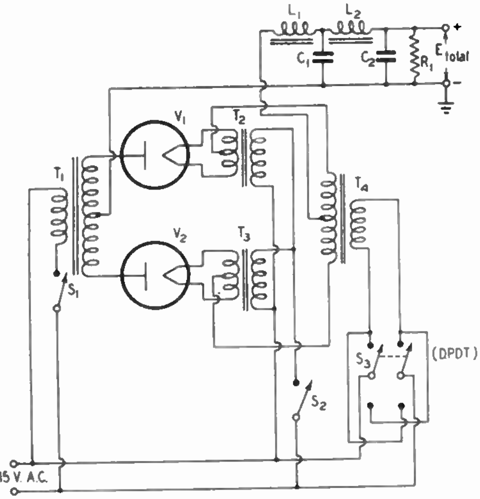


Fig. 5-16 — The new circuit combines Figs. 5-14 and 5-15 to make four different output voltages available, depending upon whether each transformer is used alone or whether the two are used together aiding or opposing. The d.p.d.t. switch, S_3, reverses the line connections to the primary of one transformer to reverse its secondary phase with respect to the other. Filter constants are the same as for conventional power supplies of the same voltage and current ratings.

for least ripple voltage. However, the difference in ripple is not important in ordinary use.

c) There is less trouble from r.f. getting into the power supply. This is because the high-potential leads of transformer T_4 are by-passed to ground for r.f. by the secondary-to-primary capacitance of the windings of T_2 and T_3. Also, the plates of V_1 and V_2 are at or near ground potential.

d) It permits cheaper grounded-anode cooling methods for heavy-duty rectifiers.

A brief technical analysis of the circuit is made easy simply by following the paths of the electrons through the various elements. Referring to Fig. 5-15, note the positive and negative signs shown at the terminals of the secondary of T_4. These are given for a particular instant (or half cycle) when the upper half of T_4 is operating so as to impress a negative potential upon the cathode of V_1. You must then agree that the center tap of this winding is positive at this same instant. Since electrons can flow through V_1 only in one direction — that is, from filament to the plate — the supply of electrons from the negative potential readily flows across the tube to the plate, which is positive because it is connected to the positive end of the half-winding (center tap) via the load resistor, R_1. It should also be observed that the lower half of the secondary of T_4 cannot function at this time because the plate of V_2 is negative with respect to its cathode through the load.

The final circuit is developed by combining Figs. 5-14 and 5-15 as shown in Fig. 5-16. For all practical purposes we have merely added another plate transformer, T_4, to the old rectifier (not counting extra filament windings). Because the lower-voltage transformer usually has poorer insulation, it is advantageous to place it in the T_1 position where it can be kept close to ground potential.

The following statements hold true:

a) The total output voltage is the sum of the voltages separately obtainable from T_1 and T_4 if these transformers are connected in phase to the power line. This can be experimentally determined by transposing the primary leads to the power line to obtain the greater output voltage.

b) The total output voltage is the difference between the voltages separately obtainable from T_1 and T_4 if the transformers are connected out of phase to the power line.

c) When the system is operating as in (b) there is no undue loss of efficiency because only the resultant voltage and not each of the canceling voltages is rectified.

d) The polarity of the d.c. voltage delivered to the load R_1 will always be the same regardless of the transformer switch connections. In other words, the positive output lead will never shift position.

e) The total output voltage is only the voltage obtainable from T_1 alone if the primary of T_4 is opened.

f) The total output voltage is only the voltage obtainable from T_4 alone if the primary of T_1 is opened.

g) The secondary of the "dead" transformer in (e) and (f) acts as an additional smoothing choke and as part of the filter circuit.

The switches shown in Fig. 5-16 provide the four different output voltages mentioned in (a), (b), (d), and (e) above. It goes without saying that all components must be designed for the power and insulation requirements of the circuit involved.

— *Comdr. E. E. Comstock, USCG*

"FREE" BLEEDER FOR C.W. TRANSMITTER POWER SUPPLIES

If your r.f. amplifier stage is properly neutralized, you can allow it to draw plate current under key-up conditions and save in three ways:

1) Greatly reduce the size and cost of the bleeder resistor.

2) Reduce the key-down drain on the power supply, thereby allowing transformers and chokes of lower current rating to be used. (Or get more useful current out of your present supply.)

3) Reduce the power bill through greater power-supply efficiency.

For good regulation, the bleeder resistor at the output of a choke-input filter is generally accepted to be about 1000 times the value of the inductance of the first choke.[1]

$$R = 1000L$$

Now suppose you have a 2000-volt power supply

[1] Dellenbaugh and Quimby, "The Important First Choke in High-Voltage Rectifier Circuits," *QST*, February, 1932.

with a 20-henry input choke. The bleeder resistor is 1000 × 20 or 20,000 ohms. The bleeder current is E/R or 100 ma., and the bleeder power is I^2R, or about *200 watts!* Two things are at once apparent:

1) A resistor of such high power rating is quite expensive.

2) The power supply is delivering 200 watts more than is necessary when the key is down, and this power serves no useful purpose other than to heat the shack.

If, for example, we connect this supply to a pair of RK-48s or 813s in push-pull, we know that with the key up, the supply delivers 100 ma. to the bleeder. With the key down the tubes draw 360 ma. The total load on the supply is 460 ma. with about 22 per cent of it wasted in the bleeder.

Now if we eliminate the bleeder (and connect a few-hundred-thousand ohms resistance in its place for safety), and adjust the bias on the amplifier tubes so they draw 100 ma. with the key up,[2] the following conditions will prevail:

With the key up:

1) The tubes act as the bleeder.

2) Rated plate dissipation is not exceeded, and tube life is not shortened.

3) The only bleeder required is a low-wattage fairly-high-resistance unit to discharge the capacitors when the power is off.

With the key down:

1) The power supply delivers 360 ma. to the tubes, and a negligible amount to the "safety" resistor.

2) Substantially all current delivered by the supply is used by the tubes for generating r.f. power.

3) The lights will blink less when the key is closed, because the *change* in current is now only 260 ma. (instead of 360 ma. as before).

Following the idea outlined here, the bleeder resistor current can be reduced or substantially eliminated under key-down conditions. The wattage rating of the resistor will be greatly reduced in any power supply feeding any r.f. amplifier. Be sure to remember these precautions:

1) Do not exceed the rated plate dissipation of the tube. (Plate dissipation with the tube acting as the bleeder is the power-supply voltage times the key-up plate current.)

2) Always have a few-hundred-thousand ohms connected across the filter, to discharge the condensers when the power is turned off.

3) Always make sure the condensers have discharged before you change coils or tubes.[3]

— *George L. Downs, W1CT*

[2] They won't oscillate if properly neutralized. For a note on these particular tubes, see page 17, May, 1947, *QST*.—Ed.

[3] In this connection, a voltmeter makes a good low-current bleeder while providing an indication of the charge left in the condensers.—Ed.

SURE-FIRE SAFETY PRECAUTION

For the expenditure of a couple of dollars for a relay and a switch, and a few hours labor, the safety system described below was installed.

A double-pole double-throw relay is used in the circuit shown in Fig. 5-17. The relay is one commonly used for antenna switching, with ceramic insulation and sufficient spacing between contacts to withstand the full plate-supply voltage. One set of relay contacts immediately grounds the B+ voltage when the transmitter switch is turned off, and the other set energizes a green panel light, signifying that it is safe to touch the final tank coil. This safety signal will not operate until the B+ is actually grounded: thus if the relay fails to operate, the green light will not come on, and the operator knows that danger is present. The red panel light is turned on whenever the transmitter switch is turned on.

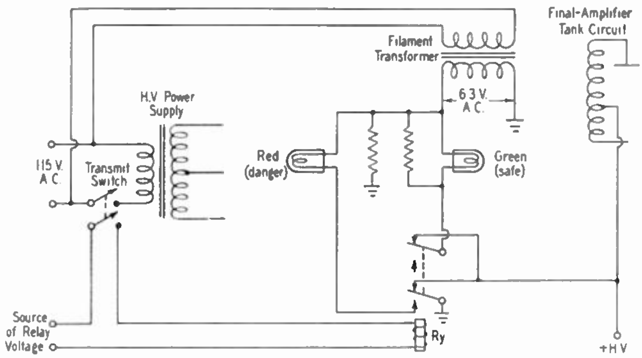


Fig. 5-17 — **Safety circuit used to ground the plate supply when the "send" switch is turned off. The relay used is described in the text.**

Because relays sometimes do not throw as they should, it is possible that the path to ground from B+ may (instantaneously) be through the pilot light and the filament winding. For this reason, a filament winding separate from any tube circuit is advised. Good insulation should be used on the lead from the relay to the green lamp to eliminate the possibility of a short to ground, which would cause the green signal to light. The key to the system: If the red light is on, stay away! If the green light is on, it is safe to touch the final tank coil. If neither light is on, or if both lights are on, something is haywire, and it will pay to ground the tank before touching it.

— *Charles F. Lober, W8ICO*

TIE-STRAPS FOR FILTER CONDENSERS

Here's an easy way to mount those surplus filter condensers which invariably come through without brackets. Take a pair of old bicycle spokes and, measuring from the threaded end, cut them slightly longer than the height of the condenser. Bend the unthreaded end of each into a hook to fit snugly on the shoulder of the can. All that remains is to feed the threaded ends through the chassis, affix the spoke nuts, and tighten.

— *Lyman H. Howe, W2TJH*

6. Hints and Kinks . . .

for the Antenna System

JUNK-YARD BEAM ROTATOR

A very satisfactory beam-rotating mechanism can be made from an old screw jack by the method shown in Fig. 6-1. The jack can be obtained for next to nothing in almost any junk yard or auto-wrecking lot

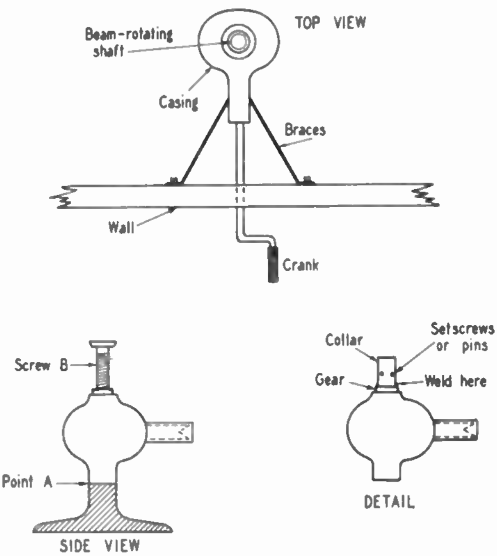


Fig. 6-1 — **Here's the novel beam-rotating gadget used at W1OPW. Made entirely of junk parts, it can be assembled and installed in a few hours.**

Have a welder cut the casing at point *A*, and discard the portion that is shaded in the side view. Then have him cut screw *B* so that it can be threaded out through the bottom of the casing. This leaves the gear structure intact. One gear protrudes through the top of the casing and rotates 360 degrees in the horizontal plane when the crank handle is turned. Have a collar made from a piece of pipe welded on this gear as shown. It will then serve as a socket for the base of the shaft that rotates the beam. The shaft should be pinned inside of the collar to prevent slippage.

Braces to provide mounting supports are then welded to the outside of the gear casing as shown in the top view. The crank handle may be run through the wall to the inside of the shack where a direction indicator may be attached if desired.

This mechanism has been in use for several months and has provided trouble-free operation, even when it was covered with a thick coating of ice and snow. In addition to the low cost and simplicity of construction, it is superior to many motor-driven systems because it permits the speed of rotation of the beam to be changed to suit the operator's convenience. All he has to do to get the beam around in a hurry is crank a little faster!

— *George Rossetti, W1OPW*

CLEARING JAMMED PULLEYS

One of my antenna pulleys had gotten gummed up or rusty and was becoming hard to operate. The pulley was at the top of a 42-foot mast that could not be lowered or climbed. Here's a hint to others faced with the same unhappy problem.

I folded a piece of waxed paper diagonally a couple of times, forming a triangular sack. I then poured several ounces of heavy motor oil in the sack, gathered the top together with string, and lashed the whole sack to a point on the antenna halyard that I knew I could pull through the pulley. The halyard was then pulled until the sack was four or five inches from the pulley, as

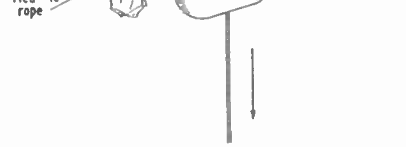


Fig. 6-2 — **A clever method of oiling a pulley at the top of an antenna mast. A breakable sack is made of wax paper and is then filled with oil. It is smashed against the pulley block with a quick yank, drenching the block with the oil.**

shown in Fig. 6-2. A quick yank on the halyard then smashed the paper sack, causing the oil to drench the pulley block thoroughly, giving it the bath that it needed to clear up the trouble.

— *Robert E. Barr, W5GHF*

WEATHERPROOFING TWIN-LEAD

Shown in Fig. 6-3 is the scheme used by W5CXS, W6PNO and XE1KE to avoid the detuning effects often encountered in wet weather with Twin-Lead feed lines. Slots are cut in the dielectric between wires, leaving just enough to serve as normal feeder spreaders and to provide enough mechanical strength to hold the spacing rigid. W5CXS suggests that the slots be cut about 1½ inches long.

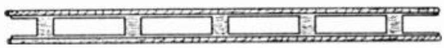


Fig. 6-3 — Method of "weatherproofing" feed lines made of Twin-Lead. Some of the dielectric is removed, leaving only enough to maintain line spacing.

A REVERSIBLE FIXED BEAM FOR TEN

For some time the writer used a horizontal folded dipole in the 28-Mc. band, and while signals were received with good intensity, objectionable interference was also received from the direction opposite to that of the desired signal. Because of the difficulty of erecting rotating mechanisms, a rotary beam was out of the question. In the mornings we wanted contacts ranging from the north of Scotland through the Mediterranean to South Africa, and in the evenings with stations in the Pacific, Australia and New Zealand. Obviously, it was undesirable to construct a sharp fixed beam that would lay a satisfactory signal into England but would not be very effective to South Africa. Also, in this particular residential district elaborate aerial structures are not entirely appreciated.

After a number of sheets of scratch paper had been filled and thrown in the wastebasket, there finally evolved what appeared, to the writer, to be a simple answer to his problem. The existing folded dipole, which was 30 feet above ground and constructed of heavy antenna wire with a spacing between the upper and lower conductors of six inches, was allowed to remain as originally constructed. An additional folded dipole, identical with the first, was constructed and the two dipoles were held 8 feet and 1 inch apart by spreaders about 8 feet 4 inches long. In other words, the two folded dipoles were placed in the same horizontal plane, parallel to each other and a quarter wavelength apart at the operating frequency. Twin-Lead 300-ohm transmission lines — *A* and *B* — *of identical length* were connected to each folded dipole. These transmission lines were made long enough to run to the operating room in the basement. Care was taken to assure that each transmission line was dropped away from its folded dipole at right angles for a distance of at least a quarter wavelength and that the two Amphenol Twin-Leads were spaced two feet throughout wherever possible. At W4SN this spacing is held except that a spacing of approximately 9 inches exists where they enter the operating room. At a convenient point in the shack the transmission lines are brought to opposite ends of a d.p.d.t. porcelain-based switch as shown in Fig. 6-4. The mechanical junction or bar between the switch arms is reinsulated with high-frequency insulating material for minimum losses. A quarter-wave phasing section of 300-ohm line is connected between the ends of the d.p.d.t. switch. Its length, *l*, equals a quarter wave at the operating frequency times the propagation factor of 0.84. From the switch arms a length of 150-ohm line is run to the antenna send-receive relay and from this point 150-ohm Twin-Lead is run, respectively, to the transmitter coupling link and to the receiver input terminals.

After construction of this antenna it was necessary to check for proper polarization. First, a signal was tuned in which appeared to be on a line perpendicular to the direction in which the folded dipoles were horizontally located. With the signal about S4 on the receiver as adjusted by the r.f. gain control, the d.p.d.t. switch was thrown from one position to the other to determine whether an appreciable difference in signal strength resulted from changing the switch position. The transmission-line connections of *one* antenna may be reversed at the d.p.d.t. switch to determine which connection produces the greatest front-to-back ratio; the connection producing the greatest figure is the correct one. If everything is connected properly and the station is in the preferred direction, a considerable increase — on the order of three or four S divisions — should be noted.

Although the folded dipoles described are heavily constructed to withstand heavy winds and considerable buffeting, there appears to be no reason why two folded dipoles constructed en-

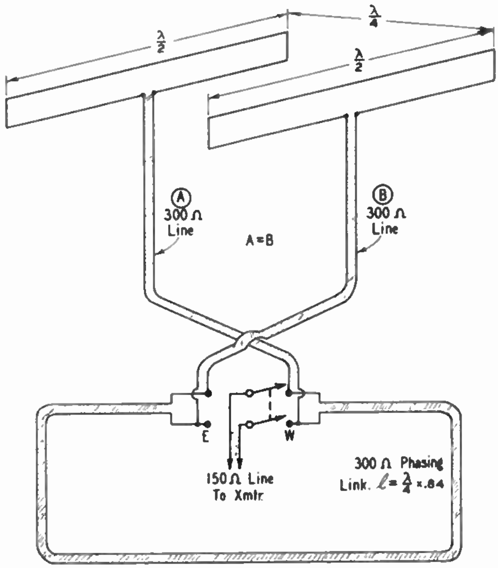


Fig. 6-4 — A reversible fixed beam for 28 Mc. Two folded dipoles are mounted a quarter wavelength apart and are fed with 300-ohm line. The directivity is made reversible by a double-pole double-throw switch as shown. Forward gain is approximately 5 db., and the front-to-back ratio is approximately 20 db.

tirely of 300-ohm line would not serve, during periods of light winds or in protected areas. Greater frequency coverage (within a given band) may result from the use of open-wire construction than with 300-ohm line, but for those who do not operate over a wide frequency range little difference should be noticed. Parenthetically, it may be stated that with the antenna arrangement in use at W4SN little change in antenna loading is observed between 28 and 29.4 Mc. Reception is quite satisfactory throughout the ten-meter band.

Phasing of two folded dipoles constructed to operate on the 20-, 40- or 80-meter bands should be satisfactory and should be productive of results. The physical requirements of support, spacing and arrangement of antennas and phasing stub will be proportionately greater than for a ten-meter antenna but, theoretically, the antenna is practical on any band.

Experience at W4SN indicates that this antenna gives a worth-while gain over an azimuthal area of approximately 75 degrees. The horizontal pattern produced by this array, simple though it is, approximates a cardioid. With the assistance of W4ILF and other amateur stations with whom tests were made, the front-to-back ratio was measured to be of the order of 20 db.; the forward gain is approximately 5 db. The addition of this folded dipole and the phasing arrangement shown in Fig. 6-4 made a worth-while improvement in the signal transmitted by our little 25-watter, and has accomplished a very encouraging reduction in interference from other stations operating on the same frequency in a direction opposite to Europe, in the mornings, and Australia and New Zealand, in the evenings.

— *Stacy W. Norman, W4SN*

"FLUTTER" PREVENTION FOR BEAM ANTENNAS

To eliminate wind "flutter" of rotary-beam elements (especially 20-meter center-supported "plumber's delights"), slip wood strips inside of the elements to damp out the vibrations. The strips should not be fastened down, but the ends of the elements may be either plugged or deformed to keep the strips from sliding out. You'll find that the strips rattle around a little when the wind blows, but the elements show no signs of getting the jitters.

In my own beam the elements are made of 1¼-inch ST61 tubing supported from a 2½-inch square boom. Before treatment the beam had a terrific flutter which shook the elements, the boom, the tower, and the house. Strips 3/16-inch square and 10 feet long were slipped inside of each element, and the ends were plugged. From that time on the problem ceased to exist.

— *William Vandermay, W7DET*

A VERSATILE PORTABLE ANTENNA SYSTEM

The antenna "system" shown in Fig. 6-5 was developed for portable use as a means of avoiding antenna troubles that had been encountered in considerable experience operating as a portable station. It has proved to be quite versatile, and saves a great deal of the time usually consumed preparing the antenna required for a particular site.

The system makes use of three 66-foot lengths

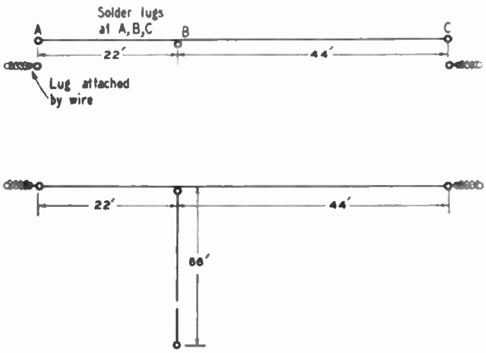


Fig. 6-5 — A timesaving portable antenna system. Three 66-foot lengths of wire are prepared in advance, making it possible to put up an antenna in jig time.

of rubber-covered "lead-in" wire. Soldering lugs are attached to each end of each length, and a third lug is connected to a point 22 feet from one end. Two ordinary glass insulators, each fitted with a lug at one end, and a few 6-32 nuts and bolts complete the equipment required.

If a 40-meter end-fed wire is desired, an insulator is fastened to one end of one of the 66-foot lengths by bolting the lug to the lug on the insulator. The other end of the wire is connected to the transmitter. If an off-center-fed antenna is called for, both ends of one 66-foot length are connected to insulators, and one of the other wires is connected to the lug that is 22 feet from one end of the piece used as the flat top.

For 80-meter operation, two lengths are connected end-to-end, and the feeder connected as described above. The fact that all wires are equipped with lugs makes for rapid installation and insures good contact without soldering. The flexible wire is preferred, as it is almost kinkless.

— *E. G. Broomer*

INEXPENSIVE FEEDER SPREADERS

While watching my XYL giving our little girl a home permanent, I found a source of inexpensive 2-inch spreaders. The plastic curlers from a "Toni" home permanent are ready-made spacers and cost only about two cents each. In my case I drilled out the inner holes and threaded in my feeder wires. The outer forked tongue holds the tie-wires.

— *Thomas W. Wing, W6MVK*

Here at W8PSV I use 14-inch knitting needles, cut in half, for my 7-inch open-wire line. They are light, fairly strong, and easy on the pocketbook.

— *Harry Stewart, W8PSV*

WIRE-SAVING IDEA FOR "SELSYN" USERS

It is often difficult to obtain a five-wire cable to connect synchro motors. This problem is simplified somewhat, however, by the fact that separate windings are used in the motors, thus permitting one wire to be used as a common lead serving both the line circuit and one of the delta circuits, as shown in Fig. 6-6.

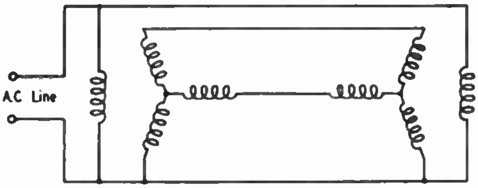


Fig. 6-6 — **Method of using four wires instead of five to connect "Selsyn" indicators. One wire is used as a common lead in two circuits.**

For indoor and temporary installations, two lengths of ordinary lamp cord may be used. If you want to reverse the direction in which one motor shaft turns, merely reverse the connections of any two of the three delta wires.

— *Roy A. Long, W6YBL*

A 40-FOOT TOWER FOR THIRTY DOLLARS

Antenna trouble, mate? Then lend an ear to a plan for a sky hook that's simple and cheap to build, yet strong enough to withstand sleet, windstorms and other inclemencies of the weather. The idea was borrowed from steel towers used in constructing the Allatoona Dam in North Georgia. Those 100-foot towers were unusually strong, capable of supporting 40-ton buckets of concrete between them.

The antenna mast, shown in Figs. 6-7 and 6-8, is a small replica of the construction tower. It looks like a 40-foot-high vine trellis, one foot square in cross section, with fourteen 3-foot 1 × 2s nailed zigzag fashion from bottom to top on four sides. The whole structure weighs only 180 pounds.

The unusual feature of this tower is the simplicity of construction. Some towers decrease in width and breadth as you build toward the top but in this case width and breadth are uniform and cross boards are all the same size, thereby saving you a lot of time measuring and sawing.

Construction

To construct the mast, lay out two sides first. Get twelve 15-foot 2 × 2s, three for each corner. Splice each three of them with 8-foot 1 × 2s, and you have four 45-foot pieces. Nail the fourteen 3-foot 1 × 2s zigzag fashion between each pair of the 45-foot lengths. The distance between each pair of long pieces is now one foot. Then nail 1-foot braces across the sides at the bottom, middle and top, three on each side.

The two sides are now ready to be put together — with more of the 3-foot 1 × 2s and short braces. When finished, you will have fourteen zigzag 1 × 2s and three braces from top to bottom on each side.

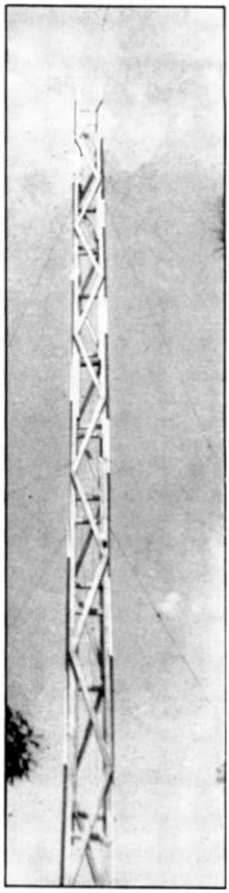


Fig. 6-7 — **The finished tower.**

The ladder comes next, and then the paint. Future builders of such towers can profit by the writer's experience in two respects. First, put the ladder on the outside rather than on the inside of the structure! While having it on the inside may add to the beauty of the finished product, the pressure of climbing feet slowly presses the steps away from the corner pieces and in time weakens the nails to the danger point. Use conveniently-spaced short 1 × 2s for the ladder.

The finished tower was painted with white creosote. White was fine, probably the best color for outside work of this type. However, the creosote flaked and peeled in about six months, making it necessary to repaint the tower with more durable outside white house paint. So use house paint the first time.

The tower uses two sets of guy wires, four from the top to support the structure and four from the middle to prevent sympathetic vibration.

First, level the site for the base. Iron stakes driven into the bedrock and bolted to the tower will help steady it. Lay bricks level within the iron stakes for the wooden mast to rest on, to discourage termites.

Now for erecting the tower. In spite of the light weight, its shape calls for the strength of six men to stand it on end. A gin pole and block-and-tackle simplify the job of getting the tower up the last 60 degrees. When it is up, tighten the guy wires and the job is finished. Hang your antenna on it, and all is set.

The long pieces for your corner posts, white pine, should run about \$7. The rest of the lumber, crosspieces, bracers and splicers, will be about \$10. Paint, one gallon of good-grade outside white, costs \$5.40. New stranded stainless-steel wire (enough for this job) runs about \$5.60. Also, you will have to invest in some strain insulators for your guy wires.

Although this totals $30, you should be able to build this tower for half the price if you dig around in the secondhand lumber piles of wrecking companies.

The tower is strong, stable and sturdy in all types of weather, including heavy wind. The tower shown in the photograph completed its second winter with flying colors — no sign of weakness in spite of much sleet and many windstorms. Such a tower should last as long as a house built of similar materials.

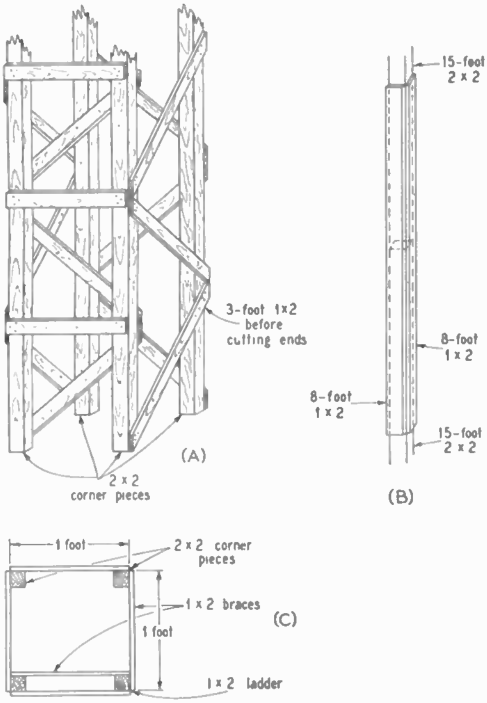


Fig. 6-8 — **Details of the tower construction. The general assembly is shown at A, with a cross-sectional view at C. The method of joining the 2 × 2 corner posts is shown in B.**

And when you want to paint again, don't hesitate to climb to the top. True, it seems risky to climb a 1 × 1 × 40-foot structure, but don't be afraid — it is stable. No "rocking" was detected when the job was done at W4HYR. Stable, weatherworthy and cheap, this tower is well worth your time and money to build.

— *W. C. Rippy, jr., W4HYR*

A COUNTERBALANCED TOWER

Adjusting a rotatable antenna, once it has been installed on top of the tower, is always a difficult if not hazardous undertaking. By the time one has climbed to the top of a 40- or 50-footer a half-dozen times, he usually loses his enthusiasm for an on-the-nose trim and is content to let it ride as it is. After six or seven years of this, we decided to see what could be done to improve the situation. One idea we had considered was a scheme for tilting the tower to ground for antenna adjustments and repairs.

The tower, patterned after a *QST* design of several years ago, is a tapering 40-foot four-legged lattice structure. To determine the feasibility of a counterbalanced arrangement, the tower was lowered to the ground. A point 16 feet from the base was selected as the most convenient spot for the hinge or pivot. Accordingly the mast was propped up on a length of 2 × 4 which served as a fulcrum at this point. Known weights, such as buckets of water, sacks of cement and the author's own weight, were used to simulate actual conditions. A 50-pound weight, representing the antenna, was placed at the top end of the mast and then counterweights were added at the bottom end to balance. It was found that the tower could safely carry a counterweight of up to 200 pounds.

The cradle which supports the hinge consists principally of a pair of 4 × 4 uprights, spaced slightly more than the width of the tower. These are joined by 2 × 2 cross-members and held securely in place by angle-iron braces. To prevent

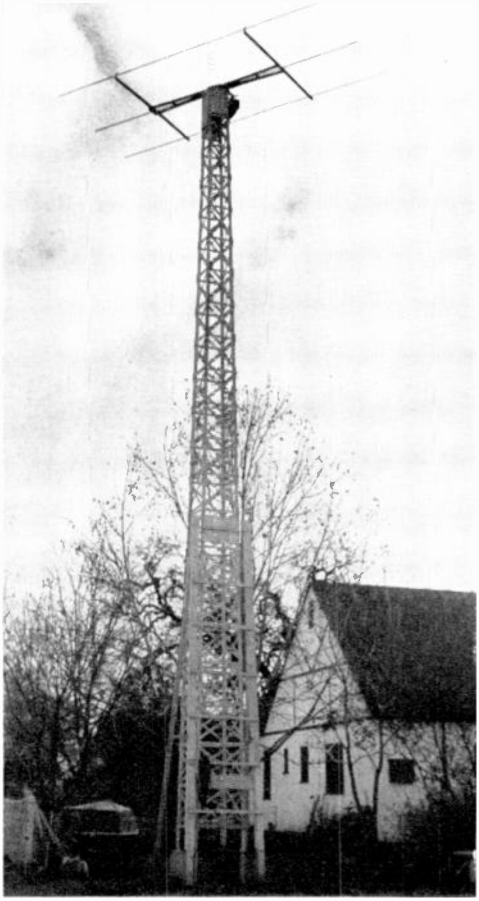


Fig. 6-9 — **W6RWO's 40-foot tilting lattice tower with the 10-meter rotatable array in place.**

rotting out at the base, the bottom ends of the 4 × 4s are not imbedded directly in the cement base but are supported about 4 inches above the ground on 3-foot lengths of angle iron set in the concrete. The lower ends of the angle-iron braces are fastened to heavy bolts embedded in the cement.

The hinge consists of a pair of iron pipes, one rotating within the other. The outer pipe is fastened to a panel on the tower, while the inner pipe, which serves as the axle, is supported in holes at the tops of the 4 × 4s.

When the cradle is ready, the base of the tower can be hoisted up into position with the top end lying on the ground. When the pipe on the tower is lined up with the holes in the tops of the 4 × 4s, the inner pipe can be slid through the holes and the outer pipe. The tower can then be swung up into a vertical position by pulling downward on a

Fig. 6-10 — **Antenna adjustments are made easily at the ground. Raising and lowering the antenna and mast top section take but a few minutes.**

rope attached to the base of the tower. The counterweight to be attached to the base of the tower can be chosen to suit any desired degree of unbalance, remembering that the weights at the ends to maintain balance are in inverse proportion to the lengths either side of the hinge. Thus, disregarding the weight of the mast itself, a pound added at the top end is compensated for by a counterweight of 1½ pounds at the base, when a 40-foot tower is hinged 16 feet up from the base. After the antenna has been mounted, different weights can be hung temporarily on the base to find the counterweight that makes raising and lowering easiest. The counterweights shown are made of cement and are bolted to the legs of the tower. When the mast is up, the bottoms of the legs are fastened to anchorages molded in the cement base.

While a fair amount of work is required to construct a tower of this type, the resulting arrangement is well worth while. To lower the tower it is necessary only to remove the four bolts at the base and push the lower end free of the anchorages so that it swings on the hinge. A 20-pound pull of the rope from the top brings the antenna down where you can work on it.

The tower measures 29 inches between legs at the base, tapering to 11 inches at the top. The four corners are made from 1 × 2 pine stock, laminated to make 2 × 2s. This makes it possible to keep the splices from occurring at the same height on all four corners. The various pieces are nailed together and glued with casein glue for additional strength and to keep the weather out. The cross-members are made of laths. The horizontal members are spaced every 21 inches with diagonal bracing in between. The cement base is 32 inches square and 30 inches deep with large bolts set 6 inches deep to hold the brackets for anchoring the mast and the cradle which provides additional support for the tower. Before mounting the tower, it should be given at least two coats of a good-grade house paint. The hinge arrangement makes it easy to repaint when this becomes necessary.

– B. F. Davidson, W6RWO

LOWERING AND RAISING A WINDMILL TOWER

THERE are old towers throughout some rural areas of the country that can be bought from farmers (if you are lucky!). Your problem then is: How shall I get it down and moved? It is fairly easy — if you know how. There are two ways to do it. The *hard* way is to climb to the top and remove the old windmill wheel and head and throw it down to the junkman. It's heavy, I warn you. And it is hard, dangerous work. Next get a cold chisel and proceed to cut off all the old rusted bolts, and take the thing down piece by piece. *One* tower is all you will wish to take down by this method. The ***easy*** way is to bolt a ten- or twelve-foot piece of 2 × 6 timber across the base of the tower, as shown in Fig. 6-11, place bracing 2 × 4s between the legs as illustrated, fasten the block and tackle to the tower, run the line over to the gin pole or tree, disconnect the legs, and lower the whole thing in one piece. Use rope guys to steady the tower during the process. You will be surprised how easily the tower comes down. The 2 × 6 prevents slipping at the base and adds a safety factor. Don't forget to dig up the anchor posts. Once on the ground you can use a cold chisel to cut off the bolts. Thoroughly buff off all rusty surfaces and apply a good coat of aluminum paint *before* reassembling. Be sure to use new galvanized bolts. It is well also to add a drop of "No-oxide" to the threads, in case the tower is taken apart again later.

You now have the tower disassembled on the ground and hauled home in your neighbor's borrowed car trailer. The corner-post sections will not exceed 22 feet in length, and may be only 11 feet long. In any case, you can haul them. The total weight of a 30-foot tower will be about 500 pounds, 600 pounds for a 40-footer and about 1200 pounds for one 60 feet high. Strangely enough, it's much easier to erect them than it is to take them down. Again, there are two ways to do the job. First dig the holes and set the anchor posts. If the tower is being raised after assembly, leave the posts loose in the holes and tamp in dirt after the tower is up and leveled.

In assembling, start at the top and bolt the four side posts to the cast-iron cap. Note that the angle irons fit *inside* the cap. There is a hole through this cap approximately 4 inches in diameter that is handy for passing feed lines and cables. On a windmill, the pump rod works through this hole. The cap will usually have ample flange space for bolting on your mounting plate for attaching the beam head. At this point it is well to have considered your method of mounting of the rotary head, because it is much easier to drill holes on the ground. Once the first four corner-post sections are bolted on, it is as easy as playing with your son's Meccano set. Simply bolt on the cross-channel irons and place the diagonal cross-wire braces over the bolts as you work toward the bottom. Now and then you see a tower with strap-iron diagonal braces. Many towers use preformed heavy twisted galvanized wires, with eyes in the ends to fit over the bolts. These tighten and adjust more easily than strap iron. With the tower completely assembled on the ground, block up the end a few feet and attach your rotary mechanism. This is the way a windmill is raised. Bolt your 2 × 6 on the underside of the legs lying on the ground, as in Fig. 6-11, placing the bottom of the legs in line with the anchor posts. Level the legs with blocks if the ground slopes. Brace between the bottom of the legs with 2 × 4s if the tower has no girts at ground level. Attach your block and tackle, and up you go! But stop after the head is far enough off the ground to permit attachment of the boom and elements. Get it all over with one operation. This is much easier than dragging them up after the tower is in the air, even if you have taken our advice and rigged up a tilting head on top. Pull the tower on up, take it a little past center, fasten the two legs on the side near the gin pole, then ease it back and bolt on the other two legs. It is as easy as that. Then knock off for coffee and sandwiches for the gang! It took just 20 minutes to put up our last tower after all preparations had been made ready.

Your final job before tamping in the earth around the anchor posts is to level the tower accurately. If you desire a catwalk to work on, bolt two 1½ × 1½ × 8-foot angle irons alongside the top girt and parallel to the ladder. Across these you can bolt 2 × 8 × 18-inch planks. Then bolt four 1-inch angle irons from a point below the top of tower to the midpoint of the platform irons to serve as diagonal supports. It is more convenient to do this on the ground. We guarantee that you will have no fear of high places with such an arrangement.

Lack of space may prevent erecting a tower in one section. In that case first set the anchor posts and level them. Then build up from the ground, piece by piece. Many prefer this method. Where the corner posts are in short sections of 11 or 12 feet this is a simple procedure and can be done by one man working alone. With a partner on the ground to pass up the pieces, you can make fast

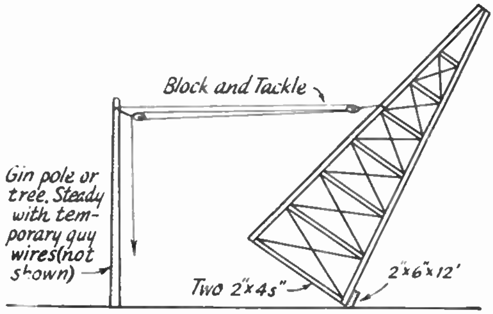


Fig. 6-11 — Suggested method for raising or lowering a steel windmill tower. The temporary 2" × 6" × 12' timber bolted to the base serves to steady the tower, and the two lengths of 2 × 4 prevent any possible buckling of the base. Temporary rope guys on either side of the tower should be used to steady the structure while it is going up or coming down. After raising the tower, the two legs nearest the gin pole should be anchored first, after which the tower can be eased back and the other two legs fastened.

time. The ladder portion goes up in sections, too. If the splices are located *above* the points where the cross girts bolt on, you can lay strong planks across the girt frames to work on as you go up.

When you are finished, you will be proud of your job. In closing let us reply to the often-asked question, "Does the grounded frame of the steel tower affect the signal?" The answer is "No!" Some of the best signals on the air today come from amateur stations using steel-tower-supported beams.

— *Malcolm B. Magers, W0OJI*

BALANCED FEED LINE WITH COAXIAL CABLE

The system shown in Fig. 6-12 has been used at this station to obtain a balanced line while still retaining the advantages of coaxial cable in shielding the feeder from pick-up. Two lengths of 52-ohm cable are used, with the shield braids soldered together at the top and the bottom of the line and grounded to the transmitter and to the electrical center of the driven element. The resulting line impedance is about 104 ohms. This can be matched to the driven element of almost any beam antenna by the simple "T" match as shown.

In my particular case, the reflector and driven elements are each 16 feet 5 inches, and the director is 15 feet 2 inches. Spacing between elements is 0.2 wavelength. The "T" bar is located 3½ inches below the driven element, and connection from the "T" to the driven element is made 10 inches each side of center.

No detuning is noticed when this line is run in close proximity to the beam elements, and it is unaffected by weather conditions. Pick-up (of man-made QRN) is reduced several decibels,

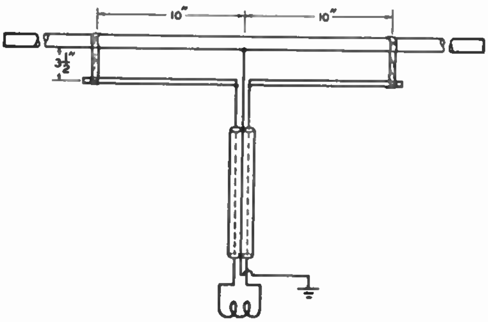


Fig. 6-12 — A balanced feed line using coaxial cable. Two lengths are used, series-connected as shown. A "T" is then used to effect the required match to the driven element of the beam.

and the line may be located at any convenient place.

— *William W. Bailey, W9AO*

HARMONIC REDUCTION WITH STUBS

Hams who are having trouble with harmonic radiation sometimes can make a substantial reduction in the amplitude of even-harmonic radiation by connecting the open end of a shorted quarter-wave stub to the antenna feeders or transmission line.

The function of such a stub is to present a short-circuit to all even-multiple harmonics of the transmitted frequency, while presenting a high impedance to the fundamental. Thus the stub causes no detuning or power loss, but eliminates the even-multiple harmonics.

The stub may be connected at any point along tuned or untuned transmission lines of either the parallel-wire or the coaxial type. A "T" connector will be necessary for tapping into coaxial lines.

If the transmission line is being used for more than one frequency band, the stub line may be made long enough for the lowest-frequency band used, and a shorting bar may be used to set the stub length to the proper position for each band. Continuous protection from lightning and static charges may be obtained by grounding the shorted end of the stub, and it will not be necessary to remove this ground during operation.

— *Roger T. Wilson, W3JHW*

USING LAMP BULBS AS DUMMY ANTENNAS

The commonplace lamp bulb is a handy gadget for measuring transmitter power output or for terminating a "flat" line during checking for harmonic radiation from the transmitter proper. The approximate resistances of common lamp sizes, at full brilliance, are as follows:

25-watt	600 ohms	100-watt	150 ohms
40-watt	350 ohms	150-watt	100 ohms
60-watt	250 ohms	300-watt	50 ohms

Use a combination of lamps that will match the transmitter power output as closely as possible. For example, if the output is 200 watts into 75-ohm line, use two 100-watt lamps in parallel; for 400 watts into 600-ohm line, use four 100-watt lamps in series, etc.

A COMPACT VERTICAL FOR 75 METERS

A vertical antenna system that has been used on 75 with good results and that is only 17 feet high is shown in Fig. 6-13. It is a version of the folded dipole, with each conductor loaded. The top of each conductor is a 12-foot length of aluminum tubing mounted at the end of a 5-foot 1¼-inch diameter ash pole. A coil of 30 turns of No. 11 d.c.c. wire is wound on the wooden pole below the end of the aluminum tubing, one lead

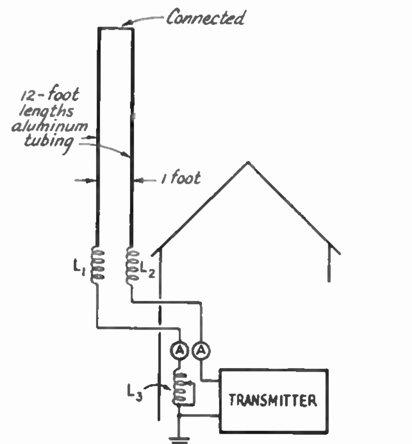


Fig. 6-13 — This small antenna has worked well at W5TG. The inductance L_3 is adjusted for equal current in the two lines. L_1 and L_2 are each 30 turns of No. 11 d.c.c. on 1¼-inch diameter wooden supports for the aluminum tubes.

from the coil going to the tubing and the other running in feed-through insulators into the shack and down the wall to the transmitter. The pole and coil are sprayed with Glyptal to protect them from the weather, and the two poles are mounted a foot apart on the side of a metal Quonset hut, with only the tubing extending above the roof.

The loading coil at the ground connection is used to tune the system. It is varied until the currents in the two conductors are equal. When the currents in the two lines are matched, the system takes power nicely and the received signals come up. The results obtained with this antenna compare favorably with those from a much larger system, and many good reports have been received with only 75 watts to the transmitter.

— *James W. Hunt, W5TG*

7. Hints and Kinks . . .

for V.H.F. Gear

ONE-TUBE V.H.F. RECEIVER

Here is a one-tube v.h.f. receiver that worked very well for me, and I thought some of the boys might like to make up a simple job that has lots of sock, even though it has but one tube. Fig. 7-1 shows the details of the circuit. For 144 Mc.

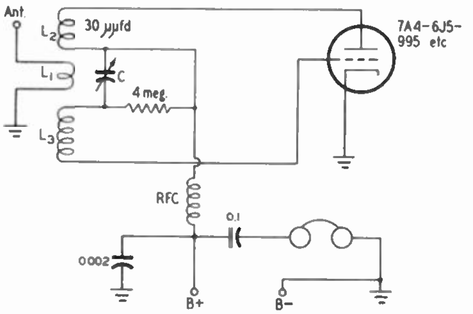


Fig. 7-1 — A one-tube v.h.f. receiver. The values of the components are shown in the diagram, except for L_1, L_2 and L_3, for which the suggested values are 2, 4 and 4 turns respectively, for the 144-Mc. band. The usual "cut-and-try" method should result in maximum performance on this receiver.

I suggest four turns ½ inch in diameter, No. 14 wire, for the plate and the grid coils. Experiments will show the exact number of turns and spacing required to cover the band in a particular receiver.

— *John J. Kaiser*

IMPROVED 144-MC. RECEPTION

Owners of the SCR-522 can make a substantial improvement in receiver performance by the use of the regular station communications receiver in the same manner that the "Q5-er" is used on the lower-frequency bands.

The communications receiver is used as an additional i.f. amplifier and audio channel. It is loosely coupled to the last i.f. transformer of the 522 by twisting a wire once or twice around the lead that runs from the last i.f. transformer of the 522 to the 12C8 detector tube. The other end of the wire is connected to the antenna post of the communications receiver. The communications set is then tuned to about 12 Mc., the i.f. frequency of the 522.

Rough tuning is accomplished with the dials of the 522 in the usual manner. Then the bandspread dial of the communications receiver is used for peak reception.

This system of reception offers all the conveniences of low-frequency operation: stable easy-to-read signals, bandspread tuning, S-meter, b.f.o., noise-limiter action, and a better audio system. Most important, however, is the improvement in signal-to-noise ratio obtained because of the narrower passband of the system. Unstable or badly-drifting signals can be received as usual on the 522 alone by turning the audio gain of the 522 up, while reducing it on the low-frequency set.

— *Francis H. Stites, W1MUX*

ALIGNMENT AID FOR V.H.F.

A simple, effective alignment indicator for receivers using superregenerative second detectors, such as those described in *QST*, consists of a 0–100 microamp. meter in series with a 0.1-megohm resistor, connected as shown in Fig. 7-2.

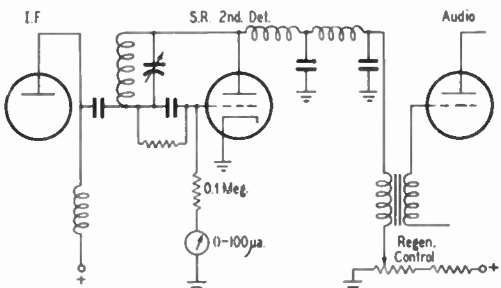


Fig. 7-2 — A simple alignment indicating circuit for use with superregenerative second detectors. By changing the values as described in the text, the same set-up may be used for field-strength measurements.

Using this set-up, and with the regeneration control turned fully off, the detector tube acts as a diode rectifier. It is not necessary to by-pass the plate to ground, because at the frequencies where these detectors are usually operated (10 Mc. or higher) the stray circuit-and-tube capacitance is usually sufficient.

With this device, and very loose coupling of the mixer grid to a signal generator, a reading of 50 to 100 microamperes is easily obtained. The i.f. and mixer stages can then be trimmed to obtain top performance.

If desired, the circuit may be used for field-strength measurements by increasing its sensitivity. In this use, the resistor should be 0.5 megohm and the meter 0–30 microamperes.

— *Erich Kohout, HB9AT*

A TWO-BIT TWO-MINUTE 420-MC. GROUND-PLANE

W7KWO, one of the more active 420-Mc. operators in the region around Phoenix, Arizona, says that a ground-plane is unquestionably *not* the world's best antenna for 420 Mc., but it can be the quickest and possibly the cheapest, if made as shown in the photograph of Fig. 7-3. Tom takes an Amphenol coaxial fitting, type 83-1R, and solders a 6½-inch piece of stiff wire (No. 12 will do, or welding rod may be used, if handy) into the center conductor. Four more pieces are soldered to the flange of the fitting for the ground-plane. If these are soldered in the position shown, the holes in the flange are left to be used for mounting the completed antenna.

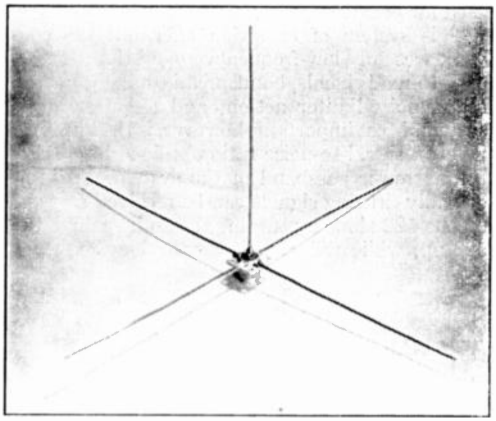


Fig. 7-3 — A new low in antenna complexity is this 420-Mc. ground-plane suggested by W7KWO. It consists of a Type 83-1R coaxial fitting and five 6½-inch pieces of stiff wire.

ADAPTING THE CATHODE-COUPLED PREAMPLIFIER TO 144-MC. WORK

The cathode-coupled preamplifier circuit described by W1DX in September, 1947, *QST* can be used on 144 Mc. with good results with only slight modification. The original circuit is retained, but the values of a few components, and the coils, are changed. The circuit is shown in Fig. 7-4.

The amplifier was built on a small aluminum chassis with a copper shield extending across the center of the tube socket. Pins 4 and 6 and the center extension of the socket are grounded directly to this shield, which is mounted on the socket screws by means of soldering lugs. The coils are made of No. 20 bare tinned wire, and are ¼ inch in diameter, spaced about $1/16$ inch between turns. The rotor of C_5 is grounded directly at the center of the tube socket and the copper shield, as is the rotor of C_2 on the opposite side of the shield. The input and output portions of the circuit are carefully shielded from one another to prevent self-oscillation.

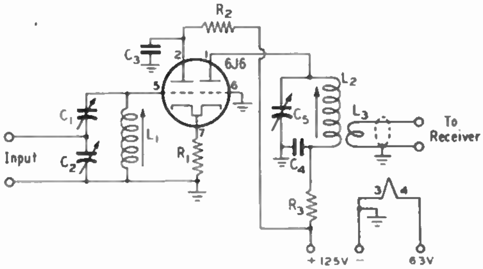


Fig. 7-4 — Circuit diagram of the cathode-coupled preamplifier adapted for use in the 144-Mc. band.
C_1 — 3–30-μμfd. mica trimmer (National M-30).
C_2 — 75-μμfd. midget variable.
C_3 — 680-μμfd. ceramic.
C_4 — 100-μμfd. ceramic.
C_5 — 20-μμfd. midget variable.
R_1 — 470-ohm ½-watt carbon.
R_2, R_3 — 1500-ohm ½-watt carbon.
L_1 — 3½ turns No. 20, ¼-in. inside diam., with $1/16$ inch between turns.
L_2 — 4 turns No. 20, ¼-inch inside diam., with $1/16$ inch between turns.
L_3 — 3 turns No. 18 flexible hook-up wire, close-wound over ground end of L_2.

This circuit was used ahead of an SCR-522 receiver with excellent results. Signals that were audible but unreadable without the amplifier became R5. Although the noise comes up somewhat with the signal, there is a definite improvement in signal-to-noise ratio and the over-all gain is equivalent to about three S-points. The input from the antenna in the case described is 300-ohm Twin-Lead, and the output to the 522 is a short length of 72-ohm coaxial cable. The entire unit can be enclosed in a small cabinet with its power supply, and is a worth-while addition to any receiver.

— *Roy R. Maxson, W6DEY*

FIELD-STRENGTH INDICATOR FOR 420 MC.

Ever try to get a radiation pattern of your 420-Mc. array? If you have, you know that reflections from surrounding objects can be mighty confusing. A person walking several wavelengths in back of the field-strength meter, for instance, will cause readings to vary widely. To get around this difficulty, W3CKP, Silver Spring,

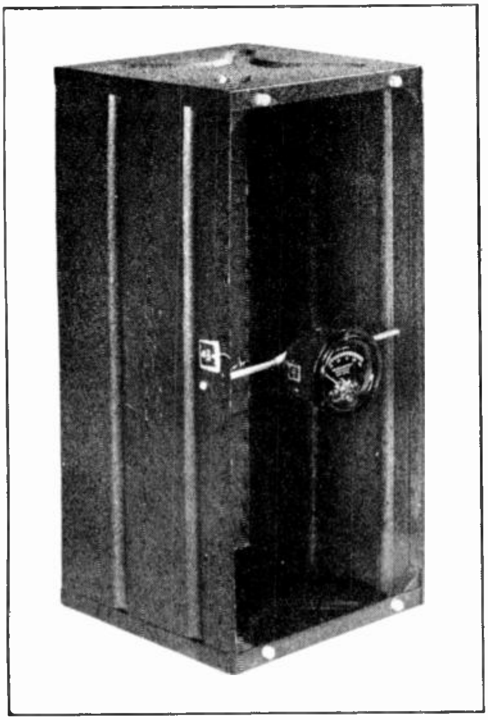


Fig. 7-5 — A field-strength indicator for 420 Mc. made from the case of a BC-375 tuning unit, a microammeter, a 1N34 crystal, and two pieces of copper tubing. This model was assembled in the Headquarters lab at the suggestion of W3GKP, who uses a similar arrangement to eliminate reflections from objects in back of the meter.

Maryland, uses one of the CS-48 storage cases from the tuning units of the BC-375 transmitter as a slot or cavity antenna for his field-strength meter.

To check the idea a similar unit was built in the Headquarters lab, and a photograph is reproduced in Fig. 7-5. As may be seen, a microammeter is mounted at the center of the box opening, in series with a crystal diode and two short lengths of tubing. Copper tubing 3/16 inch in diameter is used, as this can be readily tapped with a 6-32 thread. One section of tubing has a loop of No. 16 wire soldered to it to form a lug fitting over the meter terminal. The other piece is soldered to a 1N34 diode, the other end of which connects to the other meter terminal. The two pieces are just long enough to fit inside the box and are fastened in place with short 6-32 screws through the sides of the box.

Polarization is parallel to the wire; that is, with the unit in the position shown, polarization is horizontal. The main lobe is in front of the open side of the box. The arrangement has a useful gain over a dipole antenna, in addition to reducing trouble experienced from reflections. The only disadvantage Smitty can think of is that, with the box having a cut-off frequency of about 300 to 350 Mc., the gadget is good only for 420 Mc. and higher. He suggests that some reader put him in touch with a reputable grave robber, who would dig him up a 144-Mc. job!

TWO V.H.F. ADJUSTMENT HINTS

THE idea shown in Fig. 7-6A is useful in getting parallel-line oscillators to work. After building such an oscillator it is usually found that the r.f. voltage gradient along the two sides of the line is not symmetrical. This lack of symmetry is caused by the difference in tube and other stray capacitances to ground at the two hot ends of the line. A small tab, *C* (placed with the horizontal part clearing the chassis about a sixteenth of an inch), will balance the line and improve oscillator performance. This will also reduce the tendency toward "squegging."

Another important kink concerns the adjustment of the grid excitation in u.h.f. and v.h.f. oscillators. Condensers have been shown in equipment but their function is often overlooked. In the usual "grid-separation" circuit, the excitation is determined by the ratio of plate-cathode to grid-cathode capacitance. Normally the grid excitation is too large. This causes downward loading of the oscillator and the no-load plate current is too high.

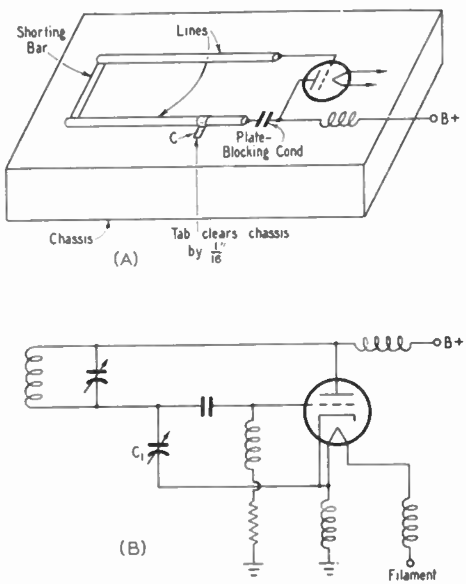


Fig. 7-6 — Two v.h.f. equipment adjustment ideas. The small tab added to the plate line, as shown in A, helps restore symmetry and improves operation. The excitation control, C_1, shown in B, is often overlooked in u.h.f. and v.h.f. oscillators. Downward loading and abnormal plate current of the oscillator will be prevented if the grid-cathode r.f. voltage is reduced by proper adjustment of this condenser.

Reducing the grid-cathode r.f. voltage by adding a 5–15-μμfd. condenser, C_1 in Fig. 7-6B, from grid to cathode, will reduce the no-load plate current and the grid current and will make the oscillator load upward as it should.

— *Laurence Fleming*

A 2-METER BCI CURE

A very stubborn and acute case of 2-meter BCI was eliminated entirely by a simple yet effective method. Ninety per cent of the interfering signal was found to be entering the broadcast receiver (one of the midget variety) via the a.c. power line. The remaining ten per cent was found on the twenty-foot wire that was being used as an antenna.

Three r.f. chokes, each made of 45 turns of No. 17 enameled wire, ⅜ inch in diameter, were used. One was inserted in each side of the a.c. line, one at the power switch and one in series with the plate of the rectifier tube. These chokes were mounted under the chassis in the clear on stand-off insulators. The third choke was mounted directly on the antenna input terminal, and connected in series with the antenna.

Any form of insulation used to cover the chokes, such as friction tape or spaghetti tubing, will reduce their effectiveness.

— *Clarence G. Jeffers, W1LZR*

ROTARY BEAM ANTENNA FOR 2-METER WORK

The construction of the rotary beam antenna shown in Fig. 7-7 is a little unusual, but the results obtained with it have more than justified the trouble encountered in its construction. The beam is the design of Russ Patterson, W4CPG, who made numerous tests with it from various fixed and mobile locations in this area. Using the beam, signals that were S4 to S5 on a comparison "J" antenna came up to S9 and better. The beam seems to be about 30 degrees wide, and has a fairly high front-to-back ratio, although not so high that nothing can be heard off the back of it.

The elements and matching stub are constructed of ½-inch thin-wall tubing. The spacing between the stub and element *A* is two inches. Other dimensions are shown in the diagram. The supporting arm for the reflector and director is a single piece of tubing, which is soldered directly to the radiator. Thus soldered joints appear at all points marked *X*. The entire assembly was mounted on a rotatable support with ceramic stand-off insulators.

Results obtained at both fixed locations and in mobile conditions with the antenna mounted on a car have been equally good. The center frequency obtained with the dimensions shown is 145 Mc.

— *J. Wayne Clark, W6CAN*

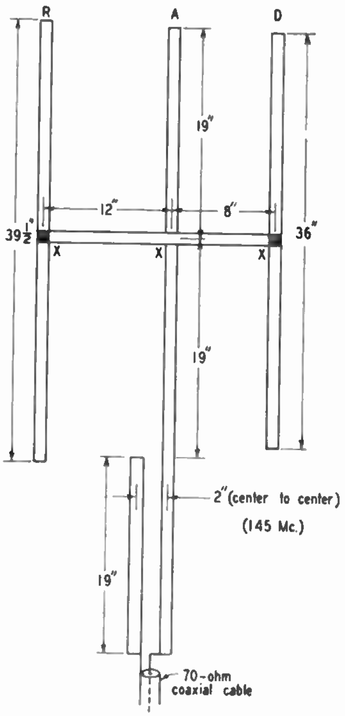


Fig. 7-7 — A beam antenna of unusual design for use in the 2-meter band.

V.H.F. MODULATOR WITH A2 AND A3

The single-tube modulator shown in Fig. 7-8 provides for both voice and tone modulation, with but a single tube. A neon bulb (with resistor removed) is used as a tone generator, for use on the v.h.f. bands where m.c.w. operation is permitted.

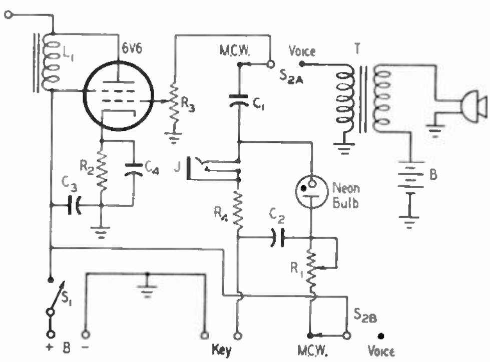


Fig. 7-8 — Single-tube v.h.f. modulator for m.c.w. or voice.
C_1, C_3 — 0.1-μfd. 400-volt paper.
C_2 — 0.2-μfd. paper.
C_4 — 10-μfd. 25-volt electrolytic.
R_1 — 0.25-megohm potentiometer.
R_2 — 470 ohms, 1 watt.
R_3 — 0.5-megohm potentiometer.
R_4 — 4700 ohms, 1 watt.
L_1 — Modulation choke, 30 hy.
B — 4½-volt microphone battery.
J — Monitor jack, closed-circuit type.
S_1 — S.p.s.t. switch.
$S_{2A, B}$ — D.p.d.t. switch.
T — Microphone transformer.

The potentiometer, R_1, serves as a pitch control. Some variation of R_4 and C_2 may also be necessary to get some neon bulbs to oscillate at the frequency desired. Insertion of headphones in the monitor jack permits adjustment of the modulation tone and provides a means of monitoring keying as well.

— *Henry Morris*

TAMING HY-75 CIRCUITS

In *QST* for March, 1945, mention was made in "Hints and Kinks" of steps to be taken in resoldering the top cap leads of the HY-75. The explanation of the need for resoldering took into account only the actual melting of the solder. It did not explain the underlying cause for its occurrence.

In an attempt to discover this reason, I have spent about 500 hours in experimenting with the HY-75 in various v.h.f. circuits. The results of these experiments show that the melting is not the result of heat generated by the tube elements during normal operation, but is caused by abnormally high r.f. currents, usually at a harmonic of the fundamental frequency, stemming from improper design of the oscillator circuit. These currents are high enough to cause considerable heat to be generated when flowing through even the small resistance presented by the soldered connection.

Fig. 7-9 shows the current distribution *at the second harmonic* on a quarter-wave tank circuit under various conditions of added inductance and capacitance. The portion of the line shown between the condenser and the shorted end of the line could be replaced by a coil and the analysis would still hold. The curves illustrate that as the line is shortened, the current maximum moves closer to the soldered connection at the tube caps. Under certain conditions it can be right at the caps, and if the tuning capacitance is at the same time large enough to offer a very low reactance at the second harmonic (or at a parasitic frequency) the amplitude of the current flowing at the caps may be great enough to cause the solder to melt.

In the commonly-used coil-and-condenser circuit, one other source of trouble may be present. If the tuned circuit is so adjusted that the portion of the coil between the condenser and the plate-supply lead can act as an r.f. choke at the undesired frequency, the condenser may then look like a short-circuit across the end of a line made up of the tube-lead inductance plus the lead to the tuning condenser, and abnormal heating will result.

The cure for these troubles will vary with different circuits, but some generalizations can be made. The use of filament chokes (27 turns of No. 18 close-wound on a 3/8-inch form) eliminates the trouble in HY-75 oscillators in the 2-meter band. Possibly the tuned-choke system shown on page 29 of *QST* for April, 1946, might work as well, but this was not tried.

The *L/C* ratio of the tuned circuit can often be altered to shift the current loop. The tuning condenser can be completely eliminated and the frequency adjusted by varying the *L* to resonate with the tube capacitances at the desired frequency. Tuning a quarter-wave line with a relatively large condenser replacing the usual shorting bar also provides proper operation. The most straightforward method is to use a shorting bar for tuning, with a high-quality blocking condenser of about 500 μμfd. The condenser must have low lead and internal inductance.

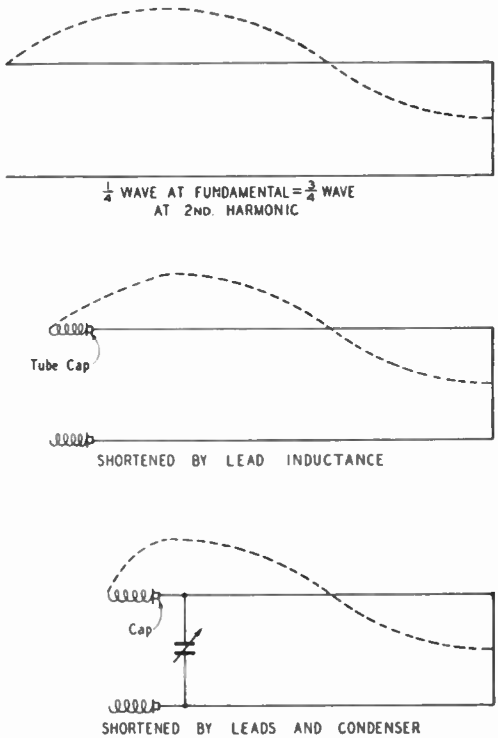


Fig. 7-9 — **Current distribution at the second harmonic along a "quarter-wave" line. If peak current occurs at or near the tube cap, as shown in the bottom sketch, overheating and consequent melting of the solder can occur.**

With the HY-75 operating in a properly-designed circuit the solder at the tube cap will not melt. Any softening of the solder is a sure warning that something is wrong with the circuit, with either harmonic trouble or a parasitic oscillation being the usual cause. Other changes may be necessary in particular circuits, but the suggestions given above should clean up the difficulty in most cases. Although these tests were made only with the HY-75, it is possible that similar conditions may exist in v.h.f. circuits using other tubes

— *George D. Perkins*

A BROAD-BAND ANTENNA FOR 50 MC.

Because he wanted to operate in the high half of the band, and still be able to do a creditable job of receiving at the low end, W1EYM, Fairfield, Conn., developed the array shown in Fig. 7-10. It consists of four similar folded dipoles, each cut for the center of the band (108 inches long) except for the reflector unit which has 4-inch extensions at each end. The dipoles are mounted a quarter wavelength apart, and fed as shown in the drawing. Though work with the antenna system is still in the experimental phase, W1EYM has established the following facts regarding its performance:

1) It provides a reasonably flat match to a 470-ohm line over the entire 50–54 Mc. band.

2) It has an average gain over the whole band of 8 db. over a half-wave antenna cut for 52 Mc.

3) The front-to-back ratio varies from approximately 3 db. at the low end to about 12 to 15 db. at the high end, this fairly high front-to-back continuing on up to 60 Mc.

The dipoles are each 108 inches long. If they were cut for the low-frequency end of the band (about 110 inches) it is believed that the good front-to-back ratio would extend throughout the band. As climbing up and down the tower for each adjustment became quite an arduous proposition, Nat has been working with scale models

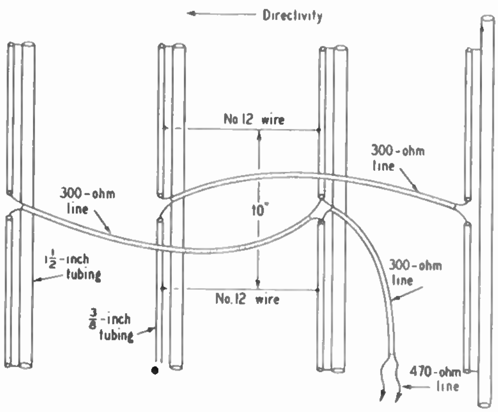


Fig. 7-10 — Detail drawing of the broad-band 50-Mc. antenna system worked out by W1EYM. Four folded dipoles, 54 inches apart, are driven as shown, the impedance at the feed-point being approximately 470 ohms. The dipoles are 108 inches long, except for the reflector element, which has 4-inch extensions at each end. Interconnecting sections of 300-ohm line are approximately 108 inches long. The section of 300-ohm line inserted between the 470-ohm transmission line and the second dipole is a half-wave long (minus propagation-factor shortening) and is used to provide a flexible section rather than for matching purposes. The sections of each dipole are 2.94 inches apart, center to center. Performance characteristics are given in the text.

on 420 Mc. Reflections have been bothering him in making accurate measurements on this frequency, and the project is being held up until tests can be conducted in an open field which will be devoid of the reflection problems.

THE "TINY TIM" 144-MC. HANDIE-TALKIE

The article on the "handie-talkie" in June, 1944, *QST*[1] brought comments and inquiries from all over the United States, Canada and South America. But the prize came from quite close to home — from a friend who, on seeing the article, observed "Why didn't you build a *small* one?" A challenge like that couldn't be ignored, naturally, and the result of it all is the new version shown in the photographs.

This "Tiny Tim" handie-talkie has been in operation for some time, first in WERS work, then on the 112-Mc. band after the reopening, and still later on the 144-Mc. band. It is 7⅛ inches high, 2⅝ inches wide, and 1⅛ inches thick, and weighs only 1½ pounds complete with batteries. Since it is small enough and light enough to slip into a coat pocket it can be carried and used on a second's notice. Good reports have been received at distances up to two miles, although its primary purpose is for communication with mobile or fixed stations which ordinarily would be within a few city blocks of the portable unit.

Two tubes are used in a transceiver circuit, a 957 as the detector and oscillator and a second 957 as the audio amplifier and modulator. If somewhat more power is desired it would be possible to substitute 958s for the 957s. The battery power supply, contained in the same case, consists of a single No. 1 flashlight cell and one midget 45-volt "B" battery (Burgess XX30). The drain on the flashlight cell is 100 milliamperes and the "B" current is only 3 milliamperes.

As shown in the circuit diagram, Fig. 7-12, a three-pole two-position switch, S_1, is used to change over from send to receive. One switch section connects or disconnects the microphone, the second section connects the proper grid leak, and the third section shifts the oscillator plate circuit from the primary of the transceiver transformer, T_1, to which it is connected for receiving, to the plate of the audio amplifier-modulator for transmitting. The headphone is made to do double duty by serving as a modulation choke during transmission.

The case is made from two pieces of aluminum.

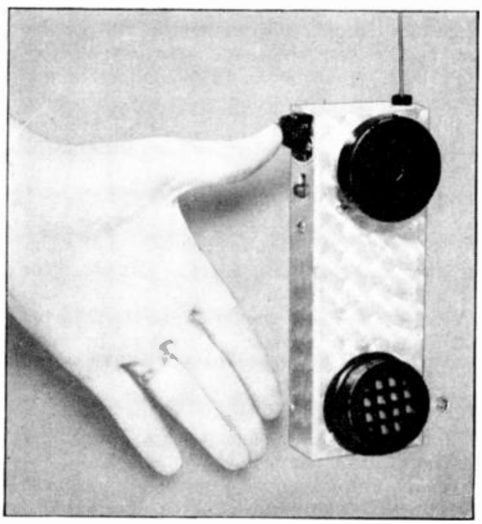


Fig. 7-11 — A handie-talkie that is really handy — its approximate dimensions are 7 by 2½ by 1 inches. Completely self-contained and small enough to be slipped into a pocket, it has a range of a mile or more in reasonably open terrain.

[1] Haist, "A Self-Contained Handie-Talkie," *QST*, June, 1944.

One, on which the parts are mounted, is in the form of a U-shaped channel as shown in the inside view. The other is bent at the top and bottom to complete the enclosure. The microphone is a single-button unit (Universal type W) mounted on a circular block cut at an angle so that it is properly tilted for voice pick-up when the headphone is held against the ear. The headphone is one unit of a 2000-ohm set mounted to the case by two screws.

The tubes are mounted by soldering the two negative filament pins (Nos. 4 and 5) to small brass angles which in turn are mounted on opposite sides of the case as shown in the inside view. The screws that hold the angles to the case also are used to mount the two switches, S_1 and S_2. S_1 is mounted underneath the tuning knob while S_2 is on the opposite side

The tuning condenser is a revamped 3 – 30-μμfd. trimmer. The adjusting screw was removed and its head was cut off, then the screw was threaded tightly into a ¾-inch length of ¼-inch diameter round polystyrene rod. The assembly was then rethreaded into the condenser so that the end of the poly rod pressed against the movable plate, thereby providing a miniature tuning condenser with the shaft extending outside the case for ready adjustment. The tuning knob is equipped with stops so that it can be rotated just sufficiently to cover the 144–148-Mc. band. The condenser and tank coil, L_1, are supported by their leads, one end of the tank circuit being soldered to the plate lead of the tube.

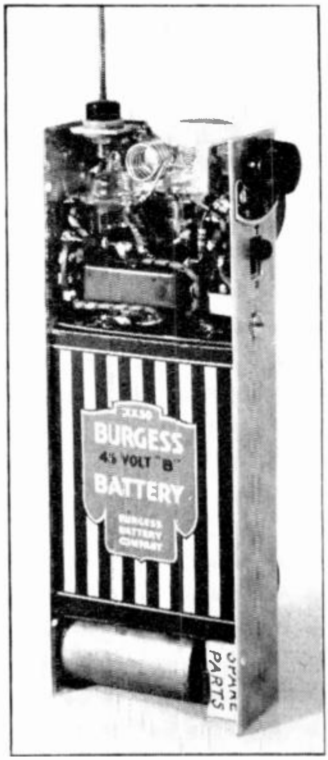


Fig. 7-13 — Inside the handie-talkie. Over half the case is occupied by the battery power supply. To save space no tube sockets are used, the connections being soldered directly to the tube pins.

The antenna plugs into a pin jack mounted on an aluminum angle which is bolted to the case at the top. Steel or brass rod ⅟16 inch in diameter may be used for the antenna; a length of approximately 18 inches is required for a quarter wavelength. The length may be pruned to the optimum figure by starting with the rod a little long and cutting off a bit at a time until the antenna shows the maximum tendency to throw the superregenerative detector out of oscillation when set in the 144-Mc. band.

— *Charles T. Haist, jr., W6TWL*

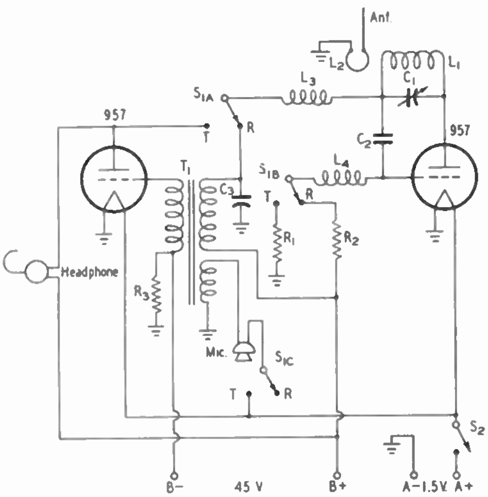


Fig. 7-12 — Circuit diagram of the 144-Mc. handie-talkie.

C_1 — 3–30-μμfd. ceramic trimmer (see text).
C_2 — 50-μμfd. ceramic fixed.
C_3 — 0.002-μfd. 200-volt midget paper.
R_1 — 22,000 ohms, ¼ watt.
R_2 — 10 megohms, ¼ watt.
R_3 — 390 ohms, ¼ watt.
L_1 — 5 turns No. 16, ⅜-inch inside diameter, length ⅜ inch.
L_2 — 1 turn No. 16, ⅜-inch inside diameter.
L_3, L_4 — 50 turns No. 36 d.s.c. on 10-megohm ½-watt resistor.
$S_{1A, B, C}$ — Triple-pole double-throw slide switch.
S_2 — Single-pole single-throw slide switch.
T_1 — Transceiver transformer (Inca I-45)

PUSH-PULL 826 AMPLIFIER FOR 144 MC.

Two-meter men who want to put in fairly high power are overlooking a good bet in the 826 tubes, now available at ridiculously low prices on the surplus market, according to W2GPO. Puss is running *600 watts* to a pair of 826s, in the amplifier shown in Fig. 7-14. The layout is unconventional, but effective. The tube sockets are mounted on edge, by means of hook bolts made from ordinary machine screws, and are maintained in alignment by stiff rods connecting the filament terminals. The grid circuit is a tuned loop of wire, and the plate tank is ¾-inch silver-plated copper, bent into a semicircular shape. This is also condenser-tuned, so that the position of the shorting bar is not changed in the course of ordinary adjustments. Neutralizing condensers are pieces of aluminum mounted in the two top socket holes on each side.

Initial experiments with this amplifier showed that far beyond the normal tube ratings could be run, but the tank circuit ran very hot. Larger tubing, plus a blast of air from a small electric fan, took care of this. Plate current is 400 ma., at 1600 volts. The driver is an ARC-5, with 400 volts on the 832-A. This provides 40 ma. grid current, at 140 volts bias, in the 826s. Grid resistor is 3500 ohms.

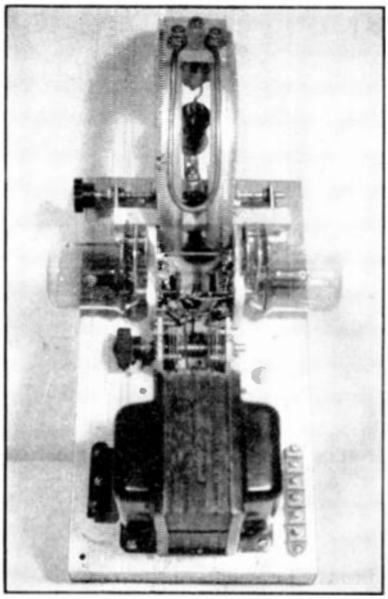


Fig. 7-14 — With this amplifier of unusual design, W2GPO is able to run 600 watts input on 144 Mc. Final tubes are 826s, mounted in a horizontal position. An electric fan is turned on the tubes and tank circuit for forced-air cooling. See text for further details.

A GRID-DIP METER FOR V.H.F.

If you do much construction work in the v.h.f. range, you will appreciate the need for a sensitive grid-dip meter to check the resonant frequency of an unknown tuned circuit. It must be small enough to couple into some of the rather minute tuned circuits that are used. To fill such a need in the Headquarters lab, the gadget shown in Fig. 7-15 was built. It is patterned after the one described in March, 1948, *QST* by W2BFD.

An acorn triode in an ultraudion circuit is mounted at the end of a thin "paddle" made from scrap Masonite. The coil of the oscillator circuit extends beyond the end of the paddle, to permit its insertion into the field of the coil of the circuit being worked on. A "push-to-operate" switch is mounted at the handle end of the paddle, so that the power, which is obtained from small external dry cells, is turned on only when a measurement is to be made. The meter, which can be a 0–1 d.c. milliampere movement, is external to the unit and is connected in the d.c. grid return through wires that are taped to the handle. The circuit is shown in Fig. 7-16.

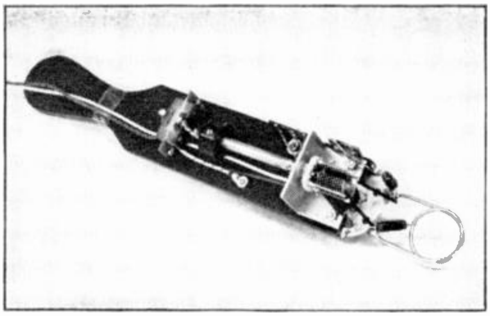


Fig. 7-15 — A handy probe-type grid-dip meter for the v.h.f. man. The tuned circuit and the acorn tube are mounted at one end of the "paddle."

A small paper scale is pasted to the front of the bracket that supports the tuning condenser, and an approximate frequency calibration is inked in.

To use the gadget to check the resonant frequency of a tuned circuit, hold it with its coil near the circuit in question and tune the dial. At the point of resonance, the grid current indicated will dip sharply.

The unit can also be used to detect the presence of v.h.f. parasitics in low-frequency gear by similar methods. Hold it with its coil near a tuned circuit in which a parasitic is suspected and tune through the condenser range. A sharp kick in grid current will be indicated when the unit is tuned to the spurious frequency.

With the layout and coil dimensions shown, this unit tuned the range between 128 and 160 megacycles.

— *C. Vernon Chambers, W1JEQ*

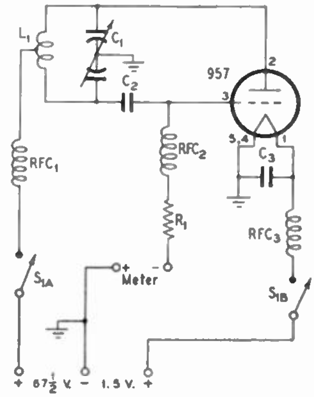


Fig. 7-16 — Schematic diagram of the v.h.f. grid-dip meter.

C_1 — 11-μμfd. "butterfly" variable (Johnson 160-211).
C_2 — 50-μμfd. ceramic (National XLA-0).
C_3 — 680-μμfd. mica.
R_1 — 68,000 ohms, ½ watt.
L_1 — 2 turns No. 12 wire, 1⁵⁄₁₆-inch i.d., turns spaced ¹⁄₃₂ inch. Ends of coil extend ⅝ inch past o.d. of coil.
RFC_1, RFC_2, RFC_3 — 1-μhy. r.f. choke (National R33).
S_{1A-B} — D.p.s.t. "push-button" type toggle switch, normally open.

8. Hints and Kinks . . .

for Keying and Monitoring

AUTOMATIC BREAK-IN CIRCUIT

With the automatic break-in circuit shown in Fig. 8-1, the transmitter is turned on with the first dot or dash, and is automatically turned off a predetermined interval (usually one-third to one second) after the operator stops keying. Between "on" and "off," the rig may be keyed as usual, provided that at no time is there an interval between keying characters of more than the length of time required for the automatic "off" action to take place. Thus the need for a stand-by switch is eliminated, permitting fast, efficient operation with the key as the only operating control.

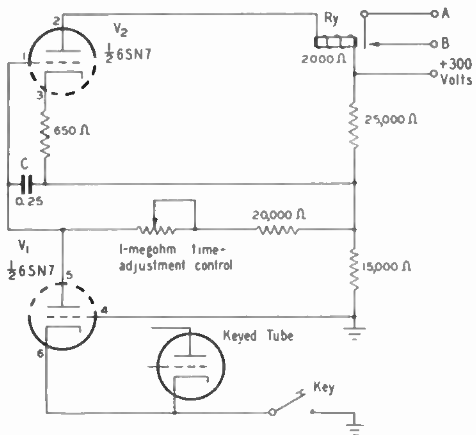


Fig. 8-1 — An automatic break-in circuit with adjustable time delay.

The circuit has two divisions, V_1, which fully charges condenser *C* each time the key is closed, and V_2, which has a s.p.s.t. relay (contacts normally closed) for switching the whole rig on and off in its plate circuit, and a time-delay circuit in its grid return.

Under "key up" conditions, V_1 is cut off, as its cathode circuit is open, and V_2 is conducting, holding contacts *A* and *B* of the sensitive relay open. When the key is closed for the first time, V_1 conducts, and its plate current, flowing through the potentiometer, increases the bias on V_2 beyond cut-off, causing the relay to close the circuit between *A* and *B*. The condenser *C*, in the meantime, has charged fully, acting as a holding bias to keep V_2 cut off. When the key is next opened, *C* starts to discharge through the potentiometer, but because the time constant of the circuit is long, it cannot discharge fast enough to permit V_2 to become conductive before the next keyed character comes along to charge it up again. Thus, the circuit between *A* and *B* remains closed so long as dots and dashes are coming along at the usual keying rate. Once the key is left open long enough for *C* to discharge, however, the circuit opens, taking the transmitter off the air. The time delay used may be adjusted to suit the operator's individual keying speed by means of the potentiometer.

The relay may be used to close the circuits of a number of other relays, thus permitting complete station control from the key. If the delay obtained is too long or too short, try replacing the condenser *C* with another of the same value. Sometimes the actual capacitance may not be that shown on the label, and in one instance I found one, with the correct label and size, that gave a delay of fourteen seconds, while most condensers tried gave a two- or three-second delay at the maximum.

I suggest that the transmitter power-supply circuit be examined to insure that the automatic break-in circuit cannot turn off the same power supply that furnishes its plate voltage! If desired, a switch may be connected across the relay contacts to disable the automatic break-in circuit when you are asked to QRS when the delay circuit has been adjusted for fast keying.

— *Henry L. Cox, jr.*

QUIET BREAK-IN OPERATION

In the November, 1945, *QST* Clayton C. Gordon, W1HRC, asked for a way to eliminate

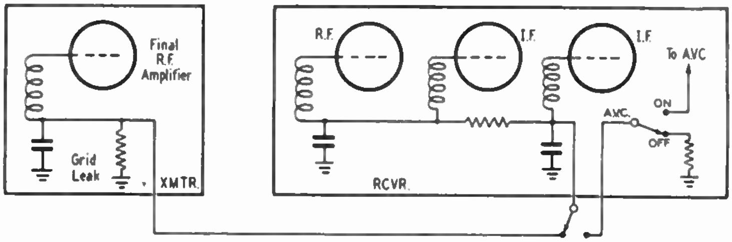


Fig. 8-3 — **Simplified schematic diagram of a gadgetless break-in system that is adaptable to many rigs with almost no effort.**

the annoying racket in the receiver when working break-in on spot-frequency nets. There are undoubtedly many others who have wrestled with the same problem who may be interested in the system shown in detail in the schematic diagram of Fig. 8-2. This was in use at W8BLO in the period prior to the war, working out very nicely in AARS work.

An auxiliary gain control, R_1, is inserted at the ground end of the normal receiver r.f. gain control, R_2. Relay Ry_2 is connected across R_1, shorting it out when the key is up. This relay and Ry_1 (the keying relay) operate from the same source of power. The normal receiver gain control, R_2, is adjusted for satisfactory reception of incoming signals; then, with the key down and the transmitter running, R_1 is adjusted for the desired level of reception of the signal from the transmitter. This system does not produce the loud clicks which result when the receiver is switched off entirely when the key is pressed, and in addition it gives one a continuous monitoring of his own signal. To protect the receiver, in case it is desired to use the transmitting antenna for receiving, an additional relay should be used to remove the antenna from the receiver when the key is pressed.

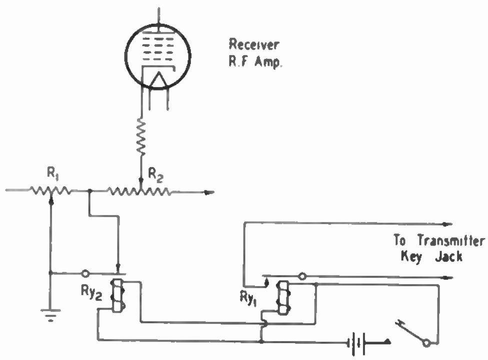


Fig. 8-2 — **A system for obtaining quiet operation when working break-in on spot-frequency nets.** Ry_2 **is similar to** Ry_1 **except that it is normally closed.**

Another idea I found useful in conjunction with this system was to feed the output of my monitor into the grid of the first audio tube of my receiver, enabling me to monitor my transmissions while working someone not on my own frequency.

— *Elwyn Guest*

A GADGETLESS BREAK-IN SYSTEM

Shown in Fig. 8-3 is a smooth-working break-in system that requires only a short length of wire and a s.p.d.t. toggle switch, plus a few minutes to hook it up. In operation it provides all the features of more complex systems, and makes working BK a pleasure. It is adaptable to any rig that contains an unkeyed self-biased stage.

A wire is run from the bias end of the grid leak to the a.v.c. line in the receiver. Thus, when excitation is present, the bias voltage developed across the grid leak is applied to the a.v.c.-controlled tubes in the receiver, reducing their gain to the point where the signal from your own rig comes out about S4. Should the other station wish to break you, he merely sends BK a couple of times, and you hear him at his normal signal strength because the receiver returns to full sensitivity between keyed characters.

At W3HLK, this system has been used successfully with a BC-459-A, which develops about 60 volts negative bias across the grid leak of the amplifier stage, and an SX-24 receiver. It should work satisfactorily with any similar set-up.

— *W. H. Packer, W3HLK*

A VERSATILE 'PHONE MONITOR

Fig. 8-4 shows the circuit of a versatile unit that will find several uses in almost any 'phone station. It can be put to the following uses: (1) to monitor the audio quality of the signal; (2) to observe carrier shift and thus detect overmodulation; (3) to read (after calibration) average percentage modulation. The circuit is simple to construct, easy to adjust, and as reliable as most of the more expensive commercially-built gadgets of similar nature.

A dual triode is used, with one section diode-connected, the other serving as a Class A audio amplifier. A 0–1 d.c. milliammeter is switched to read either the plate current of the diode or the output of the audio amplifier.

To use the unit as a simple quality monitor, the pick-up antenna is loosely coupled to the output of the transmitter, and the tuned circuit resonated. R_4, and the coupling to the transmitter, then serve as a volume control. The meter switch should be set to Position 2 when this use is made of the unit. In this position, it reads the plate current of the diode, and also serves as a resonance indicator.

For observation of carrier shift, the same procedure is followed. Any change in the meter reading under modulation will indicate carrier shift.

When an oscilloscope is available, the unit may be calibrated to serve as a direct-reading percentage-modulation indicator. To calibrate, the unit is coupled to the transmitter, R_4 is turned all the way off, and the meter switch is placed in Position 2. The coupling is adjusted to provide a full-scale reading while the carrier is unmodulated. R_2 permits a fine adjustment of this reading. The meter switch is then set to Position 1, and sine-wave modulation is applied to the carrier. Observing the modulation at the same time on a 'scope, the audio level should be increased until the carrier is 100 per cent modulated. R_4 is then adjusted to provide full-scale deflection of the meter. Thus, the meter has been calibrated to read full scale on 100 per cent sine-wave modulation. When speech input is used on the transmitter, the meter will read only about 25 per cent of full scale at 100 per cent modulation. R_4 can be used to bring the meter to full-scale deflection at 100 per cent *average* speech modulation by similar calibration against a 'scope, after which sine-wave modulation would cause the meter to read off scale. It should be remembered that the transmitter should never be modulated so heavily that the meter reads full scale, because while the *average* may be well under 100 per cent, *peak* speech values will be well in excess of 100 per cent, causing illegal splatter. Properly used, however, this unit can serve as a highly satisfactory indicator.

— *Wilf Moorhouse, VE7US*

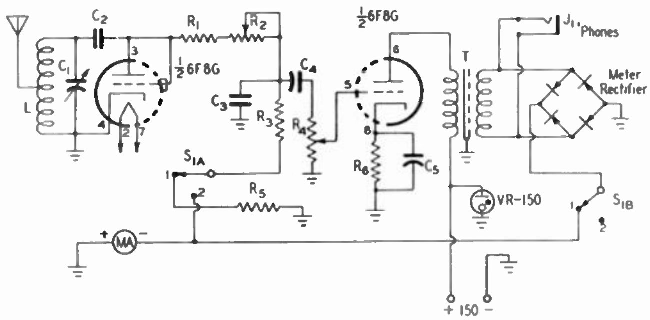


Fig. 8-4 — Circuit diagram for a versatile 'phone monitor that includes means of observing carrier shift and percentage of modulation.

C_1 — Receiving-type variable, suitable to tune desired range with *L*.
C_2, C_3 — 100-μμfd. mica.
C_4 — 0.01-μfd. paper.
C_5 — 20-μfd. 25-volt electrolytic.
R_1 — 33,000 ohms, ½ watt.
R_2 — 10,000-ohm potentiometer.
R_3 — 4700 ohms, ½ watt.
R_4 — 0.2-megohm potentiometer.
R_5 — Equal to meter resistance.
R_6 — 2200 ohms, 1 watt.
L — As required to tune to desired range with C_1.
J_1 — Open-circuit 'phone jack.
MA — 0–1 d.c. milliammeter.
S_{1A-B} — D.p.d.t. toggle switch.
T — 3:1 audio transformer.

THE "MONITONE" AS A 'PHONE MONITOR

The "Monitone" keying monitor described in September, 1948, *QST* and the 1949 *Handbook* may also be used for 'phone monitoring with a simple addition to the original circuit. Thus the gadget becomes doubly useful, and is a good bet for the man who operates both c.w. and 'phone.

Solder a lead from the positive side of the 1N34 crystal diode to the ungrounded side of the 'phone jack through a s.p.s.t. switch. To use the unit as a 'phone monitor, turn the power switch *off* and close the added switch. For c.w. monitoring, open the new toggle switch and use as described in the original article.

— *Paul Hescock, W1PRE*

"Q5-ER" AS VERTICAL AMPLIFIER FOR AN OSCILLOSCOPE

The "Lazy Man's Q5-er" (BC-453) makes an ideal vertical amplifier for an oscilloscope, and in so doing produces wave-envelope patterns of any signal the receiver is tuned to. The Q5-er is connected to the receiver in the usual fashion, and a lead is run from Pin 4 of the 12SR7 tube in the Q5-er to the vertical deflection plate of the 'scope tube. A linear sweep is needed, of course, but in most cases this will already be present.

In monitoring 'phone signals, percentage of modulation can be seen at a glance. Overmodulation, carrier hum, and the "make" and "break" characteristics of c.w. signals can also be observed. The connection to the 12SR7 does not interfere with normal functioning of the Q5-er.

— *A. T. Purseglove, W1QFB*

DUAL-TONE KEYING MONITOR

During a lonely watch aboard ship an idea for a unique type of audio keying monitor came to mind. Instead of a pure 500- or 1000-cycle note, this dual oscillator will produce a complex tone that brings joy to the heart of the brasspounder.

The idea, shown in Fig. 8-5, is simply to use the sections of a dual triode as separate audio oscillators, beating with each other. Their output is combined in a coupling transformer connected to 'phones or 'speaker. The tone is keyed by an open-type

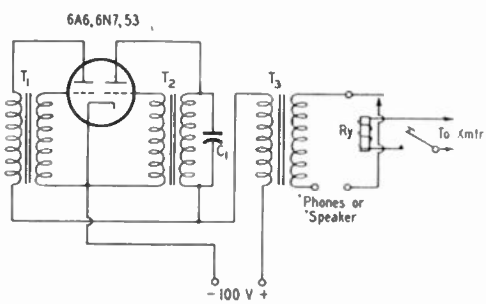


Fig. 8-5 — Dual-tone audio-oscillator keying monitor.

C_1 — 500 μμfd.
Ry — Normally open type s.p.s.t. relay to carry keying-circuit current through field coil.
T_1, T_2 — 3:1 audio transformers.
T_3 — Coupling transformer, 1:1, or may be same as others.

relay in series with the transmitter keying circuit. The field coil of the relay should be capable of carrying the normal load of the transmitter keying circuit.

It may not be necessary to use C_1, as most audio-transformer windings differ sufficiently to tune the separate oscillators to slightly differing frequencies, thus producing a complex tone.

— *J. C. Nelson, W2FW*

UNTUNED KEYING MONITOR

To eliminate the need for retuning the keying monitor every time transmitter frequency is changed, the gadget shown in Fig. 8-6 was designed. The entire set-up is simple, noncritical, and can be built compactly, permitting its use inside the receiver cabinet. There, out of the way, it does a nice job without readjustment no matter how often you QSY.

A 1N34 crystal detector is used to provide a small rectified voltage from the r.f. signal picked up on a short antenna placed near the transmitter. This voltage is then used to overcome an initial blocking bias on an oscillator tuned to the i.f. frequency of the receiver. The signal thus created appears in the rest of the receiver the same as any other c.w. signal, beating with the b.f.o. and producing any tone or volume that the operator may desire. The r.f. stages of the receiver are killed by rewiring the stand-by switch so that it removes B+ from them but permits the i.f. and audio stages to function normally.

In adjusting the unit for operation, the bias on the 6J5 must be set so that the oscillation is just triggered with each keyed character and is killed between characters. This is controlled by potentiometer R_4. The output condenser is merely clipped onto the grid of the first i.f. tube. Overcoupling to the i.f. grid will produce a signal rich in harmonics that is less tiring to the ear, but may detune the i.f. stage. The location of the cathode tap on the 455-kc. i.f. coil used as the oscillator inductance should be determined experimentally. Somewhat more than the usual "one-third up from ground" will give best results, assuring sufficient feed-back to permit the oscillator to follow fast keying. A fairly high-C circuit should be used here to obtain the degree of stability desired. Some experimentation may also be required to get the correct value for R_1. Too much resistance here will result in lack of rectified voltage, too little in excessive crystal current.

— *Rowland C. Medler, W4ANN*

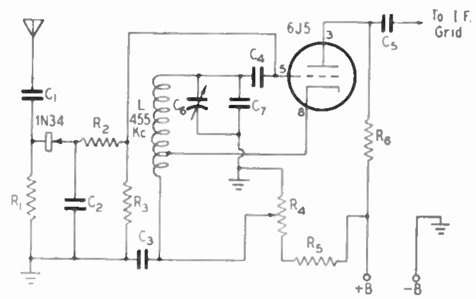


Fig. 8-6 — An untuned keying monitor that may be installed inside the receiver cabinet.

C_1 — 220-μμfd. mica.
C_2 — 0.001-μfd. mica.
C_3 — 0.01-μfd. paper or mica.
C_4 — 100-μμfd. mica.
C_5 — 5-μμfd. mica.
C_6, C_7 — As required to tune inductance to i.f. frequency of receiver.
R_1 — 1000 ohms, ½ watt.
R_2 — 0.47 megohm, ½ watt.
R_3 — 1 megohm, ½ watt.
R_4 — 20,000-ohm potentiometer.
R_5 — 0.1 megohm, ½ watt.
R_6 — 47,000 ohms, ½ watt.
L — 455-kc. i.f.-transformer coil, modified. (See text.)

AN AUDIO OSCILLATOR IN THE RECEIVER

Here's what I believe to be the simplest solution to the problem of setting up an audio oscillator to keep that fist in shape. Here's the deal. Take any radio receiver, add a condenser (about 0.01 μfd.) and a key in series between the second a.f. plate and the first a.f. grid as shown in Fig. 8-7. The volume control, R, becomes a pitch control as it affects the feed-back. When the key is open, the receiver functions normally. There are no batteries, power supplies, or gadgets kicking around in the way — nothing but the receiver that was there in the first place.

— *James E. Shea*

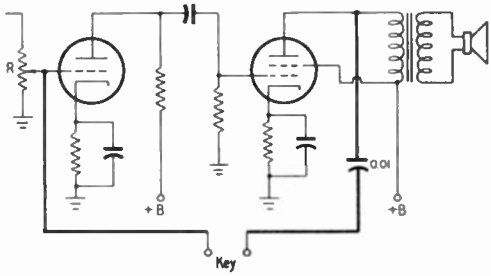


Fig. 8-7 — Converting the audio amplifier of a receiver to an audio oscillator. The volume control, *R*, becomes the pitch control when the coupling condenser and key are wired in as shown by the heavy line.

RECEIVER B.F.O. AS KEYING MONITOR

It may not have occurred to some of those who have added a "Q5-er" to their communications receivers that the idle b.f.o. in the receiver may be used as a convenient keying monitor.

If oscillator cathode keying is used in the transmitter, the b.f.o. can be keyed simultaneously simply by tying the two cathodes in parallel, as shown in Fig. 8-8. Otherwise, the b.f.o. can be keyed with a relay.

If desired, the usual b.f.o. switch can be replaced with a s.p.d.t. switch, as shown at S_1, so that the b.f.o. can be switched from normal use to use as a monitor.

If the electron-coupled circuit is used in the b.f.o., as shown in Fig. 8-9A, the circuit may be keyed by parallel feeding the cathode as at B.

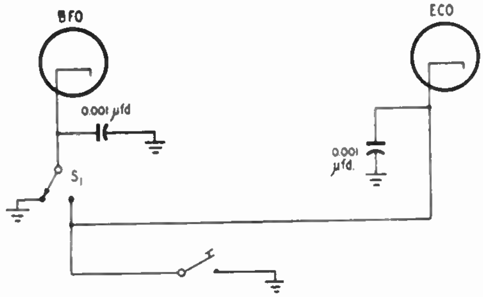


Fig. 8-8 — Keying the idle b.f.o. in a receiver that is used with a "Q5-er," to provide a keying monitor. In some receivers, it is merely necessary to tie the two cathodes in parallel, and install a switch to return the b.f.o. to its normal use when desired.

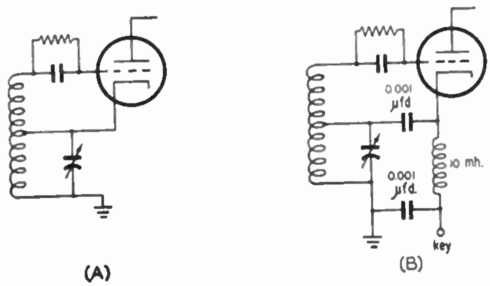


Fig. 8-9 — If the receiver b.f.o. uses the electron-coupled circuit as shown at A, it may be keyed by parallel feeding the cathode as shown at B.

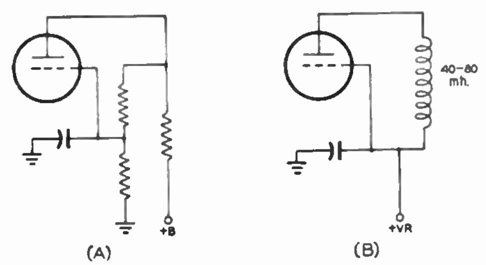


Fig. 8-10 — In cases where dropping resistors in the b.f.o. circuit (A) result in a chirpy note when it is keyed, voltage regulation may be added as shown at B.

Usually the b.f.o. is operated at low voltage through dropping resistors, as indicated in Fig. 8-10A. These resistors may be responsible for a chirpy monitor signal. If this is the case, the chirp can be eliminated by operating the b.f.o. from a VR tube working from the receiver power supply as shown in Fig. 8-10B. The b.f.o. voltage should be checked first and an appropriate VR tube selected. A VR-75 will serve in most cases.

— *Don Mix, W1TS*

A FLASHER-TYPE PEAK-INDICATING MODULATION MONITOR

The purpose of this "kink" is to describe a simplified version of one of those expensive and complicated broadcast station monitors — the kind that flashes an indicator light every time the modulation on peaks exceeds a pre-set percentage.

The indicator operates by comparing the d.c. and a.c. components that result from the detection of a modulated carrier by a diode. The relationship between these voltages is such that the audio voltage is proportional to the percentage of modulation and just equals the d.c. voltage when the carrier is modulated 100 per cent. This relationship is independent of carrier strength, so a meter operating on the comparison basis will be independent of its r.f. input voltage and will operate with accuracy without readjustment for various transmitter input powers. [For a detailed explanation of the theory of operation the reader is referred to May, 1948, *QST*. —*Ed.*]

Fig. 8-11 gives the circuit diagram of this handy device. When plate voltage is applied, C_6 charges to practically 250 volts through R_7 and R_9. R_8 and R_9 form a bias network similar to R_4 and R_5. R_9 is adjusted for cut-off, indicated by extinguishing the neon bulb. On modulation peaks V_2 conducts. It has in its plate circuit a transformer with the windings polarized so that the grid of the gas tube goes positive when the plate of V_2 starts to conduct. If the polarity of the transformer is reversed, the gas tube is driven more beyond cut-off and nothing happens. Trusting that you were lucky and the transformer secondary has been properly connected, the gas tube conducts, discharging C_6 through the neon bulb. Gas tubes have the characteristic that the grid no longer has any effect on plate current once the plate starts conducting, so the bulb remains lit until C_6 has discharged to the point where it no longer has enough voltage across it to maintain conduction through the gas tube and the neon bulb. R_7 is high enough in resistance so that sufficient current cannot be supplied to maintain conduction either, so the neon bulb becomes extinguished and the gas tube deionizes. The grid then regains control and C_6 leisurely charges up again while the circuit waits for another peak to come along. This whole cycle takes a short time and the bulb can flash brightly about twice a second. If another peak occurs before C_6 becomes fully charged, the flash will occur but will be of shorter duration; if the meter was set for 100 per cent modulation (using R_1), you had better back off on the speech gain because you are overmodulating. The length of the flash is independent of the modulation peak, because the gas tube loses control once it starts conducting.

It requires very little r.f. to operate the unit. A short piece of wire near the feeders, in the field of the antenna, or near the final tank, will pick up enough r.f. to swing the meter to nearly full scale. The larger the signal applied, the more accurate the flash indication will be.

No constructional data are given because parts locations are not critical and the builder will probably lay them out to suit himself in any event. The unit can be operated from the receiver power supply, can be built into the rig, can have its own power supply, or can otherwise be adapted to fit into the station arrangement. Any diode can be

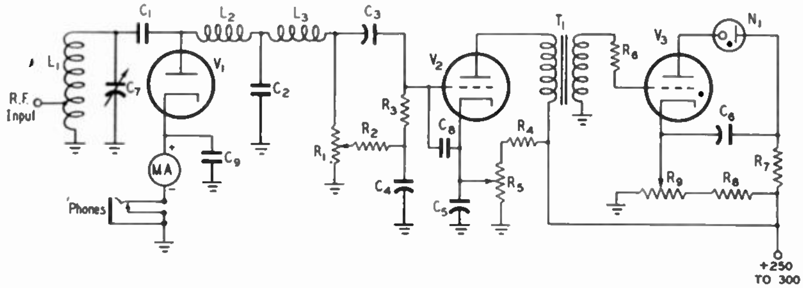


Fig. 8-11 — Circuit diagram of the flasher-type modulation indicator.

C_1, C_2, C_8, C_9 — 100-μμfd. mica.
C_3 — 0.01-μfd. 600-volt paper.
C_4, C_6 — 0.1-μfd. 600-volt paper.
C_5 — 10-μfd. 50-volt electrolytic.
C_7 — 100-μμfd. air variable.
R_1 — 50,000-ohm wire-wound linear potentiometer.
R_2, R_3 — 1 megohm, ½ watt.
R_4, R_8 — 0.1 megohm, 1 watt.
R_5, R_9 — 10,000-ohm potentiometer.
R_6 — 10,000 ohms, ½ watt.
R_7 — 0.22 megohm, ½ watt.
L_1 — Tune to operating frequency with C_7.
L_2, L_3 — 2½-mh. r.f. choke.
MA — 0–2 d.c. milliammeter.
N_1 — 115-volt ¼-watt neon bulb.
T_1 — Interstage audio transformer.
V_1 — Any diode.
V_2 — High-μ triode.
V_3 — Gas triode (884, 885, 2050, 2051, etc., triode-connected).
(V_1 and V_2 may be the two halves of a 6SL7, the half used for V_1 having grid and plate tied together.)

used for the detector, V_1, and this includes the crystal types such as the 1N34. The triode V_2 should be of the high-μ variety, so that cut-off voltage is low, resulting in better accuracy. The audio transformer can be any type of interstage transformer you may happen to dig out of the junk box, but you may have to reverse connections to the primary or secondary, as described earlier. The gas tube can be any of the types used for oscilloscope sweep generators, or one of the types used in relay circuits, such as the 2050 or 2051 (triode-connected). The potentiometer R_1 should be a wire-wound linear type. It can be calibrated and a special dial made, if you desire, by reading resistance with an accurate ohmmeter and marking the dial according to percentage of resistance between ground and the moving contact.

The meter *MA* indicates carrier shift, and the 'phone jack allows you to listen to your melodious voice as you call CQ, or gives you a chance to listen to the carrier when you are trying to locate the source of hum or distortion.

The tuned circuit L_1C_7 is left up to the builder. Coil-and-condenser combinations will depend on the band to be covered, and what the builder has on hand. The tap should be at about a third of the turns from the ground end.

The only precaution in construction is to isolate the grid of V_2 to prevent r.f. from getting into it. This causes inaccuracy when the grid gets down to nearly zero voltage. Isolation is not difficult, and r.f. probably will cause no trouble at all if a 100-μμfd. mica capacitor (C_8) is connected directly between grid and cathode. The unit in operation on the author's 10-meter 'phone rig uses one half of a 6SL7 for the diode and the other half as V_2, and no trouble was encountered so long as the mica r.f. by-pass was used.

Before applying any r.f. adjust the bias on V_2 so that the plate current is ¼ milliampere or less. A milliammeter can be connected directly across the primary of T_1 for this adjustment, since the transformer-winding resistance will be high enough to have practically no effect on the meter reading. Then adjust the bias on V_3, the gas tube, to the point where the neon bulb is extinguished but the bulb will flash when the grid lead is touched with a screwdriver. Touching this grid lead induces enough voltage through stray pick-up to trip the gas tube and flash the neon bulb. The value of R_7 *may* have to be increased when tubes of types other than the 2051 are used. Next, apply the carrier and tune C_7 for maximum meter reading, then move the pick-up lead around until the meter reads near full scale. Now R_1 can be set for any desired percentage of modulation and the neon bulb will flash when that modulation is reached or exceeded. If you are a stickler for accuracy, you might apply sine-wave modulation to your transmitter, adjust it for exactly 100 per cent as checked with a 'scope, set R_1 for 100 per cent and then adjust R_5 until the neon bulb just flickers. With the rough adjustment described earlier, the bulb may flash at about 95 per cent. Luckily, the error is in the legal direction and is of small magnitude.

The only caution in regard to adjustment is in connection with the point where the r.f. is picked up. If r.f. is picked up from some stage ahead of the modulated stage, the meter cannot flash at 100 per cent modulation because the r.f. can never reach zero, as it should, at the negative modulation peak. Once the thing is adjusted it probably can be operated indefinitely without readjustment. Mine has been operating for 18 months and is still accurate enough so that it isn't worth adjusting it. Perhaps when tubes are changed, adjustment should be made.

This instrument flashes the neon bulb when the modulation *down*-peak reaches the selected percentage. The instrument could have been designed to operate on up-peaks, but it was thought that "negative"-peak indication would be more desirable. Inequality between "negative" and "positive" peaks can be seen by motion of the meter when the carrier is modulated (carrier shift). A slight flicker of the meter occurs when a strong peak causes the grid of V_2 to go positive and draw some grid current, but this is accompanied by a flash of the bulb, warning that the modulation is excessive. Correction of the modulation corrects the slight flicker.

The DX boys should find good use for this gadget because it will give them means of keeping the modulation right up there where it counts.

— *John S. Denham, W6NPO*

A PLUG FOR YOUR BUG KEY

Here is a practical homemade plug that I have used on my bug for the past four years. It may prove useful to other bug handlers.

My plug, shown in Fig. 8-12, was made from the tapered part of a discarded fountain pen. The closed end was sawed off, and the "works" inserted. I used two straight blades from an old 'phone jack and a flat piece of insulation cut just a little wider and about a quarter inch longer than the jack blades. The cord extends out the other end of the pen barrel after having been soldered onto the jack blades. Although it may not always be necessary, sealing compound or wax may be poured in to fill the area around the blades to hold

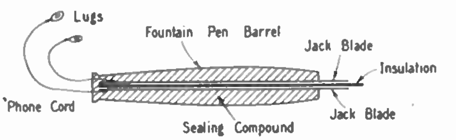


Fig. 8-12 — A plug for your bug.

them firmly in place. The cord is then attached to the bug using the lugs on the ends of the cord.

— *Wesley W. Brogan, W3ARM*

USING A PANORAMIC ADAPTER AS A MODULATION MONITOR

Here is a simple modulation-monitor idea for owners of panoramic adapters. A small d.p.d.t. relay operating from the transmit-receive switch in the transmitter is installed at the base of the 'scope tube in the adapter. The leads to the vertical deflection plates of the 'scope tube are disconnected and transferred to the normally closed pair of contacts on the relay. A pick-up loop and a link line, with a 0.001-μfd condenser in series, is then connected to the normally open pair of contacts, and is brought out so that it may be coupled to the final tank coil. The vertical deflection plates are then connected to the moving-arm contacts of the relay. No other changes are necessary.

The adapter operates normally in reception, but when the transmitter is turned on, the modulated r.f. envelope appears on the screen, permitting continuous monitoring of modulation. The position of the coupling link must be adjusted to give the correct pattern height.

— *Earl E. Ferguson, W5PAG*

VARIABLE INDUCTANCE FOR KEYING FILTERS

Here's a little stunt that may be old, but it does the job when a variable inductance is desired in your keying filter. In place of the usual iron-core choke, use the primary of a small 6.3-volt filament transformer as shown in Fig. 8-13.

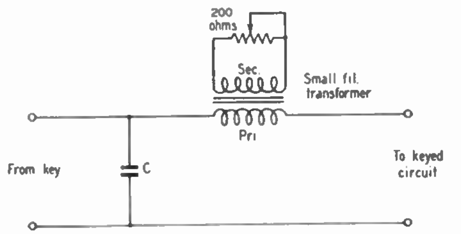


Fig. 8-13 — **A method of obtaining a variable inductance for your key-click filter. A filament transformer is used in place of the usual choke, and the inductance is varied to suit your own taste by a resistor across the secondary.**

A variable resistance of about two hundred ohms is connected across the secondary. By varying the resistance across the secondary, a continuous variation of the inductance of the primary is possible. When the secondary is completely shorted, the clicks come through just as though no inductance is in the circuit. The resistance can then be increased until the keying characteristic is as soft or hard as desired. The condenser value varies, of course, depending on the amount of current being keyed, as mentioned in the *Handbook*.

— *J. A. Turner, W9LI*

SPEED-KEY ADJUSTMENT

Correct sending with a semiautomatic speed key requires considerable manual skill which can only be acquired by practice. However, no amount of practice will produce accurate sending if the key itself is improperly adjusted.

The inked-line tape recorder provides an accurate and graphic means for "bug" adjusting. Such a recorder was described in *QST* [1] for April, 1943. Another method, using a milliammeter as an indicator, was described in *QST* [2] for February, 1934.

Preliminary Adjustments

The contact points should be carefully cleaned using a relay burnishing tool or crocus cloth. If the points are pitted, an initial dressing-off with an oil stone may be necessary, in which case care should be taken to keep the entire surface of the contact flat against the stone.

Occasionally a bug will sound "scratchy," particularly when keying an audio oscillator. If the dots are poor, the trouble is generally dirty or poorly-aligned contacts. If the trouble is on the dash side, it may be due to high resistance

[1] J. P. Gilliam, W9SVH, "A Siphon Tape Recorder . . .," *QST*, April, 1943.

[2] F. H. Schnell, W9UZ, "How's Your Fist?" *QST*, February, 1934.

between the dash lever and the shaft pivot. A flexible by-pass conductor from the dash contact adjusting screw to the frame should give a permanent cure.

Make sure that the movable and fixed dot contact points are parallel and have good contact over their entire surface. Horizontal adjustment of the movable dot contact is made by loosening the screw *L* (Fig. 8-14). Vertical adjustment is accomplished by means of the pivot bearings *J*. The pivot bearings should be adjusted so that no play can be felt when finger pressure is applied vertically to the shaft at its outer end.

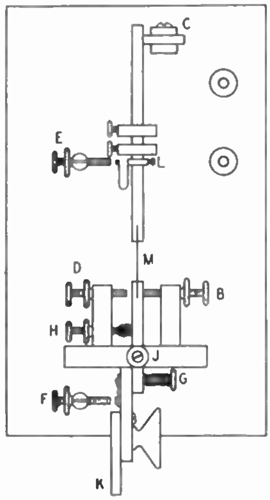


Fig. 8-14 — Critical points in adjusting a "bug."

For the preliminary adjustments, the weights should be at least halfway down the shaft. For a given speed, the exact position will vary considerably with the stiffness of the flat spring *M*.

Back off the screw *B* until the end of the shaft is resting against the damper weight *C*. Apply pressure to the thumb paddle *K*, moving the shaft slowly toward the dot side, without allowing it to vibrate. If the adjustment is correct, the entire shaft will remain straight as it leaves the stop screw and the damper weight. If screw *B* is backed off too far, the flat spring will bend to the left before the end of the shaft clears the damper weight. The stop screw should be backed out as far as possible to allow good damping action by the weight *C* without bending the flat spring when the thumb paddle is pressed slowly to the dot side. This adjustment is somewhat critical and should be carefully made.

Again press the shaft to the dot side without allowing it to vibrate. Vary the stop screw *D* until there is a gap of approximately 1/8 inch between the side of the shaft and the damper weight. This determines the swing of the shaft.

The dash adjustment is made by varying the screw *F* until the operating paddle moves the same distance to the left of center to make a dash as it moves to the right to make dots. If the paddle travel is excessive on the dash side, choppy sending is almost sure to result with spaces too wide between successive dashes If the travel is too small, the dashes may be insufficiently spaced.

The coil springs *G* and *H* should be adjusted to approximately the same tension. This will vary with the individual operator, but in any case the spring *H* should have sufficient tension to return the shaft quickly and positively from the dot side to the rest position against the damper weight. The dash spring is then adjusted to a corresponding tension. Operators of fixed stations will generally prefer a comparatively light adjustment to minimize arm fatigue, particularly if a large amount of traffic is handled. Flight operators of Pan American Airways have found that a rather stiff adjustment is necessary; otherwise, when flying in rough air, sudden motions of the aircraft will result in unwanted dots. Marine operators will find that a medium stiff adjustment will compensate for the ship's roll.

Final Adjustment

The final adjustment of the dot contacts should be made with the bug operating a tape recorder, if available. The shaft is moved slowly to the left without allowing it to vibrate. The dot contact *E* is then moved to a position where it will just make contact with the movable point without noticeably bending the "U"-shaped dot spring. Start the recorder, pulling the tape through the machine at the rate of at least 20 feet per minute. Press the operating paddle smartly to the dot side. The resulting dots on the tape should be "square," that is the length of a dot should be equal to the space between two dots (Fig. 8-15C). If the paddle is held to the dot side, a series of at least 15 to 20 dots will be made with most bugs before there is any noticeable reduction in spacing between dots. If the dot adjustment is screwed in too far, a short series of heavy dots with very little separation will result, after which the points will remain in contact even though the shaft continues to vibrate. If the adjustment is screwed out too far, very light dots with excessive spacing will result. This adjustment is extremely critical, the allowable deviation of the screw *E* being only a small fraction of a turn.

With the recorder still operating, shift the weights along the shaft according to the speed desired. Many bugs are set to make excessively fast dots. It will be found that most keys having a normal stiffness in the flat spring can be operated at a speed of about 30 w.p.m. with

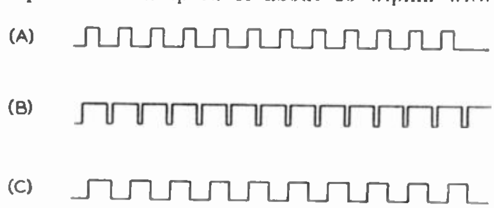


Fig. 8-15 — (A) Dot contacts too far apart. (B) Dot contacts too close. (C) Dot contacts correctly adjusted.

both weights toward the outer end of the shaft. Most operators cannot properly control a bug if the dot speed exceeds 11 per second. The rate at which your bug is adjusted can be easily determined by making a string of dots on the recorder tape for 3 to 5 seconds, timing with a stop watch, and counting the dots.

The milliammeter method of adjustment involves connecting a battery (or any suitable source of d.c.), rheostat, and milliammeter in series with the bug contacts. A typical set-up might employ a 22½-volt battery, a 1000-ohm rheostat and a 0–100 milliammeter. With the key contacts closed, adjust the rheostat (start with all the resistance in the circuit to avoid burning out the meter!) until the meter reads 100 ma. A string of dots is then produced with the bug and the average-current reading on the meter is noted. If the dots are too light, the reading will be less than 50 ma.; if too heavy, it will be more than 50 ma. The dot contact E is then adjusted, as previously described, until the meter reading hovers at approximately 50 ma. Any combination of voltage, resistance and milliammeter range may be used with this method, provided the meter reading noted during a string of dots is half that observed when the key contacts are held closed.

Obviously, there is no point in making dots faster than the operator is able to make dashes to correspond. The purpose of any telegraphic communication is to convey intelligence. Mistakes in sending have no meaning and confuse the receiving operator. The time taken to repeat an incorrectly-transmitted word will result in a net loss in speed of about two words per minute on the average. Set your bug for a speed at which you can handle it easily and without an appreciable number of errors.

Beginners with a bug, and some old hands too, will do well to imitate the 15-w.p.m. transmissions of W1AW or some press station using punched tape at moderate speed. Confine your practice to an audio oscillator until you are able to send correctly for at least two or three minutes at a rate of 20 w.p.m. During the initial practice stages, the dots should be slowed down to 6 per second. Every effort should be made at the start to achieve good control rather than speed.

— *J. M. Smith*

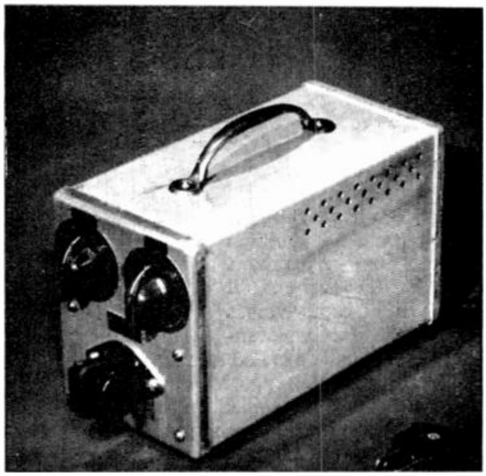


Fig. 8-16 — **The completed electronic keyer occupies little more table space than a conventional bug.**

AN ELECTRONIC KEY OF ADVANCED DESIGN

Fig. 8-18 is the circuit diagram of an electronic keyer built around the principles described in detail by the author in October, 1948, *QST*. The device features self-completing dots and dashes, single-control speed adjustment, and a simple keying lever. Exact circuit values are given to enable duplication.

Operating grid bias is obtained by means of the two divider networks made up of R_7R_8 and R_9-$R_{10}R_{11}$. R_3 and R_5 prevent excessive change in grid-input impedance with variation of the speed-control resistor, R_4. C_3 and R_6 furnish necessary grid-input stabilization. R_3 also serves to fix the maximum operating speed by limiting the current flow through R_4. Maximum resistance of the latter sets minimum speed. Values shown provide a range of approximately 12 to 50 words per minute. R_1 in series with the movable contact of the key lever limits the instantaneous discharge current of the timing network. This minimizes sparking both at the key lever and pulsing-relay contacts. R_{10} is used to vary the bias on V_2 by controlling the bleeder-current flow through R_9. This allows the weight of the keying to be varied to suit the operator's wishes. In addition, it is of advantage in compensating for differing characteristics when tube replacements are made.

High-quality condensers should be used at C_1, C_2 and C_3. Standard-make 600-volt tubulars were used in the keyer illustrated. C_1 consists of 0.05- and 0.1-μfd. units in parallel to give the required 0.15-μfd. capacitance. No particular com-

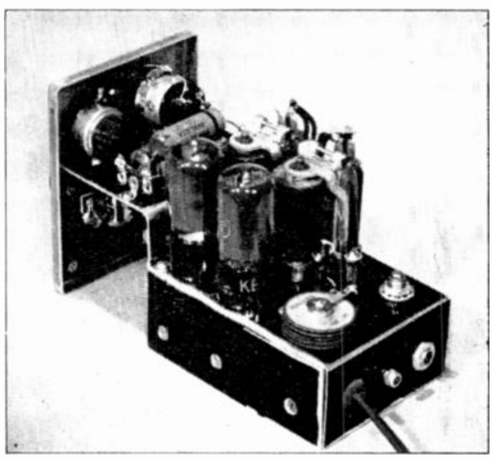


Fig. 8-17 — **Interior view showing the mounting of tubes, relays and other major parts.**

ment need be made on the power supply which uses a standard 100-ma. selenium rectifier. The 150-ohm resistor in the filament circuit drops the voltage to a safe operating value for the 50L6s. The two relays constitute the most critical components in this circuit. These should be identical and of fixed-adjustment wiping-contact design. Coil resistance, of course, must be suitable for vacuum-tube operation. So-called "sensitive plate-circuit" relays of the type having numerous adjustments should be avoided. In the experimental keyer shown in the photographs, the author used 3500-ohm Clare relays. However, any good telephone-type relay with proper contact and coil specifications should be satisfactory.

It is important that relay contact spacing be set at 0.010 inch, as measured between the movable contact and the "make" contact. To set this spacing, use a feeler gauge and carefully bend the "make" contact arm. The overtravel of the relay armature should be sufficient to give moderate wiping action on both the forward and back contacts.

The setting of R_2 in the timing circuit for the correct dot-dash ratio must be made by monitoring a circuit keyed by Ry_2. First, set R_2 at minimum resistance and with the key lever held to the dash position, set the speed control R_4 at about one-quarter scale beyond the point where the keying relay picks up. The speed control should be set at about two-thirds scale. Now, advance R_2 and at the same time swing the key lever alternately from the dot position to the dash position. To the average operator's ear, the point where the dot-dash ratio is about right is readily and easily determined. Once set, the timing circuit needs no further attention. The dot-dash ratio of the keyer will remain true at all sending speeds.

The photographs show how the electronic keyer is built to occupy a minimum of space at the operating position. The construction is compact but not overcrowded. A semiautomatic-key assembly was altered to serve as the control lever. Aside from the portability angle, the author favors a design wherein the keyer is built as a unit separate from the key lever. This makes for a more orderly operating position — since one advantage of a keyer of this type is the simple lever required. Lead length is not critical and the keyer unit can be incorporated right in the exciter unit or transmitter proper. A semiautomatic key can be converted to single-pole double-throw action in a matter of minutes. The shorting connection between the stationary dot and dash contacts is removed and the vibrating arm is locked by strapping it to its backstop with a rubber band.

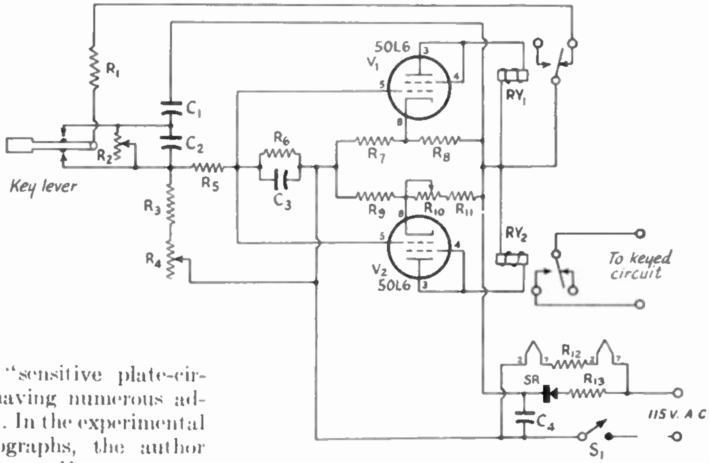


Fig. 8-18 — Practical keyer circuit.

C_1 — 0.15-μfd. 600-volt paper.
C_2, C_3 — 0.05-μfd. 600-volt paper.
C_4 — 40-μfd. 150-volt electrolytic.
R_1 — 470 ohms, ½ watt.
R_2 — 0.5-megohm variable (dot-dash ratio control).
R_3, R_5 — 0.22 megohm, 1 watt.
R_4 — 2-megohm variable (speed control).
R_6 — 2.7 megohms, ½ watt.
R_7, R_9 — 2200 ohms, 1 watt.
R_8 — 10,000 ohms, 2 watts.
R_{10} — 5000-ohm variable (shaping control).
R_{11} — 6800 ohms, 1 watt.
R_{12} — 150 ohms, 5 watts.
R_{13} — 39 ohms, 1 watt.
Ry_1, Ry_2 — Sensitive-type relay (Clare Type J, 3500 ohms, s.p.d.t.).
S_1 — S.p.s.t. toggle.
SR — 100-ma. selenium rectifier.

Contacts are then adjusted to give the desired s.p.d.t. action.

In closing, the writer wishes to acknowledge, with thanks, valuable suggestions contributed by A. R. Burns of Highland Park, Calif., in the development of certain portions of the circuit described.

— *F. A. Bartlett, W6OWP*

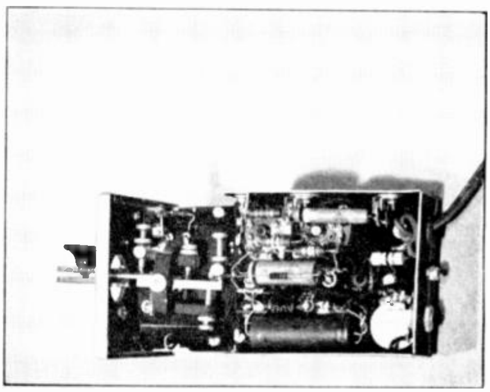


Fig. 8-19 — This bottom view of the electronic keyer shows a compact but orderly arrangement of the minor components.

9. Hints and Kinks . . . for Test Equipment

FIELD-STRENGTH METER WITH ADJUSTABLE ANTENNA

Here is a simple and handy type of field-strength meter for use on any frequency up to 1000 Mc.

This unit has only four main components: a 6-foot flexible roll-up type steel rule, a high-frequency crystal, a d.c. microammeter and a copper ground plate in the bottom of a wooden box. The crystal is connected in series with the ruler and the ground plate, and the meter is connected in parallel with the crystal.

As shown in Fig. 9-1, a small plywood box was constructed with a sloping front panel and with a carrying handle on the top. The flexible roll-up ruler pulls up out of a slot in the top of the box to the required height to give a sufficient deflection on the meter. Pin jacks on the front panel permit the easy placement of shunt resistors across the meter to reduce its sensitivity. (A 0–1 milliammeter has been used in place of the 0–30 microampere meter with some sacrifice in sensitivity.)

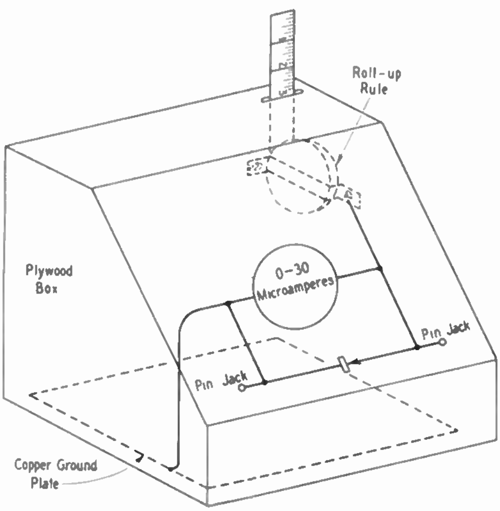


Fig. 9-1 — An X-ray type drawing depicting the connections made in the field-strength meter. Note the counterpoise, a copper ground plate in the bottom of the compartment.

A meter such as this is very handy for tuning up an u.h.f. antenna or transmitter and also may be used to check relative field strengths and directional characteristics of the antenna.

Its use is not limited to u.h.f., and the unit shown here has received as much use in adjusting an airplane transmitter on 3150 kc. as it did in connection with a television antenna on 900 Mc.

This simple meter should not be confused with a wavemeter having a tuned circuit as this one is in no way selective as to frequency. It's a mighty handy gadget, just the same.

— *Philip S. Rand, W1DBM; Harry S. Whittemore, W1BR; and Joseph H. Marchese*

FIELD-STRENGTH MEASUREMENTS WITH A VOLT-OHMMETER

After pondering for some length of time in an effort to avoid having to build a permanent field-strength meter to tune a beam antenna, the following brain child resulted.

Using your volt-ohmmeter, or a 0–1 ma. meter, tie a 1N34 crystal diode across the ends of the test leads where they enter the meter box. Place the ohmmeter, with the leads attached, a half-wavelength or more from the antenna that is to be adjusted. Spread the test leads out on the ground to resemble a dipole with the ohmmeter at the center. Set the ohmmeter to the 0–1 ma. scale, aim the beam at the meter, and turn the transmitter on. The position of the meter may be changed to provide more, or less, deflection of the meter as required. Beam adjustments can then be made as usual.

If the meter registers backward, reverse the connection of the crystal diode. Variations on this may consist of lengthening the test leads to a total length of a half-wave at the operating frequency to increase the "deflection sensitivity" of the set-up. A remote-indicating device may be made by using Twin-Lead to connect a pick-up dipole at some distance to an ohmmeter located at the beam to make one-man adjustment possible.

— *Frederick L. Moore, W4JYB*

FULL-WAVE CRYSTAL-RECTIFIER FIELD-STRENGTH METER

Increased sensitivity can be obtained in the crystal-type field-strength meter by employing two crystals in a full-wave circuit and a microammeter instead of the more common milliammeter. Thus observations can be made with this tubeless instrument at a greater distance from the station transmitting antenna than is possible with single-crystal field-strength meters.

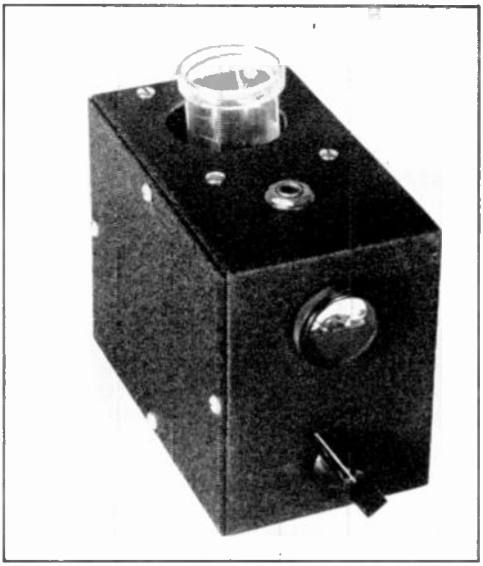


Fig. 9-2 — This field-strength meter, weighing only a few ounces, is small enough to be held comfortably in one hand. It requires no power supply.

The complete circuit schematic is given in Fig. 9-3. Each half of the center-tapped secondary, L_2, is tuned separately by a section of the dual variable capacitor, C_1. A closed-circuit headphone jack, J_1, is provided for aural monitoring of a modulated signal, but headphones should be removed from the circuit when using the microammeter. Six plug-in coils are used to cover the range of 3.5 to 200 megacycles.

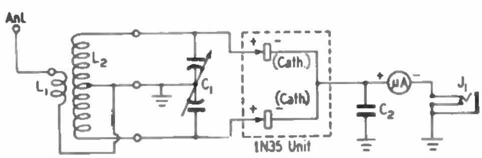


Fig. 9-3 — Circuit of the full-wave crystal-rectifier field-strength meter.

C_1 — 50-μμfd.-per-section midget variable.
C_2 — 0.0022-μfd. mica.
L_1, L_2 — See coil table.
J_1 — Miniature closed-circuit 'phone jack.
μA — 1-inch d.c. microammeter, 200-μa. scale (International Instruments, Inc., New Haven, Conn.).
1N35 — Dual-crystal-diode assembly — Sylvania.

The device is built in a 3 × 4 × 5-inch steel box and is small enough to be held in one hand. The coil socket is mounted on a small piece of aluminum suspended from the top edge of the box on metal pillars at the corners. A clearance hole is cut for the coil so that it may be removed from the top. The tuning condenser is fastened to the front edge of the box. Since the writer did not intend to use the instrument for frequency measurement, the condenser was fitted with a plain knob, but a small dial such as the National type AM may be used if calibration is desired.

COIL TABLE

Dimensions for L_2, Fig. 9-3

3.5-7 Mc. — 86 turns No. 26 enam., close-wound.
7-14 Mc. — 36 turns No. 24 enam., close-wound.
14-28 Mc. — 20 turns No. 22 enam., 1 inch long.
28-54 Mc. — 12 turns No. 22 enam., 1 inch long.
50-100 Mc. — 5 turns No. 22 enam., 1 inch long.
100 200 Mc. — 2½ turns No. 22 enam., 1 inch long.

L_1 in all cases is 1 turn No. 24 wound in space between halves of L_2 (see text).

The double-diode crystal unit is a Sylvania type 1N35, but two individual 1N34s may be substituted if preferred. The crystals are wired in between the tuning condenser and the headphone jack in front of the coil opening. The microammeter is a one-inch instrument with a 200-μa. scale. It is mounted on the front edge of the box above the tuning control. The antenna terminal is a small feed-through insulator at the rear of the box.

The coils are wound on Amphenol type 24-4P four-pin 1¼-inch forms. Winding L_2 is divided into two equal halves spaced slightly on the form to leave room for the single-turn pick-up coil, L_1. The accompanying table gives dimensions for L_2 for various frequency ranges.

When using the field-strength meter, a vertical length of stiff wire, such as bus bar, attached to the antenna input terminal will suffice as a pick-up antenna on all frequencies. The meter may be calibrated in frequency from a signal generator.

— *Rufus P. Turner, K6AI, ex-W1AY*

ANOTHER USE FOR THE CRYSTAL WAVEMETER

For those who have built the crystal-diode absorption wavemeter described in the *Handbook*, Fig. 9-4 shows a method of using it as a sensitive r.f. indicator for tuning antenna systems. The plug-in coil of the wavemeter is removed from its socket and in its place a plug made from an old tube base is inserted. The plug is connected to any convenient length of 72-ohm Twin-Lead. Battery clips may then be used to tap the line across the shorting bar of a stub or at the center of the antenna. The antenna being adjusted should then be loosely coupled to a near-by dipole

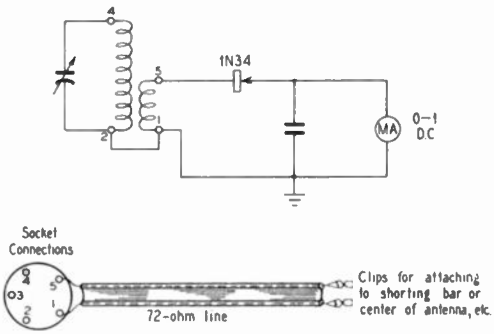


Fig. 9-4 — A method of using the sensitive crystal wavemeter as an r.f. indicator for antenna adjustments. The tuned circuit of the wavemeter is replaced by any convenient length of 72-ohm line. No internal changes are required.

that is connected to the transmitter. Very little power will be required to get a usable indication on the milliammeter. Matching adjustments on the antenna may then be made, observing the results on the meter. It should be noted that the indicator should never be connected to a portion of the antenna that is above r.f. ground potential, as it would then add capacitance and unbalance, destroying the meaning of any reading obtained.

— *George S. Woods, W2SWN*

MEASURING GALVANOMETER RESISTANCE

It is sometimes necessary to measure the resistance of a deflection galvanometer or microammeter when no other meter is available. This can be done very simply, using the instrument to be measured as its own current-indicating device. The other apparatus required consists of a fixed resistor, a calibrated variable resistor or decade box, and a battery cell, connected as shown in Fig. 9-5.

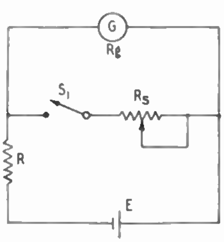


Fig. 9-5 — Measuring the resistance of a meter by utilizing the meter itself as the current indicating device. See text for component values.

The voltage of the battery should be such that R is large compared with the expected value of R_g, the quantity to be measured. R is then chosen to limit the current through the galvanometer to a safe value, preferably near full-scale deflection. R_s must be capable of adjustment to a resistance at least equal to the expected value of R_g. The battery voltage need not be accurately known, but R_s must be known to the same decimal (not *per cent*) accuracy by which it is desired to determine R_g.

With S_1 open, read the current through the galvanometer on its scale. Close the switch and adjust R_s until the reading on G is exactly one-half of the first reading.

If R is large, 100 times or more the value of R_g, then the setting of R_s has the same value as R_g with a small error. For the general case where R is not so large, or to determine the exact value, R_g may be found by application of the formula

$$R_g = \frac{RR_s}{R - R_s}.$$

— *E. M. Yard*

SOME HANDY TEST PROBES

A set of inexpensive test probes using small lamps have been found convenient on my workbench, and they can be carried in the pocket when necessary.

In Fig. 9-6A, a probe which can be used as an ohmmeter is shown. It requires two penlight cells and a pilot lamp such as the Sylvania S48, rated at 0.06 ampere at 2 volts. The lamp will light dimly at about 0.7 volt and about 0.03 ampere. Thus with a 3-volt supply this probe can be used to test circuits with resistances up to about 75 ohms. This range includes many of the coils, transformers and other circuit components commonly encountered. In testing low-resistance leads the current rating of the lamp will be exceeded, although it should "take it" if flashed only momentarily.

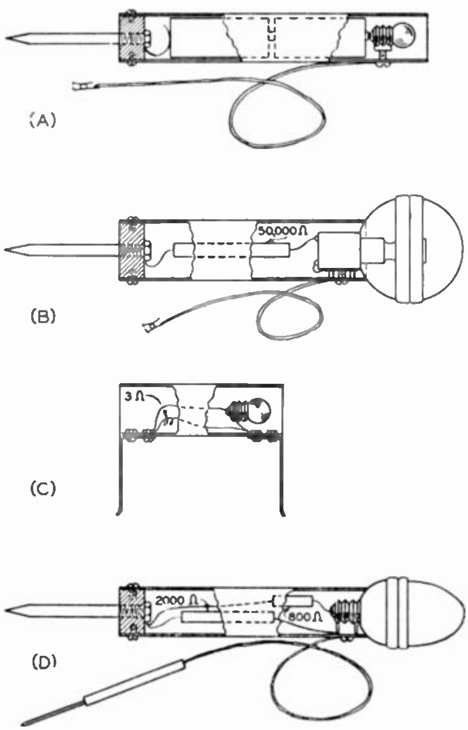


Fig. 9-6 — (A) Probe substitute for low-resistance ohmmeter. (B) Probe substitute for a.c. and d.c. voltmeter. (C) Probe tester for low-voltage cells. (D) Probe tester for high-voltage batteries.

The probe of Fig. 9-6B may be described as a substitute voltmeter for a.c. or d.c. It uses a neon bulb such as the GE type G10, with no resistor in its base. The bulb is connected in series with a 50,000-ohm 1-watt resistor. The starting voltage is about 65 volts, d.c., and 50 volts, a.c. The resistor limits the current to a safe value up to about 400 volts. If too high a voltage is used an arc will start between the elements of the tube. The relatively high impedance of this probe permits its use as a substitute for a voltmeter for testing circuits. It readily determines type and polarity of voltage. On a.c. both elements of the tube will glow. On d.c. that element which is connected to the positive side of the circuit glows. As the brilliancy of the glow increases with the voltage, a rough estimate of the voltage is possible.

The probe shown in Fig. 9-6C is convenient for testing "A" batteries under load, which is supplied by the coil of resistance wire shown in the diagram. For testing flashlight cells the load may be about 3 ohms and the bulb rated at 1.5 or 2 volts.

A probe used for testing "B" batteries is shown in Fig. 9-6D. A 6-watt 115-volt bulb is used, connected in series with an 800-ohm ½-watt resistor. Because of the nonlinear current characteristics of metallic-filament lamps, it is difficult to estimate changes in voltage by the brightness of the filament. The 800-ohm resistor in series with the filament tends to increase the linearity of the circuit, thereby making it easier to spot a low-voltage battery by a change in the brightness of the filament. A test load is supplied by a 2000-ohm 1-watt resistor shunted directly across the battery. A 45-volt battery in good condition causes the filament to glow red. A good 22½-volt battery will cause the filament to glow at the threshold of visibility. The probe may be used momentarily on a 90-volt battery, although the load current will be increased to a point which greatly overloads the 1-watt resistor.

The general construction of these probes is shown in the drawings of Fig. 9-6. In the cases of A, C and D, ⅝-inch diameter bakelite tubing is used as the housing, and in the case of B, ⅞-inch diameter. The point of the probe is a ⅛-inch rod threaded into a plug which is fastened into the end of the tubing with screws. A convenient method of mounting the bulbs is to solder a nut or binding post to the base to receive a screw passed through the wall of the tubing. The same screw may be used for connection to one of the test leads. As the larger bulbs are easily broken, it is well to wrap them with a turn or two of rubber tape as shown in the drawings.

— *Robert C. Paine*

BATTERY-POWERED ONE-TUBE 450- AND 1500-KC. SIGNAL GENERATOR

Here at our ATC Headquarters, I do the radio servicing work for our Special Service section as well as the majority of the work on the fellows' personal radio sets. I needed a small signal generator and tried out one originally designed by P. W. Winsford, G4DC. After slight modifications the circuit now appears as shown in Fig. 9-7. The location of the taps on the coils was determined by experiment. The unit was calibrated for 1500 and 450 kc. by checking with a Super-Pro. The signal output is brought out of the cabinet through a three-foot shielded lead.

— *Maj. Joseph D. Andrew, Chaplain, USA, W4EFG*

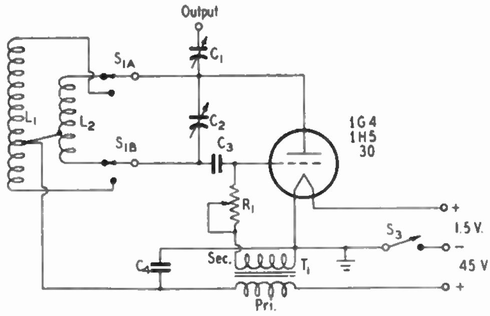


Fig. 9-7 — A battery-powered signal generator for 450 and 1500 kc.

C_1 — 3–30-μμfd. trimmer.
C_2 — 500-μμfd. variable.
C_3 — 100-μμfd. mica.
C_4 — 0.0022-μfd. mica.
R_1 — 1-megohm potentiometer.
L_1 — 140 turns No. 30 d.s.c. on 1¼-in. form (450 kc.).
L_2 — 42 turns No. 20 d.s.c. or enameled wire on 1¼-in. form (1500 kc.).
S_{1A-B} — D.p.d.t. toggle or rotary switch.
S_3 — S.p.s.t. toggle switch.
T_1 — Audio transformer.

A TRANSITRON UTILITY OSCILLATOR

The wide-range transitron oscillator circuit shown in Fig. 9-8 serves a multitude of purposes around the ham shack, providing a simple means of measuring small capacitances, determining the resonant frequency of any coil with a known capacitance across it, and even measuring the stray capacitances present in an oscillator.

The circuit will oscillate whenever a coil or a resonant circuit is connected across the terminals marked *L* in Fig. 9-8. The calibrated condenser provides a method of measuring small capacities by the substitution method, and of determining the resonant frequency of any coil with a given amount of *C* across it. The circuit will oscillate with almost any value of inductance; for example, anything ranging from a filter choke to an i.f. transformer. The oscillator can be made to operate over a frequency range of about 20 c.p.s. to 10 Mc.

The 6SJ7 tube forms a conventional transitron oscillator, while the 6E5 magic-eye tube serves to indicate oscillation. Since the screen current for the 6SJ7 must flow between the *L* terminals, a d.c. path between these terminals must always be provided.

In use, the magic-eye angle is set to some convenient position by adjustment of the grid-bias control, R_1. Then a coil, or a coil-and-condenser combination, is connected between the

L terminals. Oscillation will produce fuzzy edges on the eye shadow, and may change the shadow angle. The frequency of oscillation may then be determined by any convenient method, such as an absorption wavemeter, heterodyne frequency meter, or a calibrated receiver. If a resonant circuit, such as an i.f. transformer, is to be checked for frequency, the jumper to the calibrated condenser should be removed. Allowance should be made for the distributed capacity across the *L* terminals, including internal tube capacities and stray wiring capacities.

The circuit may be used as a simple oscillator at any frequency within its range by winding a coil of suitable inductance for the frequency range desired and connecting it across the *L* terminals. It is then tuned to the exact desired frequency with C_5. If the *L/C* ratio is kept within reasonable limits, the harmonic content will be very low. For example, with the set oscillating at 1 Mc., only the first six harmonics were audible on a near-by communications receiver. An old filter choke was found to be self-resonant at about 1300 cycles. Adding a little extra capacity caused it to be resonant at about 160 cycles.

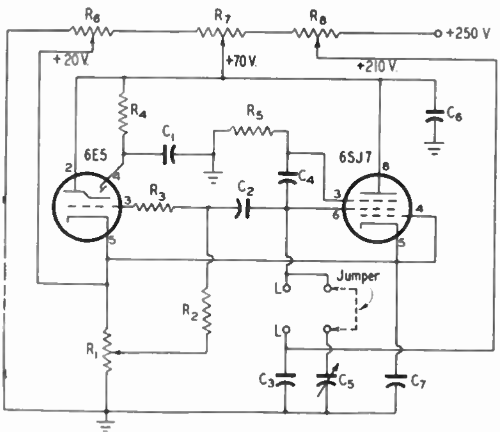


Fig. 9-8 — A wide-range transitron utility oscillator for the ham shack. The sliders on R_6, R_7 and R_8 should be adjusted to give the voltages shown in the diagram.

C_1, C_7 — 0.25-μfd. 600-volt paper.
C_2 — 0.02-μfd. 600-volt paper.
C_3, C_4, C_6 — 0.1-μfd. 600-volt paper.
C_5 — 350-μμfd. receiving-type variable.
R_1 — 2000-ohm potentiometer.
R_2, R_4 — 1 megohm, ½ watt.
R_3 — 0.18 megohm, ½ watt.
R_5 — 0.1 megohm, ½ watt.
R_6, R_8 — 1200 ohms, 10 watts, with slider.
R_7 — 7000 ohms, 10 watts, with slider.

The capacity of a small condenser may be found by noting the change of the calibrated-condenser capacity required to keep the oscillator signal in tune (b.f.o. on) on a receiver when the unknown condenser is connected across a coil at the *L* terminals. Larger capacities may be determined by measuring the frequencies with and without the unknown capacity shunted across the coil, and then calculating the unknown capacity from the bandspread-condenser formulas. Similarly, the stray capacity of the oscillator circuit may be computed using the calibrated condenser to give a known capacity change.

— *Henry L. Cox, jr.*

A CATHODE-COUPLED OSCILLATOR

THE CIRCUIT shown in Fig. 9-9 is that of a two-terminal oscillator, known as a "cathode-coupled" oscillator, "first cousin" of the "cathode-coupled" multivibrator. It is easy to construct, simple to adjust, and the circuit (except for the *LC* tank) will oscillate from 20 *cycles* to 80 *megacycles* by attaching the proper *LC* circuit at points *A* and *B*. The top limit of one test set-up (a 6J6 without r.f. chokes in the heater) was approximately 208 Mc. Bandswitching may be accomplished easily, as only one "hot" lead need be switched.

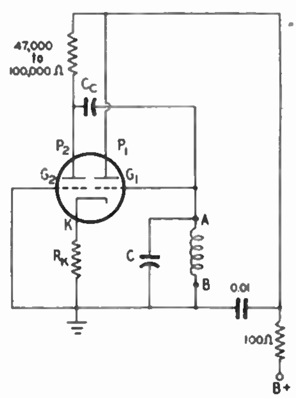
The only critical value is R_k which should be between 1000 and 3000 ohms. Less than 1000 ohms will result in a poor waveform (observed at 50 kc.). A value greater than 3000 ohms will cause reduced output, but with an improved waveform when used with low-*Q* tank circuits. The tuned circuit looks into a cathode follower which results in light loading. The cathode waveform consists of pulses and is high in harmonic content.

This oscillator can be grid-modulated by injecting an audio voltage on Grid 2 using a transformer by-passed for r.f. Distortion sets in with over 30 per cent modulation and attempts to modulate 100 per cent resulted in pulsed output.

A quartz crystal can not be successfully tied in at *A-B* to give crystal results. The circuit will oscillate or multivibrate at the natural frequency of the resistor or r.f. choke used as a grid return. For crystal control, the crystal must be added at C_c, or separate cathodes may be connected together by a crystal. This is satisfactory for low-frequency crystals where the unit may be operated as a stabilized multivibrator. In either case, the *LC* circuit or *RC* time constant must be near the crystal frequency. If the *LC* circuit is placed in the amplifier plate, Miller-effect frequency modulation obtains by modulating Grid 2.

Oscillation is persistent. Keying is excellent at 10 Mc. using a 6J6 tube with four volts

Fig. 9-9 — A cathode-coupled oscillator. The cathode resistor, R_k, should be between 1000 and 3000 ohms. Suitable *LC* combinations are connected between Grid 1 and ground to produce oscillations ranging from 20 cycles to 80 megacycles. Twin triodes, such as the 6J6, are useful in this circuit.



on the heater and only *three volts* on the plate.

Stability measurements were made at 50 kc. where good observations could be made on my 'scope. Changes in plate voltage from 150 to 50 (on a 6SN7GT) caused a frequency change of only 0.1 per cent.

Original references to this circuit were obtained from an article by F. Butler presented in the November, 1944, issue of *Wireless Engineer*.

— *Frank C. Alexander, jr.*

A CONDENSER CHECKER AND OUTPUT METER

An easily-constructed condenser checker and output meter is shown in Fig. 9-10. I used a 2E5, but a 6U5 or a 6E5 would work just as well. Provision is made for two sets of test prod connections. Prods *A* are used for checking condensers, either paper or electrolytic. Prods *B*

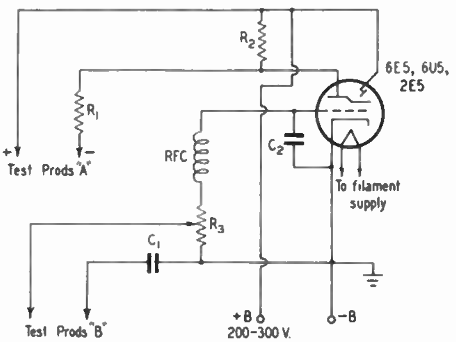


Fig. 9-10 — Condenser checker and output meter using a "magic eye" tube. R_1 is adjusted until shorted prods *A* will close shadow. R_2 is 1 megohm. R_3 is a 100,000-ohm potentiometer. C_1 and C_2 are 0.01-μfd. 600-volt. The r.f. choke was salvaged from an old b.c. receiver.

serve as an output meter or signal tracer, in the a.f. portion of a receiver. The value of R_1 (about 3300 ohms) is adjusted until the shadow just closes with prods *A* shorted. R_3 is a gain control. The condition of condensers can be determined after a little practice. The polarity of the prods should be observed in checking electrolytic condensers.

— *L. R. Hecox, W7FGB*

AN IMPEDANCE METER

Shown in Fig. 9-11 is a handy gadget that can be used to measure directly the impedance of chokes, transformers, large paper condensers,

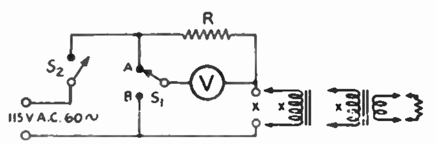


Fig. 9-11 — Simple impedance-measuring gadget. Unknowns are compared against known resistances as described in the text.

R — 4000 ohms.
S_1 — S.p.d.t. switch.
S_2 — S.p.s.t. switch.
V — 0–150 a.c. voltmeter.

etc. Measurement of that unknown output transformer will be a simple job with this unit, and although its accuracy is not perfect, it is close enough to make it a welcome addition to any ham shack.

The principle of operation is explained by Fig. 9-12. The voltage is measured across a known

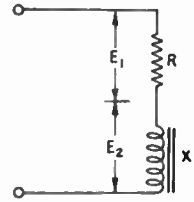


Fig. 9-12 — The basic circuit used in the impedance-measuring unit.

resistance *R*, and then across the unknown impedance *X*. Then by application of the formula $Z = RE_2/E_1$ you have the impedance in ohms, or a reasonable facsimile thereof, of the unknown. By the use of an inductance-capacitance-frequency chart, measurements can be converted easily to henrys or microfarads.

When measuring transformers, the secondary or the winding not under test must be loaded with a resistor of the value of the winding. Hence the 4-ohm voice coil of an output transformer under test must be loaded with a 4-ohm resistor if accurate primary-impedance readings are to be obtained.

The unit in use at my shack is built in a small steel utility box, and the formula has been simplified to $Z = 4000B/A$ and marked on a card which is pasted just above the meter.

— *Kit H. Carlos, W3MJB*

GRID-DIP OSCILLATOR

One piece of equipment which does not seem to have attained its deserved popularity among amateurs is the grid-dip oscillator. Among the uses of this instrument are checking the resonant frequencies of tuned circuits (without the necessity of applying power to the circuit), measuring inductance and capacity, and finding the resonant frequencies of antenna systems. A simple version of the grid-dip oscillator which will be found very useful around the average ham shack is shown in Fig. 9-13. A 6E5 "magic eye" tuning indicator has been substituted for the usual milliammeter to indicate change in grid current. Besides being cheaper, it is extremely sensitive, and is immune to damage from overload. A 6J5 is used as an ordinary Hartley oscillator, with the 6E5 connected to indicate oscillator grid voltage. When power is absorbed from the tank circuit by another circuit tuned to the same frequency, a sharp indication is obtained on the tuning eye. With its help, a new transmitter can be closely tuned up before applying any power at all.

The unit becomes a sensitive absorption wavemeter when switch *S* is opened, giving a much more accurate indication than can be obtained with the usual pilot bulb, and yet without fear of damaging an expensive meter. By plugging a pair of 'phones into the closed-circuit jack, the unit can be used as a diode monitor or oscillating detector (with the plate switch *off* and *on*, respectively). For checking the natural frequency of an antenna, it will be found convenient to couple the coil to the antenna by means of a link line, as described in the *Handbook*. The method of measuring *C* and *L* is also adquately described therein. Calibration curves for each coil range can be made with sufficient accuracy for most normal work, but in any case, the oscillator frequency can be measured with fair accuracy by

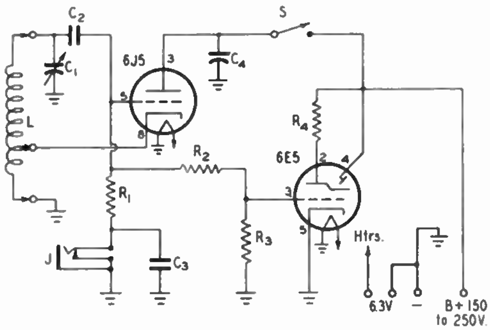


Fig. 9-13 — A grid-dip oscillator for general utility in the ham shack.

C_1 — 150-μμfd. midget variable.
C_2 — 220-μμfd. mica.
C_3 — 0.001-μfd. mica.
C_4 — 0.01-μfd. paper.
R_1 — 0.1 megohm, ½-watt carbon.
R_2 — 4.7 megohms, ½-watt carbon.
R_3, R_4 — 1 megohm, ½-watt carbon.
L — (2.5–7 Mc.) 29 turns, tapped at 1 turn, 1¼-inch diam.
(6–14 Mc.) 12 turns, tapped at 1 turn, 1¼-inch diam.
(12–35 Mc.) 5 turns, tapped at ¾ turn, 1¼-inch diam.
(30–60 Mc.) 3 turns, tapped at ½ turn, ½-inch diam.
J — Closed-circuit 'phone jack.
S — S.p.s.t. toggle switch.

tuning it in on the station receiver. A standard 3 × 4 × 5 metal box makes a convenient housing for all parts, with the coil plugged into a socket on one end, and the tuning-eye screen visible through a hole in the top.

— *R. V. McGraw, W2LYH*

A VACUUM-TUBE VOLT-OHMMETER

Most radio amateurs and servicemen are finding it hard to obtain the more elaborate and expensive testers. The circuit shown in Fig. 9-14 may be found of value in the construction of a simple and practical unit for use with other test equipment on hand, filling the need for a high-range ohmmeter and high-impedance input voltmeter for testing station apparatus. The basic microammeter required may be that in the regular volt-ohmmeter which every amateur should have available. The 200-microampere meter used in this volt-ohmmeter was originally obtained from a General Electric photocell light meter and is now also serving in a portable volt-ohmmeter of conventional design.

The entire v.t.v.m., including batteries, should be built up in a metal case to prevent leakage to the circuit under test, which might occur with a wooden cabinet. The unit is readily portable and light in weight if small batteries are used.

As seen in Fig. 9-14, the unit can be used as an a.f. signal tracer by plugging 'phones or a magnetic speaker into J_5, in place of the meter, and connecting the input to J_3 and J_4. This assumes that the tube is operated sufficiently high on the linear portion of the E_gI_p curve so that audio distortion is not excessive. If the tube is biased near the cut-off point the a.c. sensitivity will be slightly greater, but the unit cannot then be used successfully as a signal tracer in a.f. circuits except with a meter as the indicator.

The 20,000-ohm potentiometer, R_5, furnishes bucking voltage to balance out the residual current in the meter for zero-setting adjustment, and also furnishes bleeder current of about 1 ma. through the cathode resistor for initial bias. If desired, R_4 may also be made variable to adjust the maximum scale reading, but with a little experimentation a fixed resistor of the right value can be found. The 1-megohm grid input control, R_3, may be calibrated for use as a voltage divider to increase the voltage range. It also serves the purpose of "zero-ohms adjuster." The voltage-divider resistors were chosen arbitrarily so that no calibration chart or graph is needed for the d.c. and "high-ohm" ranges, since the readings can be obtained by applying a multiplying factor to the regular volt-ohmmeter reading. The d.c. scale is practically linear, so the error introduced will be negligible for ordinary testing purposes. However, the a.c. scale resembles a square-law curve,

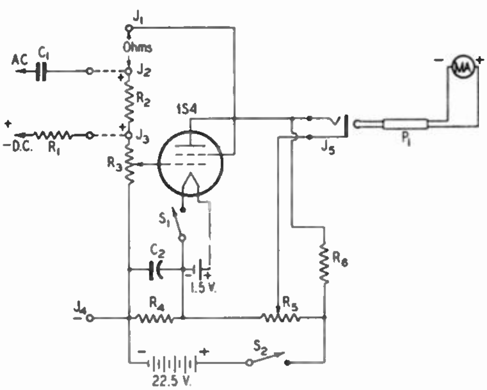


Fig. 9-14 — V.t. volt-ohmmeter with plug-in meter.

C_1 — 0.1-μfd. 600-volt (in a.c. test lead).
C_2 — 50-μfd. 150-volt electrolytic.
R_1 — 0.33 megohm (in d.c. test lead).
R_2 — 15 megohms.
R_3 — 1-megohm volume control.
R_4 — 2000 ohms.
R_5 — 20,000-ohm potentiometer.
R_6 — 12,500 ohms.
J_1, J_2, J_3, J_4 — Tip jacks.
J_5 — 'Phone jack.
MA — 200 microamperes.
P_1 — 'Phone plug for meter.

so a calibration chart should be drawn utilizing any reasonably-accurate calibrated source of variable voltage that may be available.

In the meter described the full-scale sensitivity on a.c. is about 2.1 volts and on d.c. 1.125 volts, which is raised to 1.5 volts by the isolating resistor in the test lead and multiplied to approximately 18 volts by the 15-megohm resistor. The 1-megohm potentiometer can be used to multiply the maximum input up to about 300 volts on the high range. Resistances up to about 1000 megohms may be measured with a fair degree of accuracy. No low ranges are provided, since most existing instruments measure up to 1 megohm or so. If the meter used is not marked with an ohms scale, a chart may be made by testing several resistors having known values of resistance or by using the following formula:

$$R_X \times R \frac{(I_M - I)}{I},$$ where R_X is the unknown resistance indication,

R = initial resistance in circuit,

I_M = full-scale current reading,

I = current reading with unknown resistance across "ohms" terminals.

If a 1-ma. meter is used the plate voltage should be increased to 45 or 67.5 volts and the bias resistor adjusted for proper operation.

— *Roy McCarthy*

MODULATING THE TEST OSCILLATOR

A simple way to add modulation to the r.f. test oscillator is shown in Fig. 9-15. In this circuit the primary of a small interstage audio transformer, *T*, serves as a Heising modulation choke and a feed-back winding for a simple audio oscillator. Dual triodes such as the 6SN7 are ideal for the purpose, and any type of oscillator could be used instead of the series feed-back type shown. If a Clapp or an ECO is used as the r.f. oscillator, tubes with separate cathodes must be used.

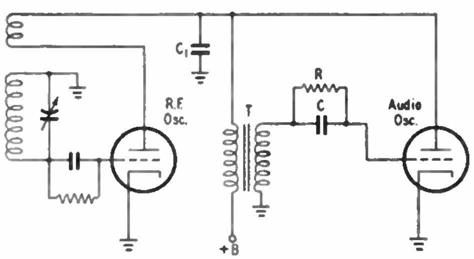


Fig. 9-15 — A simple method of applying tone modulation to the r.f. test oscillator. An old interstage audio transformer is used as combined Heising modulation choke and feed-back winding.

The tone may be changed by adjustment of the grid leak, *R*, and the condenser, *C*, in the audio-oscillator section of the tube. Suitable values in most instances will be 1 megohm for the resistor and 220 μμfd. for the condenser. C_1 should be 0.001 μfd. or less to avoid by-passing the audio frequencies.

— *Clifford Bader, W3NNL*

CHECKING THE FREQUENCY OF CRYSTAL BLANKS

Several ingenious methods have been suggested for getting rough checks on the frequency of a crystal blank during the grinding process, but none of them seems to be quite as simple as this:

Take a flat sheet of aluminum or copper about six inches square, and connect it to your receiver antenna post by a short lead. Place the plate glass on which the grinding is being done over this sheet. You can tune in the crystal frequency on the receiver by the scratches you hear as the crystal is being ground. You can then follow the scratching noise along the dial as you grind. When nearing the frequency you desire, the regular methods of crystal checking must be used, but up to this point the scratches will tell you what you want to know. This procedure saves the time usually required to wash, rinse and dry the crystal blank, replace it in a suitable holder, and fire up the oscillator stage each time you want a rough frequency check to show just how far you still have to go.

— *Elmer A. Gunther, WØACC*

EXTENDING THE RANGE OF THE C-R-L BRIDGE TO 10 MEGOHMS

The usefulness of the impedance bridge described in the July, 1944, issue of *QST*[1] can be increased by extending its range to 10 megohms. All that is required is the addition of another position to the multiplier switch and a simple

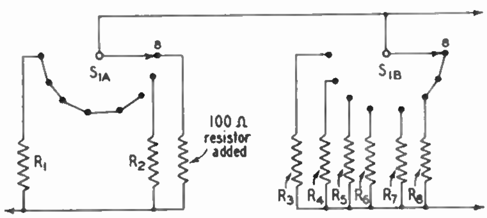


Fig. 9-16 — Modification required for extending the range of the C-R-L bridge to 10 megohms. The original diagram appeared in *QST* for July, 1944.

wiring change as shown in Fig. 9-16. Although a 7-position switch was specified in the parts list in this article, in most instances a standard 11-position switch was probably used. Move the stop on the switch over so that it covers 8 positions instead of the original 7. Connect a jumper between Positions 7 and 8, so that the 0.1-megohm resistor R_8 is brought in when the switch is set to Position 6, 7, or 8. Insert a 100-ohm resistor between Position 8 and the common terminal on the other gang of the switch. With this simple change, when the multiplier switch is set to Position 8, the *C-R-L* dial reading is multiplied by 100,000, producing a full-scale reading of 10 megohms.

— *Athan Cosmas, W2PKD*

[1] "An Inexpensive Impedance Bridge," Cosmas, *QST*, July, 1944.

10. Hints and Kinks . . .

for the Shack

CONVENIENT JUNCTION BOX

The compact unit shown in Fig. 10-1 was patterned after a commercially-built unit, designed to provide a convenient a.c.-line outlet box for use in test set-ups requiring the application of power to several units at one time. It cuts down on the amount of "haywire" usually required in such cases, and eliminates the usual problem of "Where the heck am I gonna plug *this* in?"

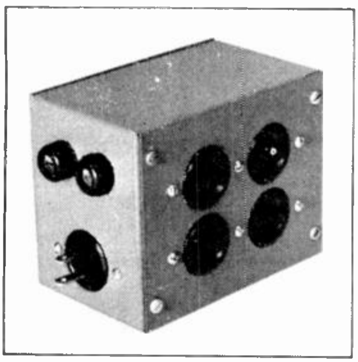


Fig. 10-1 — Here's one way of solving the problem of not having sufficient a.c. outlets in the shack. Eight a.c. receptacles are mounted on a 3 × 4 × 5-inch utility box, along with line fuses and an input connector.

Eight standard a.c. receptacles are mounted on the sides of a 3 × 4 × 5-inch utility box. A male a.c. plug and two fuse-holders are mounted on one end of the box. The wiring arrangement is shown in Fig. 10-2. It is suggested that the fuses be rated a little below the rating of the fuse in the house-wiring circuit that is used to supply the box. In this way, if a fuse blows, it will be the one in the box before the one down in the cellar!

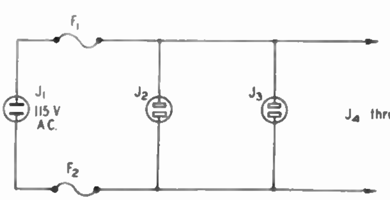


Fig. 10-2 — The output receptacles are wired in parallel across the input jack. J_1 is a standard male a.c. plug, while J_2 through J_9 are panel-mounting a.c. receptacles.

Variations on this scheme will suggest themselves, and if desired, toggle switches may be mounted near each receptacle to give control of the individual circuits within the box.

—*C. Vernon Chambers, W1JEQ*

INDIRECTLY-LIGHTED BEAM INDICATOR

The attractive beam indicating device shown in Figs. 10-3 and 10-4 is both inexpensive and easy to build. A great-circle map, centered on a city near your own, is framed and mounted in front of two 15-watt lamp bulbs. A Selsyn motor, coupled to its mate at the antenna, is mounted between the bulbs, with its shaft extending through a small hole at the center of the map. A transparent compass card is placed over the

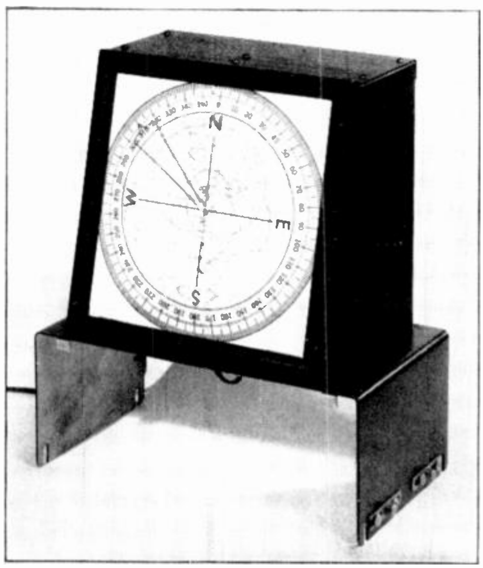


Fig. 10-3 — An attractive indirectly-lighted beam indicating device.

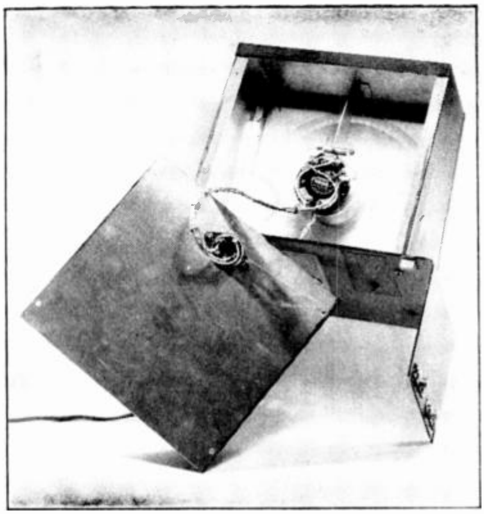


Fig. 10-4 — Rear view of the beam indicator, showing method of mounting the Selsyn and the lamps. Control wires are cabled and run out of the box through a 5-prong terminal mounted on the rear cover-plate.

map, and the entire assembly is firmly supported within a sloping-front box as shown in the photographs.

As an added refinement, the map itself may be "plasticized" for a small additional cost. Hams in larger cities should have no trouble in finding someone who can do this work. The result is similar to the plastic-cased discharge papers, oil-company courtesy cards, etc., that most of us have seen. If it is not possible to have the map plasticized, it may be mounted on a sheet of clear cellulose acetate.

The pointer should be made of lightweight material so that its own weight will not cause it to shift position after the beam is aimed in a given direction. If necessary, a double-ended pointer can be used, trimming the end to produce a true balance that will permit it to stay put, without putting a load on the Selsyn motor.

The unit shown was built by Julius Galin, W1LOP, of the Headquarters laboratory, from ideas suggested by himself and Jack Matthews, W3DPA.

A WORLD-TIME SLIDE RULE

A time indicator is a useful and interesting gadget to have around the shack, especially when working DX. With it you can tell what time it is at the station you are contacting or at any other point on the globe. It also provides a rapid means of converting local time into some common reference time, such as GCT. There are several good calculators on the market, but the one shown in the sketch is simple enough so that any ham can make one. The few materials required are easy to obtain and the work involved takes only a matter of an hour or so.

Scales, such as the set shown in Fig. 10-5, are glued over the regular scales of an ordinary cheap slide rule of the type selling for a quarter or half a dollar. As an alternative, a reasonable substitute can be made from strips of cardboard. Use a wide strip for the back. Then glue on the narrower strips carrying the upper and lower scales. This will leave a path for the sliding strip between the upper and lower scales. A substitute for the glass slide can be made by cementing a piece of celluloid to a couple of small pieces of wood or bakelite.

The scales may be drawn up with India ink by hand or perhaps more conveniently with a typewriter. If the carriage of the typewriter is not long enough for the complete length, each scale may be typed in halves and the sections glued together. The calibration marks are made with the apostrophe mark, the typewriter providing automatic equal spacing. The time marks represent 15-minute intervals, while the meridian marks represent 15-degree time zones. The top and bottom scales are the same except that the upper one is calibrated in city locations while the lower one is calibrated in degrees east and west of Greenwich. The city marks are made opposite their corresponding time meridians, which can be taken from a globe or map.

Operation of the time slide rule is quite simple. If you wish to determine the time at some DX station you may be working, set the slide so that your clock reading is opposite your location on the top scale or your time meridian on the bottom scale, reading the time at the DX station under the name of the town on the upper scale or over the time meridian of the DX station on the lower scale. Referring to Fig. 10-5, with the slide set as shown, when it is 6 A.M. in New York it is 3 A.M. in San Francisco, 1 P.M. in Moscow and 7 P.M. in Manila. To convert to GCT use the same procedure, reading GCT on the upper slide scale above 0 degrees on the bottom scale. Thus, as Fig. 10-5 shows, 6 A.M. New York time is 1100 GCT; 7 P.M. Manila time also is 1100 GCT.

In setting the slide to your local time, the slide usually will extend either to right or left so that part of the fixed scales will not be covered. For instance, with the slide set as shown in Fig. 10-5,

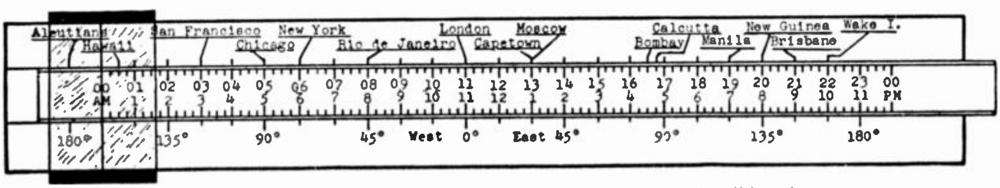


Fig. 10-5 — World-time calculator made from an inexpensive slide rule.

the time in the Aleutians is not shown. In cases like this, slide the glass indicator over the "00" mark on the slide after it has been set to your local time. Then slide the other "00" mark at the opposite end of the slide under the hairline, thus covering the desired DX point. The changing of "00s" results in the slide extending to the left, and times indicated are in the day preceding the local day; in other words, "yesterday." When it results in the slide extending to the right, the times indicated are in the day following the local day, or "tomorrow." Whenever it is not necessary to change "00s" to cover the desired DX point, the day at the DX point is the same as locally.

As an example, suppose it is 2 A.M. in New York and we want to find out what time it is in Hawaii. When the slide is set with 2 A.M. under the "New York" mark (or over the 75-degree mark), the left-hand "00" will come over the 105-degree W. mark. The glass slide is set at this point to hold the place while the slide is reset with the right-hand "00" over 105 degrees W. The time of 8:30 P.M. now will be found under "Hawaii." Since the slide is extending to the left, it means that it is 8:30 P.M. of the preceding day. Therefore if it is 2 A.M. Tuesday in New York, it is 8:30 P.M. Monday in Hawaii.

As a second example, if it is 6 P.M. in Chicago, what time is it in Manila? Setting 6 P.M. under "Chicago" brings the right-hand "00" over the 0-degree mark on the bottom scale, leaving "Manila" uncovered. Shifting the left-hand "00" over the 0-degree mark shows that it is 8 A.M. in Manila. Since the slide is extending to the right, it means that Manila is in the next day. If it is 6 P.M. Tuesday in Chicago, it is 8 A.M. Wednesday in Manila.

In general, the time for any given location is taken as the sun time at the nearest 15-degree meridian. For example, EST is 75th meridian time, PST is 120th meridian time, etc. Throughout the world, however, there are many local exceptions to this rule. Hawaii, for instance, runs on a time differing from the nearest time meridian by 30 minutes. Bombay also runs on a 30-minute difference, while Calcutta's time is 6 minutes ahead of 90th meridian (east) time. There is a 20-minute difference in Singapore's time. When these exceptions occur, the time marks for the upper scale will, of course, come in between the even hour marks.

— *W. J. Christian*

AVOIDING FROZEN FISTS

Few shacks are adequately heated, and though the operator may be comfortably dressed, his fingers may still become too numb and sluggish for deft keying. A mitten is hardly practical.

The solution is an ordinary gooseneck desk lamp, bent close down directly above the hand. A 40- or 60-watt bulb at a distance of six to eight inches soon spreads a pleasant warmth from wrist to fingertips. The lamp will give a good light for log and note pad besides keeping your fist from "freezing."

— *A. F. Scotten, W6ZMZ*

MASTER CONTROL SWITCH

The system of operating control installed here may interest others contemplating the use of low power transmitters with a common transmit-receive antenna. A bat-handled s.p.s.t. toggle switch located in a convenient position (near transmitting key or where the left hand can manipulate it easily) does the trick.

This master toggle switch controls three relays, either 6- or 115-volt types, as follows:

Relay No. 1 — d.p.d.t. (antenna change-over).
Relay No. 2 — s.p.s.t. normally closed (receiver B-plus switch)
Relay No. 3 — d.p.d.t. (headphones).

Connect so that in transmit position,

Relay No. 1 — connects antenna to transmitter.
Relay No. 2 — opens B-plus to receiver.
Relay No. 3 — connects headphones to monitor.

Then, in receive position,

Relay No. 1 — connects antenna to receiver.
Relay No. 2 — closes B-plus to receiver.
Relay No. 3 — connects headphones to receiver.

This affords a quick and efficient change-over, little short of break-in operating.

— *Harold W. Ryall, W1NKW*

DE LUXE CALL-LETTER PLATES FOR THE MOBILE "SHACK"

A new type of sign material called "Scotchlite" is now available, and is widely used on highway signs. This material reflects light and makes an excellent call-letter plate for a ham's car.

"Scotchlite" is a sheet of waterproof flexible material covered with ground glass. The call letters are stenciled on, using thick paint pigment from the bottom of the can so that the paint will not run. Most sign shops now carry this material. If you have a sign made up, be sure to take along a sheet of tin or aluminum to use as the backing plate so that the sign maker can fasten the "Scotchlite" to it with the special waterproof glue that is provided. A variety of colors is available. I use a similar sign (with the name of my town on it) when hitchhiking back from club meetings late at night.

— *George C. Robinson*

AN OPERATING CONSOLE FOR THE AMATEUR STATION

Mounting equipment in a console desk was suggested by looking over many commercial installations which tend toward this arrangement. Such a console was built at W9EYN several years ago and has been a source of great satisfaction. Nearly every visitor to the shack contemplates construction of something similar when they realize all the advantages possible. The design makes a hit with the XYL also, since most of the unsightly equipment that usually clutters up the operating table is neatly mounted out of sight. An entire station may be built into such a console, depending on size and how much auxiliary

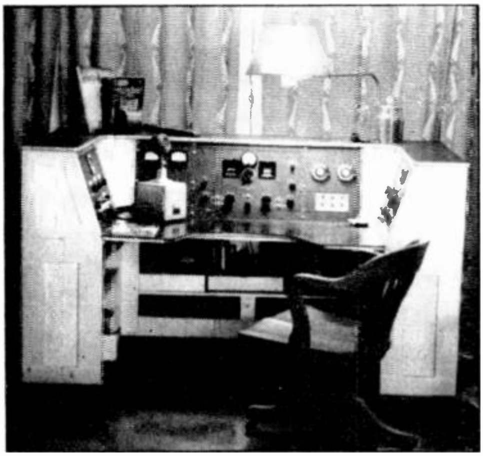


Fig. 10-6 — Front view of the operating console. The panels beneath the writing shelf have been removed to show the space available for power supplies and other units not requiring adjustment.

equipment it is desired to locate at the operating position. In our case, it was decided to mount only the receiver, exciter, speech amplifier and monitor in the desk — with, of course, the necessary power and bandswitching controls for a remotely-located transmitter.

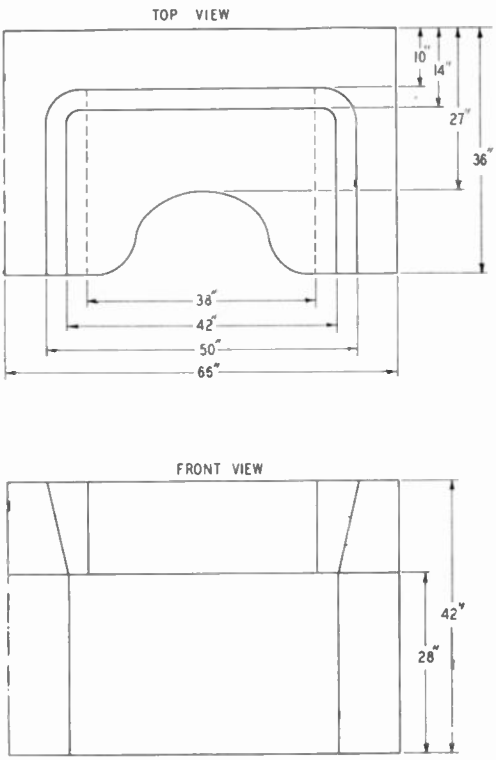


Fig. 10-7 — Outline dimensions and layout of the console. Note the low (28 inches) writing shelf that offers a high order of operating convenience and comfort.

There are many possible arrangements for equipment. It would seem logical to mount the receiver in the center panel with sufficient space remaining for power controls, monitor, modulation indicator, and similar accessories. The VFO may be located on one side with speech-input control and speech amplifier on the opposite. There is ample space for power supplies, as well as other units not requiring direct control, in the rear lower section of the desk. Lower side cabinets have room for logbooks, *QST* files, and other station necessities.

As to construction, it is suggested that the console be made in detachable sections. It becomes a rather large piece of furniture and difficulty might be experienced if it had to be moved. In the desk there are six handy sections. Three lower units make up a U angle which is bridged by the operating table top. Three upper sections mount the panel equipment. The sections may be made up in the form of open framework,

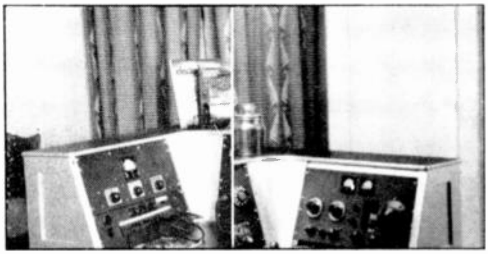


Fig. 10-8 — Close-ups of the side panels of the console. The controls for the speech amplifier and the audio circuits are located on the left panel. The right-hand panel contains the VFO and the exciter.

with spaces not filled by equipment paneled in with plywood or other type material. Angle-iron strips can be used to mount the panel-supported equipment. Each side section should have removable cabinet-type doors to allow access in rear. The back of the console might be left open. A shelf across the back lower section affords plenty of space for power supplies.

Complete constructional details are not given here, but Fig. 10-7 supplies suggested measurements. The operating table top is lower than usual. This allows a more comfortable position for the arms and shoulders. A semicircular cut-out is made in the front of the table to allow the operator to reach controls conveniently, and the position is excellent for a key or bug located at one side. The suggested dimensions allow the mounting of two 19-inch panels in the center, and one 19-inch panel to the right or left.

If good wood is used the desk might be finished in natural grain and a really nice piece of furniture constructed. Our desk got a coat of flat paint which has been since regretted. To trim and finish the project, cover the table top and upper shelf with battleship linoleum, securing the edges with metal strip available for the purpose.

— *Joe Rohrer, W0EYN*

NEON-BULB PROTECTOR

DOZENS of neon bulbs are tossed into the ash can because they rolled off the operating desk and smashed on the floor. A simple way to avoid this is to wind a piece of insulated hook-up wire around the base once or twice, give it a twist, and cut off the ends, leaving about an inch of each end of the wire sticking out. These short tabs will prevent the bulb from rolling, and will keep it on the desk where it belongs.

— *H. A. Fanckboner, W9BPS*

A RACK-TOP OPERATING TABLE

HERE at W2OLU, the "shack" is located in the living room, part of a three-room apartment. Something definitely better than the desk, already overcrowded, was needed for an operating position. In the process of design, it was decided to incorporate some simple structure that would enable the radio gear to be held securely in a rack, or on shelves, over the table. How this was done, at a total cost of only ten dollars, is the theme of this article.

The combined table and rack finally built gives a man room enough to pound a key and still rest his arm on the table top — it's 36 inches wide and 30 inches deep. Over this there is space for six standard-size relay-rack chassis, 12 × 17 inches. While the whole affair is home-constructed and is hardly a "glamor" job (cost precluded this), it is definitely presentable — sufficiently so that the XYL did not object to having it in the living room. Incidentally, the whole job was completed in the aforementioned three-room apartment, over the week end, without disturbing any of the other tenants. (Cliff-dwellers, please take note.)

Fig. 10-9 — The finished rack-top operating position, ready for occupancy.

List of Materials

2 fir plywood panels, 2 ft. × 4 ft. × ⅝ in.	$ 4 80
2 pcs. clear fir, 2 in. × 4 in. × 6 ft.	1 92
2 pcs. clear fir, 1 in. × 5 in. × 6 ft.	1 50
1 pc. pine, ⅝ in. × 6 in. × 4 ft.	.75
1 tempered Presdwood panel, 2 ft. × 3 ft. × ⅛ in.	.66
4 doz. No. 8 flat-head wood screws, 1½ in. long (for table top and shelf tops)	20
6 doz. No. 8 round-head wood screws, 1¼ in. long	30
1 box ¾-in. "wiggle" nails	10
5 doz. small screws, ½ in. long (or ½-in. brads) (for fastening Presdwood panel)	20
Total	$10.43

The key to the whole construction is the use of standard-size plywood panels. This ham application of the module principle definitely pays off in this case. It cuts down on labor and construction time, and there is no waste involved. Every piece of wood paid for is utilized 100 per cent. The sketch shown in Fig. 10-10 will enable any amateur to cut the lumber to size after obtaining

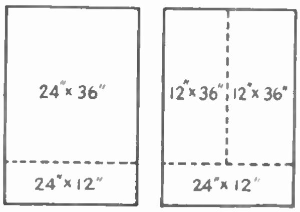


Fig. 10-10 — Two 2 × 4-foot plywood panels are cut as shown in this sketch to form the rack.

it from the local lumber yard. I cut all the pieces to size in the bathroom, and sanded them down; only when ready for the final assembly did it become necessary to move into the living room.

Standard-size ⅝-inch 5-ply fir plywood panels, 2 × 4 feet, were utilized to make up the table top, the sides and the shelves of the rack structure. In order to add an extra six inches of depth to the operating table, without involving waste or additional expense, a piece of pine, 6 inches wide and ⅝ inch thick, was joined to the 24 × 36-inch piece of fir plywood, using corrugated fasteners or "wiggle nails" as they are sometimes called. I used a dozen, spaced every 3 inches, to tie the two pieces of wood securely together. This brings the top up to 30 × 36 inches in size. Around the edge, under the top, is a rail made from so-called 1 × 5-inch board (actually 4½ inches wide and ¾ inch thick). One six-foot length was cut exactly in two, at 36 inches. This provides the front and back rails. Allowing ¾ inch at each end, the side-rail pieces were cut 1½ inches short of 30 inches, or 28½ inches. Flat-head wood screws, 1½ inches long, are screwed through the table top to hold the rail in place. This gives a smooth working surface. Three inches in from each corner, and spaced six inches apart, a total of 22 screws holds the table top to the rail, five in each side and six along the front and the rear. This makes the whole assembly quite rigid.

To make the table top 30 inches from the floor, four legs, 29½ inches long, were cut from finished 2 × 4-inch stock. They are securely held to the rails by six wood screws, using three on each surface. The sketch of Fig. 10-11 should make this clear. The two rails are also butt-joined by three wood screws where they meet. Staggering the wood screws in the corners makes for greater strength, and there is less chance of splitting the wood. The use of screws makes for more work than nailing, it is admitted, but the resulting job is exceptionally rigid, without a trace of shimmy even though the legs are not crossbraced. Furthermore, the legs can be removed for transporting and a loose screw can be tightened while a nail can't — a point worth considering in steam-heated buildings, for furniture has a bad tendency to dry out, especially in the winter months.

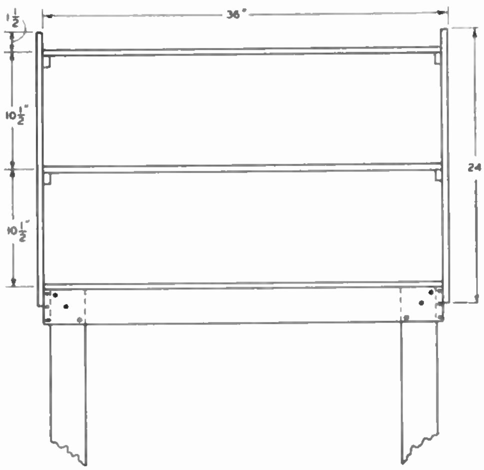


Fig. 10-11 — **Sketch showing dimensions of operating table and method of assembly.**

The two 12 × 24-inch pieces are used for uprights in the superstructure and the two 12 × 36-inch pieces form the shelves. The 12-inch remnant from the 6-inch pine board is sawed into four pieces 1½ × 12 inches. These are used to support the shelves between the uprights. I used 10½-inch spacing between the shelves, and it worked out fine, but this could be modified to suit the builder.

The whole rack structure was a trifle shaky when mounted on top of the table, but adding a sheet of ⅛-inch Presdwood to the back really tied things down! This sheet overlaps the rear of the table to permit its being fastened to the rear rail as well as to the shelves and the uprights. This brings the top edge of the sheet about one inch above the top shelf of the rack. This works out fine in practice since it is high enough to hold the top chassis in place and yet does not interfere with leads out of the rear. In the back of the lower spaces, holes were drilled where necessary to pass plugs and cables through the Presdwood back. As the table-rack is being used here, it houses four 11 × 17-inch chassis, plus a homemade superhet on the left of the table top, with keys, control switches and Variac on the right-hand end of the table. However, it could be utilized to hold up six 12 × 17-inch chassis, as it stands, or modified to suit almost any desired arrangement.

Because the table-and-rack is in the living room, the whole affair was given a coat of clear lacquer, which ran up the cost another 75 cents. The material shown in the list was bought in the suburban New York area. I doubt if prices could be much higher in any other locality; but this still amounts to the best ten dollars I have ever invested in ham radio.

— *Neil A. Johnson, W2OLU*

AN INEXPENSIVE TRANSMITTER CONSOLE

In designing the transmitter cabinet shown, our objective was a self-contained transmitter with a high degree of safety that would be readily accessible for adjustment or repair. It was to be of lightweight construction and, above all, pleasing in appearance. The usual amateur requirements of ease of construction and low cost were also important factors.

A piece of 20-gauge cold-rolled steel 44 by 72 inches was laid out as shown in Fig. 10-14. Notches and cuts were made with a pair of tin snips, and the corners were bent on a local tinsmith's sheet-metal brake. The round front corners were made by making a series of very slight bends within a predetermined area. It would be well to practise making the round corners on a piece of similar metal before starting the corners

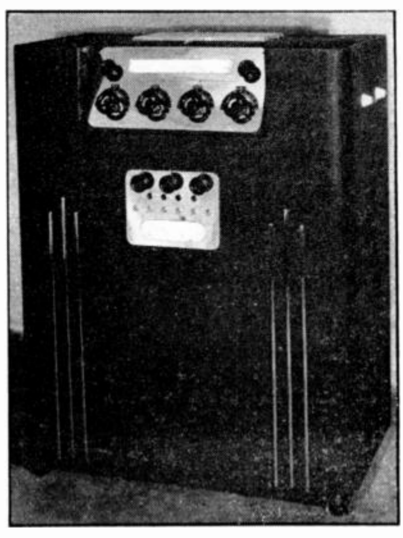


Fig. 10-12 — **The homemade transmitter console at W8MGS rivals any commercial product in appearance and convenience. The meters, set behind a Lucite panel and using homemade scales, are indirectly lighted.**

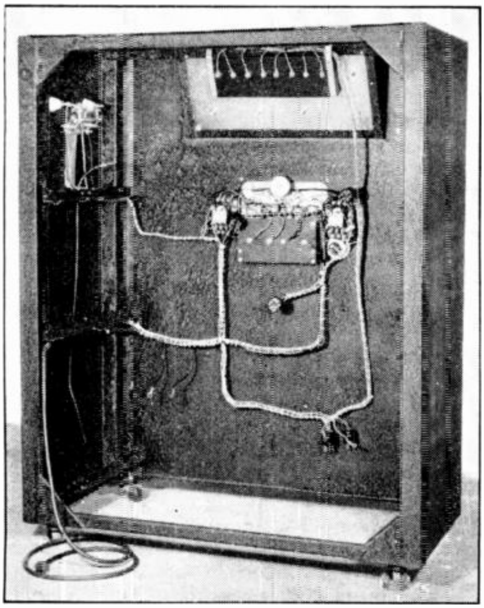


Fig. 10-13 — A rear view of the cabinet with the chassis removed, showing the antenna relay on the left-hand wall and the plug-in power cables.

of the cabinet. Channels, corner braces, top strips and top-corner gussets should also be cut and formed as shown.

All parts were spot-welded together into one solid unit. First, however, in order to save the welder's time, all parts were riveted together with very small tinsmith rivets, in just enough places to maintain the correct shape of the cabinet. The weld spots were spaced approximately one to two inches, a procedure that gave a very rigid final product. All outside joints were filled with a 95-5 hard solder. This solder melts at 400° F. and, since the steel conducts away the heat fairly well, a husky soldering iron must be used. The acid flux was rinsed off with plenty of clean water to prevent subsequent corrosion. The excess solder from the corners and joints was removed with a file and then smoothed with steel wool and emery cloth, making the unit look as if it were only one piece of steel.

After the cabinet was completed, the lid was cut to fit and the opening was cut out. The lid fits flush within the space provided for it, and small ¼-inch reinforcing channels were riveted and soldered on the underside to stiffen it. Hinges were riveted and soldered at the back-underneath side of the lid, and provision was made for bolting the hinges to the rear channel so that the lid could be removed at any time if it were necessary.

The cabinet was painted by a local instrument concern which had facilities for baking crackle finishes. However, if a crackle is not available or desirable, several coats of either grey or black brushed enamel would look very attractive.

To dress up the cabinet, a few strips of stainless-steel trim were mounted on the front and an aluminum grille mounted on the lid. The grille was made from a sheet of aluminum cut into strips approximately ¾ inch longer than the ventilating opening. Then slots were cut in the ends of the strips just long enough to permit the strips to fit in the opening. Spacers and long brass rods threaded on the ends were used to keep the polished and lacquered aluminum strips in place. The front of the meter case is made of polystyrene (or lucite). The meter scales are illuminated indirectly by pilot bulbs which are placed between the meters.

The tuning wheels and knobs connect to the tuning condensers, selector switches and other controls by flexible cables. The various lengths that were necessary were cut from automobile radio control cable. This can be done easily and back-lash from loosened turns can be avoided if the cable is first tinned in the vicinity of the cut. Then a ¼-inch copper tube about one inch long is slipped down over the point to be cut and the tube filled with solder. The tube is then cut in the center and serves as a short shaft. The final tank condenser was connected by two insulated universal joints because the angle between its shaft and the tuning wheel shaft was too sharp for flexible cable.

For safety to the operator an interlock switch is used under the lid to cut off all power when the lid is raised, and a protective circuit with two overload relays and one master holding relay is used to protect the high-voltage power supply in

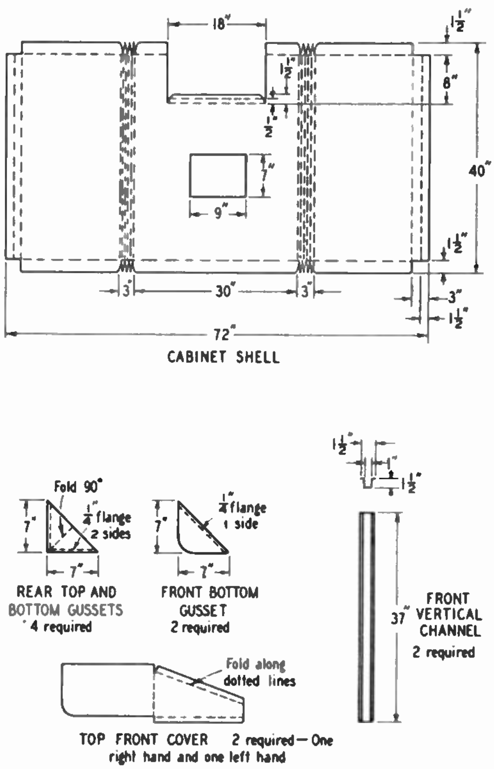


Fig. 10-14 — Details of the cabinet shell and reinforcing members. The material is 20-gauge cold-rolled steel.

case of an overload or accidental short-circuit. Relays for antenna change-over and in the low-voltage transformer secondary center taps are controlled by a single "send-receive" switch.

The transmitter and power-supply chassis were cut and formed from 18-gauge steel. Rivets were used to fasten the flanges in the corners and these joints were also filled with solder. The chassis were cadmium plated and then buffed to get a mirror finish. All three chassis are supported at the ends by small ¾-inch angles which are bolted to the rear flanges and front vertical channels of the cabinet.

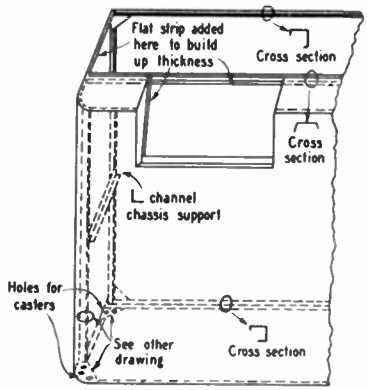


Fig. 10-15 — Assembly details of the transmitter console. The pieces are assembled with small rivets and then spot-welded.

All wiring from meters, switches and relays is cabled and terminated at the chassis in 6-prong sockets and plugs. This permits removal of any chassis from the cabinet to the workbench and, by the use of an extension cable, still allows the removed unit to be energized and tested.

— *S. E. Garber, W8MGS*

PLANNING THE SHACK FOR APPEARANCE AND CONVENIENCE

Not every ham has the chance to build his own shack (known as "home" to the wife and parasities), but when he does he wants to make the most of the opportunity. Here are a few suggestions and experiences gained from doing such a job a short time ago.

Put down on paper every possible improvement you can figure on before you ever start to build and discuss them with your contractor before you build, or you may find that your ideas cost more money than you can afford.

A ground system is essential to any properly-installed radio station, so a little thought should be given this before work is actually started. In my case, a couple of hundred feet of one-inch wide copper ribbon was obtained, and one strap was put in lengthwise and two crosswise in the excavation, with the ends being brought up to the top of the foundation, and *outside* of the foundation. These ends provide places to tie on any additional ground network which may be put in later. Straps should be soldered on inside the foundation and brought up for connection in the radio room and to the work bench. A network of heavy copper wire can be used equally well, if no ribbon is available. After the house is built, all pipes and metal work can be bonded together and connected to the same ground strap.

The electrical installation would probably give the amateur his best chance to improve the radio room, as compared to the average house-wiring job. In my case, a Cutler-Hammer overload-breaker center provided circuit control for four 15-, one 24- and one 35-ampere circuits. The last two provided for three-wire services and, since I did not plan to use an electric stove, the 35-ampere circuit went to the ham shack, by way of three No. 8 wires. A pair of twist-lock receptacles provide two 110-volt circuits, one on each side of the line, while 220 volts is available from the hot wires in each of these two circuits. The twist-lock receptacles have plugs which are inserted and then rotated a portion of a turn to prevent their working out with heavy cables attached — and perhaps interrupting a QSO. Ordinary home outlets provide connection for receiver supply, desk lamp, electric clock and other equipment requiring a small amount of current. A single extension cord comes from the nearest outlet to a five-gang outlet box located high up inside the knee hole of the desk, making it unnecessary to run a number of cords from desk to wall. A store-type indirect-lighting fixture using a 200-watt bulb gives adequate light for everything except reading.

Receiving antennas for the broadcast receivers in the house can be installed in the walls when the house is being built, and come out at the special antenna outlet plates available. This will make it unnecessary to run any wires outside except the regular transmitting antenna. Connections to the transmitting antenna come through the wall by way of Navy-type Pyrex bowls and heavy brass rods.

Built-in shelves and cupboards would be very handy in a shack, and every effort should be made to provide room for *QST*s, catalogs, old logs and many other items which clutter up an operating desk. Large panels of Celotex can be screwed to the wall (assuming the room is not finished in Celotex) to take maps and QSL cards. An extra-wide door served me very well when I discovered that my new operating desk had a minimum dimension of 30½ inches. Linoleum on the floor would give an opportunity for insertion of an ARRL diamond in the center, and commercial cut-outs of compass directions are also available. Linoleum must be waxed and polished for wear and appearance, however, and shoes and furniture leave marks hard to polish out.

Trimming for the radio room can include aluminum venetian blinds instead of curtains and, if your pocketbook can stand it, chrome-steel furniture. Strip carpeting can be used instead of a full-size rug — probably you won't be shifting your furniture every few days as your wife does!

— *Eugene A. Hubbell, W9ERU*

11. Hints and Kinks . . .
for Converting Surplus

REVAMPING THE BC-348-Q RECEIVER

The BC-348-Q is a receiver which has attained widespread use and acclaim by the amateur fraternity. It lends itself well to changes which make it more efficient from the amateur's standpoint. The purpose of this article is to describe some of the simple changes made in a receiver of the "Q" series (110-volt a.c. adaptation) and to point out other more difficult changes which can be made if the owner so desires.

In order to change the circuit the physical layout of the set had to be altered slightly. One making these changes can suit his own preference and station requirements in the location of switches, jacks and plugs.

Antenna Terminals

Beginning with the antenna terminals and working through the set to the output transformer, the first addition was an auxiliary set of "Ant.-Gnd." terminals placed at the rear of the chassis. A terminal strip was bolted to the frame of the set at the rear, as shown in the photograph of Fig. 11-8, and a wire was brought from the "Ant." terminal on the panel along the lateral side of the antenna unit (*190*) to it. The ground connection was made directly to the chassis via a small lug under the bolt holding the terminal strip. A $1^3/_{16}$-inch hole was cut in the cabinet to allow access to the new terminals (Fig. 11-2).

At this point it might be mentioned that if one desires to use balanced input on any band with this receiver he can isolate the antenna-coil ground return and bring it out to a third terminal at the rear. It is also necessary to clip condenser *41*. This change necessitates removing antenna unit *190*, a difficult task in itself, and subsequently realigning the r.f. end.

First R.F. Stage

In the original circuit the first r.f. stage is connected to operate as a triode. Increased r.f. gain can be obtained by changing this stage to pentode

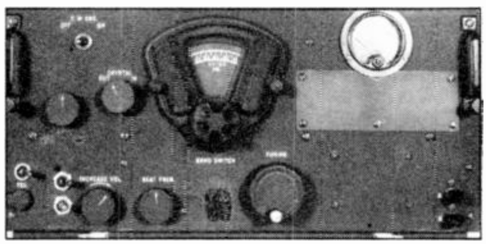


Fig. 11-1 — A view of the panel of the revamped BC-348-Q. An S-meter has been installed at the upper right. Of the three toggle switches in the lower left-hand corner, the left-hand one is for send-receive, the upper right controls the a.v.c., and the lower one turns on the noise limiter.

operation. At the installation being described, the first r.f. stage was also removed from the r.f. gain-control circuit. The circuit for these changes appears in Fig. 11-3. As seen in the diagram, G_3 is connected via the shield to ground as in the original. The jumper between G_2 and the plate is removed and a 0.01-μfd. by-pass condenser is placed between G_2 and ground. A 70,000-ohm

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BC-348-E, M, P, R, S *(see BC-348-O)*		BC-459-A	112–113	F-3, Wilcox	107–108
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		BC-645	120–124	SCR-522	116–120

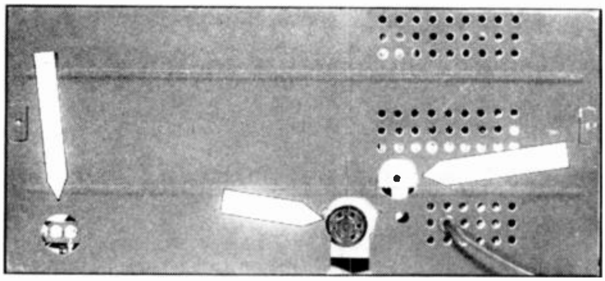


Fig. 11-2 — A rear view of the BC-348-Q with the case replaced, showing clearance holes cut in the case.

resistor is inserted between G_2 and a point on the lug side of the 15,000-ohm resistor, *99-3*. It is important that this plus lead connect to the B+ bus below resistor *99-3*. Condenser *65* is shunted to ground by a 250-ohm ¼-watt resistor. The lead between the cathode of the first r.f. stage and G_3 of the second r.f. stage was removed, allowing the first r.f. stage to operate "wide open."

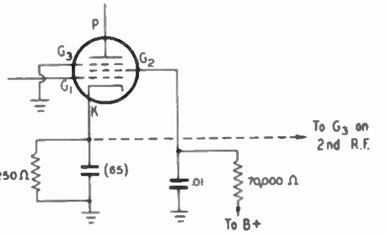


Fig. 11-3 — The modified first r.f. stage. The lead represented by the dotted line is removed, and the cathode returned to ground through the 250-ohm resistor. [See Fig. 11-9 and later text for an alternative modification of this stage. — *Ed.*]

Gain Controls

Continuing through the circuit, the next change was the incorporation of separate r.f. and a.f. gain controls. The "AVC-OFF-MVC" switch, *169*, was removed and in its place was inserted a s.p.s.t. switch (S_1 in Fig. 11-6) to control the a.v.c. network to be considered later. Circuits for r.f. gain, a.f. gain, and a.v.c. are given in Figs. 11-4, 11-5 and 11-6.

The dual potentiometer, *110*, was removed and in its place was substituted a 0.35-megohm potentiometer with switch. This unit controls the a.f. gain and the 110-volt supply to the primary winding of the power transformer. The leads to the former volume control were not disturbed other than to attach them to the new potentiometer-switch unit. The two potentiometers in the dual control can be separated readily, allowing the 20,000-ohm section to be used as a separate r.f. gain control. This particular control has a special taper so it is advisable to use it. It was mounted on the panel just to the left of the crystal switch. Leads were carried below through holes drilled in terminal board *198*, located below crystal unit *160*. It is important that the 100-ohm resistor, *107-3*, be removed from the r.f. gain-control circuit and utilized in the a.v.c. circuit alone.

The a.v.c. circuit is connected with a switch placed between ground and resistor *107-3*. This switch was mounted in the hole previously occupied by switch *169* and acts as the a.v.c. on-off switch. The circuit for the a.v.c. control is given in Fig. 11-6.

Noise Limiter

A noise-limiting circuit similar to that which has appeared in many issues of *QST* was inserted. The circuit for this is given in Fig. 11-5. Switching the network into the circuit produces very little reduction of volume. A switch was placed in a hole drilled in the panel just below what is now

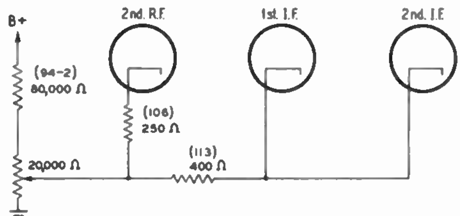


Fig. 11-4 — The gain-control circuit is revised by separating the tapered 20,000-ohm potentiometer from the combination control and connecting it as shown.

the a.v.c. on-off switch. The noise-limiter network could be permanently connected into the circuit without diminishing the efficiency of the receiver, if one doesn't want to bother with the switch.

When the crystal-filter network is switched into the circuit, the selectivity of the receiver is markedly increased but the gain of the receiver is diminished. Because of this some users might like an additional stage of audio. This was not added at this station, however.

> • There are two versions of the BC-348, both made to the same performance specifications but differing considerably in circuit design. One group is identified by the suffix letters J, N and Q, the other by the letters E, M, P, O, R and S. The conversion procedure presented in these pages for the BC-348-Q is applicable to the first group, that for the BC-348-O to the second group.

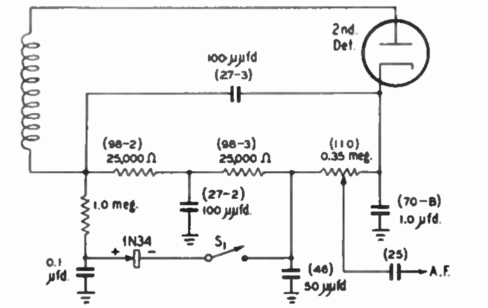


Fig. 11-5 — **A shunt-type noise silencer is added to the second detector by revising the circuit slightly and adding a 1N34 crystal diode, a 1-megohm resistor, a switch and a 0.1-μfd. condenser.**

Output Jack and Coupling

The output transformer *155a* has two output taps designated "high" and "low." The "high" tap has an impedance of approximately 4500 ohms to match a headset and the "low" tap has an impedance of 500 ohms to match a line. Some users who have not discovered that the resistance values given in the *Instruction Handbook* accompanying the receiver refer to d.c. resistance instead of impedance, will be pleasantly surprised at the increased gain which follows the incorporation of a 500-ohm-to-voice-coil transformer at the 'speaker end of the line. As shown in the photographs, a jack was mounted on the chassis at the rear adjacent to connector *SO-104* and a corresponding 1³⁄₁₆-inch hole was cut in the cabinet. Condenser *61-8* was moved slightly toward the output transformer. This jack is used for 'speaker output and the "low" tap is connected to it. Another lead was run from the "high" tap to one of the jacks on the front panel and is reserved for headphone use. The upper headphone jack was removed and in its place a s.p.s.t. switch was inserted in the power-transformer high-voltage center tap for send-receive. There are provisions for a send-receive relay through Pins 2 and 6 in *SO-104*, but the screen circuit controlled by 2 and 6 was used for an S-meter, and as a result other provisions for send-receive relaying and switching are necessary.

S-Meter

The S-meter circuit is given in Fig. 11-7. The meter used was a 0–150 microammeter, although a higher-range one can be used, and it was mounted in the upper right-hand corner of the

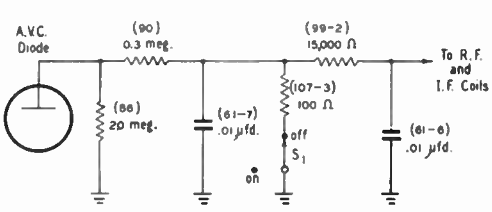


Fig. 11-6 — **The circuit location of the a.v.c. on-off switch.**

panel, as shown in the photograph. The circuit constants for the meter were found to be critical, but if those given are used one should experience no difficulty. It might be mentioned that in order to obtain a greater swing of the meter it is necessary to decrease the 0.15-megohm resistor and to decrease the swing this resistor is increased. When the r.f. gain is decreased the meter tends to go off scale to the right and when the c.w. oscillator is turned on it tends to go to the left. Because of this a separate switch could be placed at point *X* on the diagram.

The plug connector *SO-104* was removed from the set, and in its place a 6-prong socket was used. This was mounted in the end of an old i.f. can. The shield can was cut down to fit the available space and it made a very rigid support for the socket and also made it possible to mount the socket at the extreme rear edge of the chassis, using the same tapped holes and screws which were used with the original fitting. It was necessary to replace the original fitting, since no plug was available which would match *SO-104*. Terminals 1 and 5 were disregarded, since they were taken care of by the 'speaker jack already mentioned. The send-receive connections, paralleling the s.p.s.t. switch on the panel, were made to two of the socket terminals. In this way an external relay can be used with the send-receive switch on the panel remaining in the "off" position. This facilitates break-in operation. Terminals 2, 6 and 7 or 8 (ground) were connected to three of the other terminals and the three make up the point where the S-meter connects into the circuit. The 1000-ohm potentiometer was mounted on a small angle and the resistor network mounted on it. The meter leads were then carried forward to the meter position on the panel. In order to use a plug to fit the 6-prong socket it was necessary to enlarge the rectangular opening in the rear of the cabinet with a rat-tail file. The metal is very soft and is easily removed to the desired configuration. In order to mount this new plug arrangement, it was necessary to remove the shield which separated the original from the

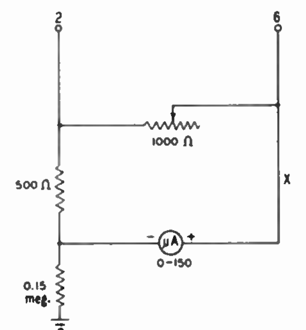


Fig. 11-7 — **The S-meter circuit requires a 0–150 microammeter and three resistors. For greater meter swing, the 0.15-megohm resistor should be replaced by one of a lower value. If a higher-range meter is used, such as a 0–1 milliammeter, the 0.15-megohm resistor should be replaced by a resistor of lower value.**

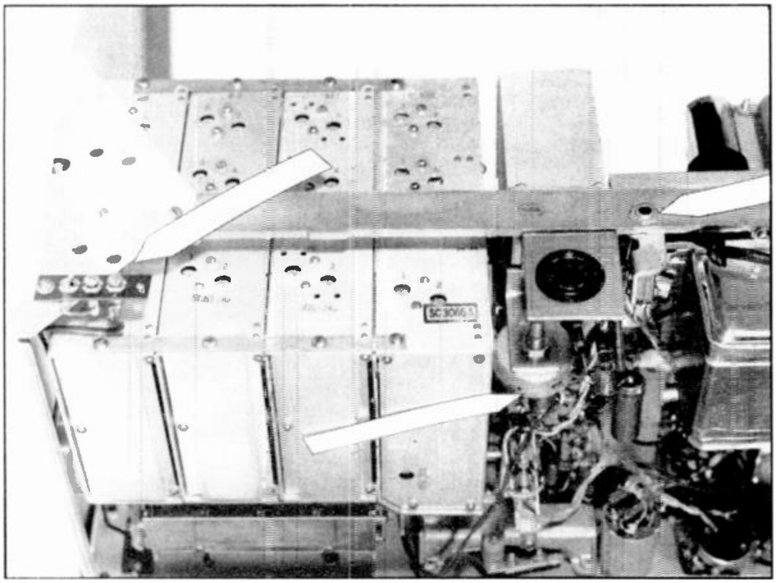


Fig. 11-8 — This view of the rear of the BC-348-Q shows how the antenna binding posts, the S-meter zero-set potentiometer, the output speaker jack and the 6-prong socket for connecting to an external send-receive switch are installed.

rear of the cabinet. The screws which held this shield in place were used to fill in the holes in the panel resulting from the removal of the nameplate. Removing this plate made the receiver take on a less military appearance. Black paint was used to cover the various unwanted markings on the panel. "Decal" titles now available could be used to complete the panel markings for the new controls.

Upon completion of all changes, the i.f. stages were peaked with the crystal in the circuit. The effectiveness of this receiver need not be described to those who already own it, for it makes a very satisfactory amateur instrument. The changes described can be made in a few hours at a minimum of expense. The author wishes to acknowledge his gratitude to W6FTU and W6SHK for the suggestions and help which they gave in the conversion of the receiver.

Dr. Paul M. Kersten, WØWIT

The many inquiries concerning the changes made in my BC-348-Q as described in the above article make it seem worth while to supplement the original conversion procedure with a postscript covering further beneficial changes made since that time.

Beginning at the r.f. end and working back, the 0.002-μfd. mica condenser in the antenna lead (circuit designation *22*) was removed, as was also the 75-μμfd. unit (*41*) which parallels the antenna coils. Each can be reached by removing the bottom shield plate of the antenna-coil compartment. The "Antenna-Ground" terminals were removed from the panel and a small 100-μμfd. variable condenser was placed in the hole left from the "Antenna" terminal. This was wired between the antenna input and ground, thereby making it possible to tune the antenna coils for added gain.

In the first r.f. stage an 1852 was substituted for the 6SK7, with a remarkable improvement in signal-to-noise ratio. In the original article it was shown that the first r.f. tube was run "wide open" as a pentode instead of as a triode. In addition to changing the plate and screen resistors to allow the 1852 to operate at nearly rated voltages, it was removed from the a.v.c. circuit. This was accomplished by grounding the bottom end of the 1-megohm grid resistor (*87-1*) and removing the lead which previously connected it to *98-1* and *96-2*, 25,000- and 50,000-ohm resistors respectively. The resulting circuit is shown in detail in Fig. 11-9.

In the second r.f. stage, the cathode resistor (*106*) was decreased from 250 ohms to 100 ohms. In order to raise the screen voltage on this stage the series screen resistor (*93-4*) was decreased from 100,000 ohms to 27,000 ohms. Since this made the S-meter read "high," the 150,000-ohm resistor to ground in the S-meter circuit was increased to 240,000 ohms. Fig. 11-7 of the earlier conversion will make this clear.

In order to keep the S-meter from going off scale when the r.f. gain was decreased when using m.v.c., a toggle switch was placed in one lead to the meter so the meter can be discon-

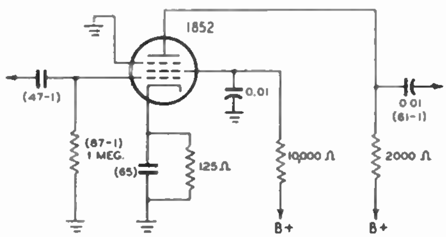


Fig. 11-9 — R.f. stage converted to use an 1852. In addition to the changes described in Fig. 11-3 and the earlier text, the lower end of the 1-megohm grid resistor (*87-1*) is removed from the a.v.c. line and connected to ground.

nected. The switch was mounted on the panel just to the left of the meter.

The i.f. gain was increased by decreasing the bias on the first and second i.f. stages. This was done by reducing the cathode resistor (*113*) from 400 to 200 ohms.

"Send-receive" switching is accomplished by cutting the center tap of the power transformer. The panel switch is paralleled by leads brought to a plug on the rear of the chassis for remote-control operation.

The author is indebted to many fellow hams from all parts of the country for these additional suggestions and they are offered so that more can benefit by them.

— *P. M. K.*

CONVERTING THE BC-348-O (AND BC-224) RECEIVER

THE BC-348-O receivers have two stages of r.f. and three stages of i.f., and with a few changes can be made to compare favorably in electrical performance with much higher-priced receivers. As supplied to the Army, the receivers were designed to operate from a 28-volt d.c. supply, but since all the tubes used in the receiver have 6.3-volt heaters the sets may easily and inexpensively be modified to operate from a 115-volt a.c. supply.

A number of the models of the BC-224 series differ from the 348s only in the heater circuit, so most of the changes described here can also be made to the 224s.

Power Supply

The one essential change is in the power supply to the receiver. First, the dynamotor chassis is removed and all the parts stripped from it. The terminal strip is the only part to be retained for installation. By the gentle use of a hammer and a block of wood the dimples that held the heads of the dynamotor mounting blocks can be flattened out so they will not interfere with the mounting of the new parts. The power supply diagramed in Fig. 11-11 may now be built on the old dynamotor chassis.

It is then necessary to separate the original 28-volt wiring into 115-volt power-supply wiring and 6.3-volt heater wiring. By clipping the ground connection loose from Terminal 7 of *SO-143* on the back of the chassis and removing the dial-light supply wire from Terminal 1 on the front

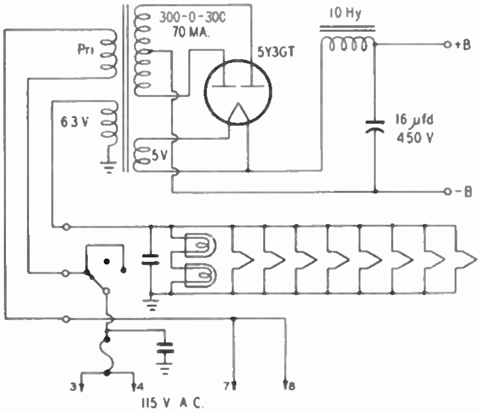
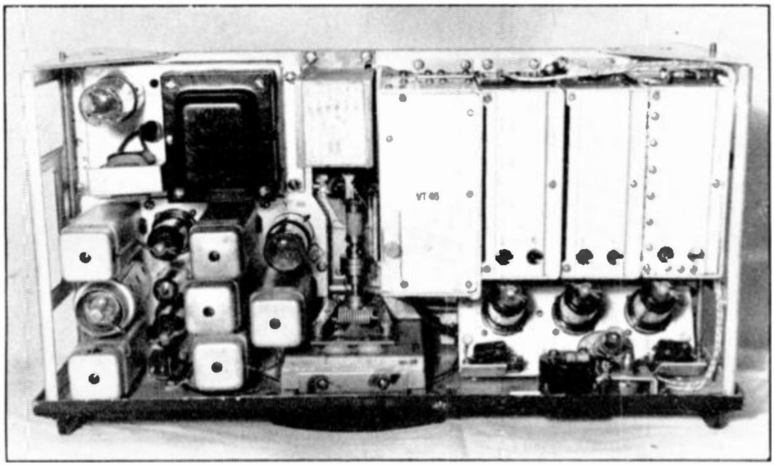


Fig. 11-11 — Circuit diagram of the power supply, showing rewired heater and dial-light circuit. The 115-volt connections can be made to the former 28-volt d.c. terminals.

section of the "AVC-OFF-MVC" switch, the original 28-volt supply circuit can be used to lead in and switch the 115-volt supply. Next, the tube heaters must be wired in parallel and *R-501*, the tapped resistor for heater balancing, removed from the circuit. Fig. 11-11 shows the rewired heater and dial-light circuit. *R-500* and *R-503*, the fixed and variable resistors in series with the dial lights, are disconnected and removed from the receiver. Changing the heater wiring for parallel operation is relatively simple if the method shown in Fig. 11-12 is followed. It is necessary to break the old heater wiring only at the two points marked with Xs; the two sections of resistor *501* can simply be shorted out.

By connecting a jumper between Terminals 2 and 6 and connecting 115 volts a.c. to Terminals

Fig. 11-10 — A top view of the modified BC-348-O, showing the power supply (upper left) that replaces the dynamotor and the S-meter with its potentiometer for zero adjustment (lower right). The meter is mounted in the space formerly occupied by the dimmer control. This view also shows the miniature power amplifier between two of the i.f. tubes.



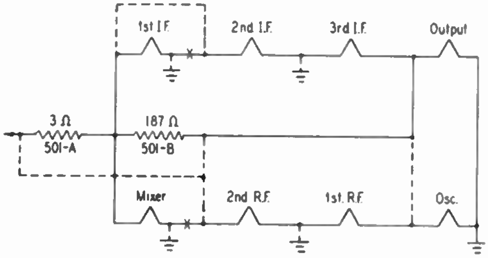


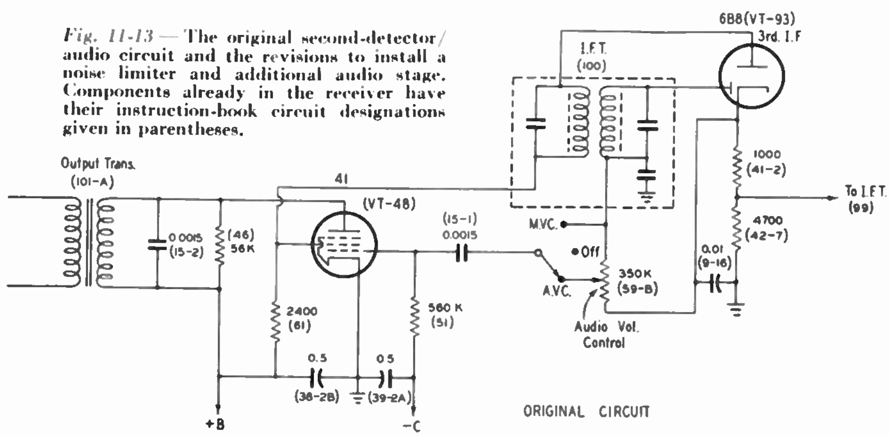
Fig. 11-12 — Rewiring the heater circuit. The original wiring is shown by the solid lines. Dashed lines indicate the changes to put all heaters in parallel. Xs indicate the only points where the original wiring need be opened. The changes in the lower row of tubes can all be made in the r.f. section; it is not necessary to open the oscillator shield can.

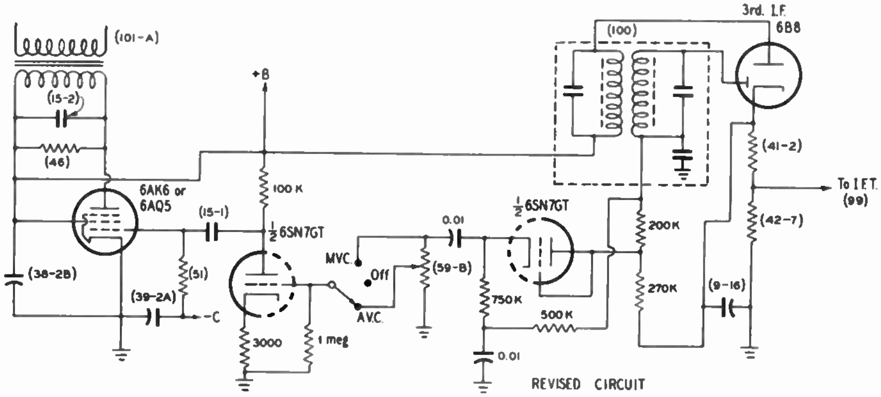
4 and 8 of *SO-143* the receiver is all ready to go and is pretty hot. However, it does lack some of the features usually available in amateur receivers, such as a noise limiter and S-meter, and the operating voltages applied to the r.f. stages do not allow operation at the most-favorable signal-to-noise ratio.

Noise Limiter

Since the author's QTH is badly beset by noise, the noise limiter was an item of the highest priority. A germanium diode was considered, but the back resistance of these crystals is lower than that of some of the resistors in the audio input circuit, and it was thought that they would not serve satisfactorily in a series-limiter circuit. A thermionic diode seemed to be the only solution to the problem. Since most limiter circuits result in a loss of audio gain it was decided to install an additional audio stage. Space for one miniature tube was found in the center of the i.f.-audio chassis. At the time the conversion was made there was no miniature twin triode available that had independent cathodes, so the easiest solution seemed to be to install a 6AK6 or 6AQ5 output tube in the new socket, and install a 6SN7 twin triode in the space occupied by the original output tube. (RCA has since announced the 12AU7 twin triode using a nine-pin socket slightly larger than the seven-pin button base. This tube has a center-tapped heater so that it can be operated on a 6.3-volt heater supply. If this tube is used for a noise-silencer-and-first-audio stage it is not necessary to move the output stage.) The modified audio system is shown in Fig. 11-13. The numbers in parentheses are the original circuit designations for parts already in the receiver. Actual values also are shown for assistance in identification. New parts are identified by their actual characteristics.

Fig. 11-13 — The original second-detector/audio circuit and the revisions to install a noise limiter and additional audio stage. Components already in the receiver have their instruction-book circuit designations given in parentheses.





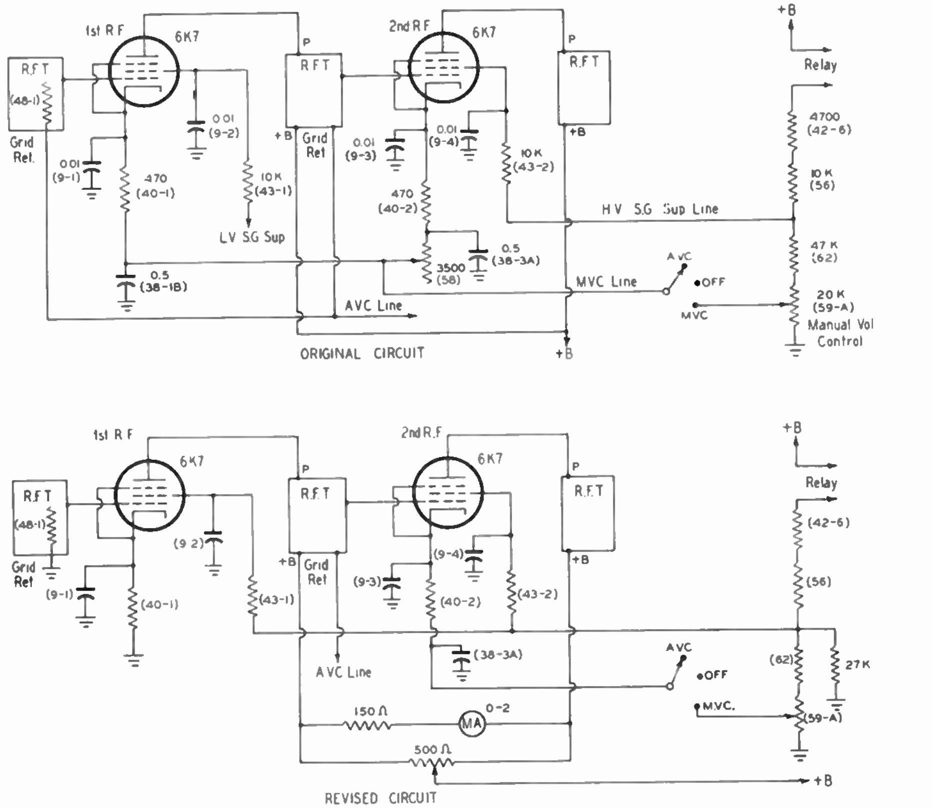


Fig. 11-14 — R.f. circuit changes to take the first r.f. stage off the gain control and to install an S-meter.

"Souping Up" the Front End and Installing an S-Meter

In general, the best signal-to-noise ratio can be obtained from a receiver when the first r.f. stage is operated at maximum gain. To obtain this condition the first 6K7 is removed from the a.v.c. and m.v.c. busses and is connected to the higher-voltage screen supply. When the first r.f. stage is removed from the a.v.c. bus, resistor *48-1* (0.1 megohm) in series with the grid return is left in the circuit to protect the grid of the tube from drawing excessive current should the receiver be overloaded by the local transmitter. The bottom end of resistor *40-1* is removed from the m.v.c. bus and grounded. The supply end of screen filter resistor, *43-1*, is disconnected from the blank pin of the first r.f. socket and connected to the blank pin on the second r.f. socket, which is the higher screen-voltage supply. After making these changes the receiver was tested on strong local stations and with a high-gain converter for six and ten meters no overloading was detected. All changes are completely diagramed in Fig. 11-14.

When a strong signal is applied to the receiver and it is operating with a.v.c., or when the manual volume control is turned down, the screen voltage on the tubes increases to quite a high value. This causes no difficulty when the tube bias is also increased, but since the first tube now operates at a constant bias it is necessary to improve the regulation of the screen-supply circuit. This is accomplished by connecting a 27,000-ohm resistor from the junction of resistors *56* and *62* to ground. In the b.f.o. section, the 10,000-ohm resistor that shunts the plate supply should be removed from the circuit to prevent lowering the screen voltage when the b.f.o. is turned on. This resistor is *43-4* in the original circuit designations.

Once the above changes are made, it becomes very simple to install an S-meter circuit. The variable resistor (*58*) on the end of the tuning condenser is removed and the connections shorted together. The mounting bracket for this rheostat should be saved to mount the S-meter zero-set control. A 1½-inch meter with a full-scale deflection of 2 ma. or less is installed in the space originally occupied by the pilot-light dimmer control, and the zero-set potentiometer is mounted to the right of it. These parts must be carefully fitted into the available space. The meter is then connected in a bridge circuit between the first and second r.f.-amplifier plates. As the grid bias of the second r.f. amplifier is varied, either by a.v.c. or m.v.c., the bridge will be unbalanced and the meter will indicate the unbalance current. Since the tubes in the two r.f. stages are alike and are operated at the same electrode voltages in the absence of any a.v.c. or m.v.c. voltages, the drift of the zero point because of line-voltage changes is much smaller than would be the case were only one arm of the bridge circuit a vacuum tube.

A cable socket to fit *SO-143* could not be found, so it was replaced by a six-pin Amphenol plug. The casting that held *SO-143* was drilled so that the long No. 4 bolt could be located only ⅛ inch from the outside edge. Then with a little careful filing and drilling the six-pin plug was fitted into the available space and secured in place by the long No. 4 bolt. The output, relay (send-receive switch) and 115-volt connections are made to the plug.

Once the changes listed above are accomplished the BC-348-O leaves little to be desired in the way of a stable and easy-to-operate amateur communications receiver.

— *W. B. Bernard*

SERVICING XTAL FILTERS IN THE BC-348

Lack of ventilation in BC-348 receivers that have been converted for a.c. operation with built-in power supply sometimes leads to failure of the crystal-filter section. Excessive heat from the power supply melts the gummy substance covering the three-section crystal holder, causing it to seep into the holder and deposit on the crystal and the electrodes.

The remedy was found to be quite simple and easily performed. The crystal and its holder, which are directly behind the crystal switch, should be removed and taken apart. Clean the crystal and all parts of the holder by scrubbing with warm water and soap. Rinse and dry thoroughly, being careful to avoid touching the crystal with anything that will leave dirt or grease on it. Reassemble the crystal in the holder, seal all seams with Duco household cement, and wire it back into the circuit. Results are surprisingly good.

— *Herbert K. Armistead, W4WM*

ELIMINATING BACK-LASH IN BC-348 RECEIVERS

Back-lash in the tuning mechanisms of the BC-348 series receivers can be eliminated by slight adjustment of the screws that mount the tuning condenser. The holes in the bracket on the condenser are sufficiently large to allow the condenser to be moved far enough to take up the back-lash. It is only necessary to loosen the screws on the dial end of the condenser mounting bracket and the subpanel casting. Twist the screwdriver blade until the slack in the gears is taken up, and then retighten the mounting screws.

—*Kenneth A. Jenkins*

IMPROVING THE PERFORMANCE OF THE BC-342 RECEIVER

As it stands, the 342 makes a fair ham receiver. It's built like a battleship and is just about as stable, mechanically. Evidently a lot of thought has been given to electrical stabilization of the high-frequency oscillator, too, because the drift is low and the direct-reading dial calibration is quite accurately maintained.

However, some of the 342's characteristics, presumably dictated by military requirements, leave a good deal to be desired in amateur communication. The operating voltages on the r.f. tubes are such that the gain is held down, with the result that the signal-to-noise ratio is not what it might be. There is a big drop in output when the filter is switched in; also, the receiver has no selectivity control and normal i.f. alignment results in the crystal's working at the very maximum selectivity at all times. The frequency range of the set is from 1500 to 18,000 kc., so that only three ham bands are covered. There is a bad a.c. hum in headphone reception. There is noticeable back-lash in the tuning mechanism, varying in different receivers but amounting to as much as 5 divisions on the vernier dial in some. There are only two ways the set can be shut off during transmission: by turning the gain control to minimum, or by opening the a.c. switch and letting the tube heaters get cold.

Most of these things can be fixed up. Changing the tuning range would be a major operation, but

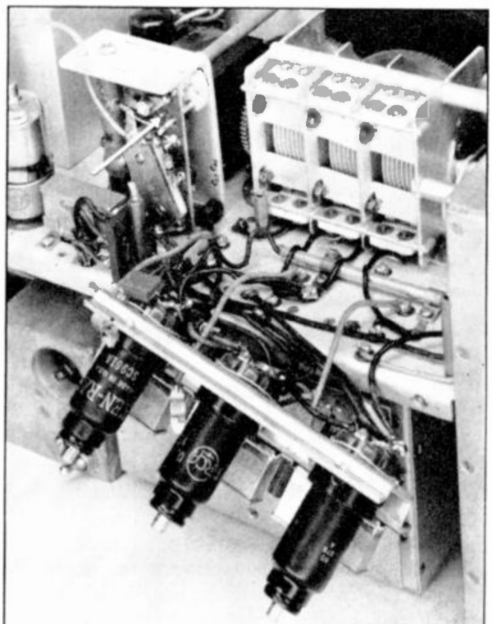


Fig. 11-15 — By taking out a few screws, the plate holding the r.f. tubes in the BC-342 can be pulled out, exposing the socket wiring. The parts in the crystal-filter unit also are more accessible when the r.f. tubes are out of the way. The arrow points to the stud mentioned in the text.

that problem can be dodged by building a converter for the frequencies higher than 18 Mc.; in fact, the set is rather nicely arranged for working with a converter because the shielding is excellent and the antenna input is designed for coax cable, both factors contributing to interference-free converter reception.

The electrical changes to improve the performance are fundamentally simple. Taking the various points in turn:

R.F. End

Boosting the gain in the r.f. stages — and particularly in the first stage — materially improves the signal-to-noise ratio. As the set is wired, the cathode resistors of the first and second stages — R_1 and R_7, respectively — are 500 ohms; these should be reduced to 250 ohms each. The screen resistors, R_3 in the first stage and R_9 in the second, should be reduced from the design value of 40,000 ohms to 20,000 ohms. These changes raise the screen voltage to 130, approximately, and reduce the grid bias at maximum gain to about 3 volts. It is also advisable to remove the first tube from the manual r.f. gain control so that this tube always runs wide open in c.w. reception with m.v.c.: this keeps the signal-to-noise ratio high when the r.f. gain is reduced to give a comfortable signal level.

To make the changes it is necessary to remove the shield plate at the rear of the chassis behind the r.f. and mixer tubes. This can be done by taking out the four screws on top and lifting off the plate. The screen resistors are on the mounting strip underneath the plate and are identified by the near-by circuit symbols. The easiest and quickest way to make the change in screen-resistor value is to shunt R_3 and R_9 with 40,000-ohm ½-watt resistors, rather than by substituting 20,000-ohm units directly, the original resistors being wired in such a way that it is a real problem to get them out.

The cathode resistors for the two r.f. stages are mounted alongside the tube sockets, and are inaccessible until the mounting plate (Fig. 11-15) for the tubes is removed from the chassis. This plate is held by the two threaded studs at the extreme ends at the rear and by two screws at the front. Take out the screws and remove the grid caps from the tubes; the plate can then be pulled out to the limit of the grid leads, making the socket wiring easy to get at. The cathode resistors are mounted between the cathode pin on the socket and an insulated tie point alongside; clipping the leads is the simplest way to get them out. The 250-ohm ½-watt substitute for R_1 should be soldered between the cathode pin and a convenient ground point such as the shell pin on the socket, but the replacement for R_7 should be connected to the same points as the original resistor. After these changes have been made the mounting plate and shield should be reassembled.

Raising the gain by this method should make the trimmer on the first r.f. stage show a definite peak on noise with the antenna disconnected.

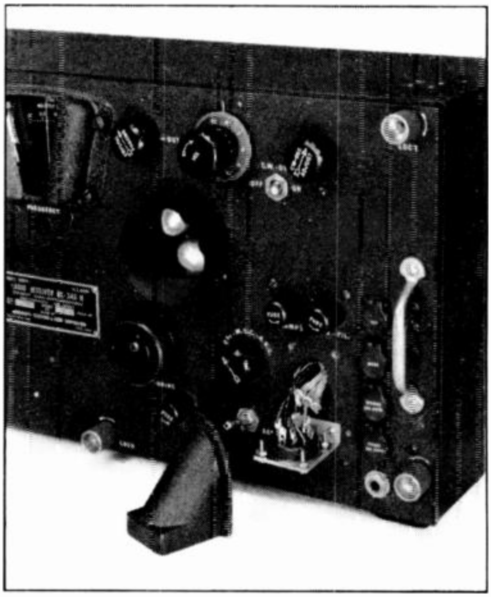


Fig. 11-16 — A large-size tuning knob in place of the vernier control makes the BC-342 easier to tune in amateur work. This photograph also shows the octal socket installed in the cable outlet in place of the special connector supplied with the set. The socket takes an ordinary octal plug and provides a convenient outlet for filament and plate voltages for a converter, among other possibilities. Note that the cap (an item with high nuisance value) has been removed from the jack that has been switched over to the first audio stage.

Crystal Filter

The principal trouble with the crystal filter is that the capacitance of the phasing condenser is too large. This condenser (C_{51} in the circuit diagram) has a maximum of 50 μμfd. and has a switch blade on its rear shaft extension to short-circuit the crystal when the condenser is turned to maximum capacitance. In the "crystal out" position, therefore, the 50-μμfd. phasing condenser is connected directly across the secondary of the i.f. transformer. With the crystal in, the phasing condenser ordinarily is set at about one-fifth of maximum, or somewhere in the vicinity of 10 to 15 μμfd. As this capacitance is in series with the crystal-holder capacitance under these conditions, the shunting capacitance across the transformer secondary is less than 10 μμfd. Thus simply switching the crystal in and out causes a capacitance change of 40 μμfd. or more. The result is that if the transformer is lined up without the crystal it is badly out of alignment when the crystal is switched in, and vice versa.

The cure is quite simple: the crystal switch should be arranged to close when the phasing condenser is at *minimum* capacitance. Unfortunately, the switch blade is pinned to the condenser shaft — in a spot where it is practically impossible to get the pin out without wrecking the condenser and the surrounding parts. However, a small stud used as a stop to prevent continuous rotation of the condenser is mounted in the bakelite plate, and this stud can be used as a switch contact instead of the one normally provided. It is only necessary to solder a wire from the stud to the regular fixed contact and the job is done. Be sure to clean off any soldering flux so the edge of the switch blade will make good contact with the stud. The switch and stud are accessible from the rear of the receiver when the filter-assembly cover, held by four screws at the top corners, is lifted off.

As an alternative method, the switch blade can be forced around 180 degrees on its collar, since it is only crimped to the latter. It may break in the process, but if it does it can be soldered to the collar. This will permit using the old fixed switch contact.

The trimmer in the i.f. transformer secondary (on top of the "first detector" transformer) has to be adjusted after making this change. It may be lined up on noise with the crystal switched out. Thereafter the signal strength, when the signal is peaked on the crystal, should be the same with the crystal as without it. The crystal selectivity is not too great — just about optimum for ordinary operating.

As a refinement which makes the phasing control somewhat easier to operate, plates can be taken from the condenser stator to reduce the maximum capacitance. Removing four of the seven fixed plates still leaves plenty of phasing range and makes adjustment less critical. The plates can be broken from the solder holding them to the support rods and then fished out. It is not necessary to remove the filter assembly from the chassis, provided the r.f.-tube section is dismantled as previously described.

A.C. Hum

Some reduction in hum can be effected by adding capacitance to the filter, and it is possible to find room underneath the chassis for a couple of midget 8-μfd. electrolytics. However, the real cure is to shift the 'phones to the first audio stage. Either or both 'phone jacks can be used for this purpose. The lowermost one is the easiest to get at; simply clip the wire running to the jack spring and solder a lead from the spring to the grid prong on the 6F6 socket. With this change the headphone volume will be less, of course, but the hum disappears. The 6F6 socket can be reached by taking out the pin in the inner power-supply hinge, removing the two screws holding the power-supply unit to the top of the chassis, and swinging the power unit out of the way on the outer hinge.

If more headphone volume is wanted, it can be obtained by substituting a 6Q7 for the 6R7 second-detector first-audio tube. The cathode bias resistance should be changed, since the 6Q7 is a high-μ tube. Soldering a 300-ohm ½-watt unit across R_{28} will suffice; this resistor is on the mounting board at the edge of the chassis. A further increase in volume will result if a 50,000-ohm resistor is similarly shunted across R_{49}, the filter resistor in the diode circuit, the design value of this resistor being 0.5 megohm.

This method of connecting the headphones in the first audio stage makes no provision for silencing the loudspeaker when the 'phones are plugged in. More serious, however, is the fact that if no 'speaker is used, or its plug is pulled out when the 'phones are in use, the 6F6 output tube is left without a load. Strong signals or bursts of noise cause quite high voltages to build up across the primary of the output transformer — high enough to cause sparking inside the tube. The same thing happens, incidentally, when high-impedance 'phones are used in the second-audio jack; in one case we know of the voltage was high enough to break down the insulation in the shielded lead that runs from the transformer to the plate of the 6F6. An effective remedy for this is to replace the 'speaker jack with a standard jack of the shorting type wired so that the hot lead from the output-transformer secondary is shorted to ground when there is no plug in the jack.

Send-Receive Switch

The send-receive switch on the 342 does not shut off the receiver "B" supply as is customary in communication receivers, but if regular send-receive switching is wanted it can be incorporated by a simple change in the wiring. Remove the leads from the switch and tape the exposed ends. Ground one switch terminal. Take the bottom plate off the power unit and disconnect the high-voltage center-tap lead from the negative terminal of the filter condenser. This lead has a plain brown covering. It is long enough to reach to the switch terminal, so may be pushed through the grommet with the other power leads and soldered directly to the switch. The switch then breaks the negative high voltage before the filter, and so turns the "B" voltage on and off without the clicks that accompany switching in the positive output lead.

Back-Lash

The back-lash problem is a sticker. We haven't found a satisfactory solution to it, although from all indications it is wholly in the worm-gear combination that drives the condenser shaft and not in the gears connected to the tuning knobs. More intimate contact between the worm and the toothed gear might be the answer, but there seems to be no way to get it without taking the whole assembly off the chassis; there appears to be a possibility of adjustment but the condenser frame is pinned to the gear-assembly casting. The pins, as usual, are inaccessible without a major disassembly job.

In some cases an improvement can be effected by tightening the spring tension on the worm shaft, which can be done by carefully loosening the setscrew in the collar, pressing the collar tightly against the spring, and retightening the setscrew. This will prevent any thrust in the shaft and thus keep the worm from moving back and forth. In a couple of cases doing this reduced the back-lash by about one division on the vernier dial.

Odds and Ends

A number of other changes can be made in the receiver to make it more adaptable to ham work, although they have nothing to do with its electrical performance. One simple thing that makes tuning a lot easier is to substitute a big knob for the miniature job on the vernier control; the shaft is ¼-inch so any standard knob will fit. A large knob will cover up the vernier scale, which may be a disadvantage if the scale is used for logging purposes. However, it is probably preferable to log directly from the frequency scale.

Rubber grommets in the holes in the slide fasteners on the bottom will keep the receiver from scratching the operating table and make it practically impossible for the set to slide, even with a hefty push.

The cable outlet is practically useless unless a special plug is obtained to fit. However, an Amphenol MIP octal socket fits perfectly in place of the original connector insert, even to the mounting holes. The socket mounting plate extends a little beyond the edge of the receptacle, in one or two spots, but can easily be filed off so the cover can be replaced. Installing such a socket provides an easy means for bringing out filament and plate voltages for operating a converter, for example, and leaves extra contacts for external "B" switching (a lead in parallel with the hot lead to the send-receive switch) and for introducing a keying-monitor tone (a lead to the secondary — already brought out in the cable — of the interstage audio transformer). The unused wires originally running to the connector can simply be clipped off.

A tone control can be installed for cutting down high-frequency noise; a simple one is a 0.02-μfd. condenser connected between the grid of the 6F6 and ground. It can be cut in and out of the circuit by a toggle switch which may be mounted in the hole now occupied by the spare-fuse holder.

— *George Grammer, W1DF*

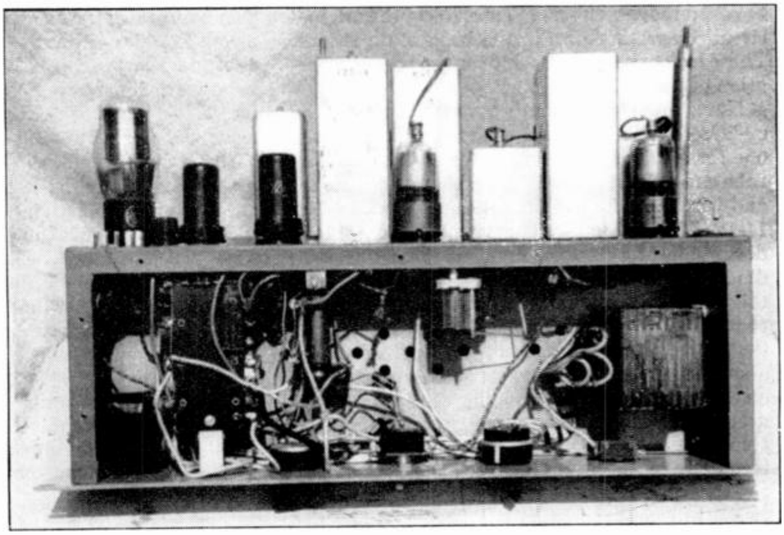
A.M. OR N.F.M. RECEPTION WITH THE WILCOX F-3

Very little modification is required to use the Wilcox F-3 receiver as the i.f. amplifier following a converter for a.m. reception. However, it is not especially difficult to go one step further and adapt it for narrow-band f.m. reception as well. The conversion described here will allow either true n.f.m. or a.m. reception.

The first step is to remove the protective shield box that covers the tubes and coils. The top and bottom of the chassis follow and then the front panel itself. This leaves the inside of the receiver nicely exposed so that any work to be done can be completed easily. The power transformer must be set back to provide a little depth behind the panel at one side, so two new holes should be drilled one inch to the rear of the present ones that hold the unit in place. This leaves ample space to mount a switch behind the panel on the right-hand side. This switch, mounted in the spot formerly occupied by the frequency nameplate, is a s.p.s.t. unit used to break the high-voltage center-tap lead from the transformer for send-receive control. The center control, marked "Noise Control," should be removed from the circuit and from the panel and the hole enlarged to take a d.p.d.t. switch for a.m.-f.m. change-over. In the f.m. position, the switch also shorts out the a.v.c. bus to give a little extra gain.

The next step is to change the crystal socket from the three-pronged aircraft type to an octal of the wafer variety. This requires drilling two holes, but in replacing the crystal shield can it will be found that two bolts will be enough. While the oscillator can be made self-excited, crystal control seemed a good idea because it provides an i.f. channel that is not going to wander in frequency when the set is jarred or the line voltage fluctuates. The crystal used in this unit was 3845 kc., with the oscillator below the

Fig. 11-17 — A view of the modified Wilcox F-3 with the cover off the chassis. The 6J5 audio tube is just to the right of the 80 rectifier. To the right of the 6J5 is the 6SJ7 limiter, and behind the 6SJ7 is the discriminator assembly.



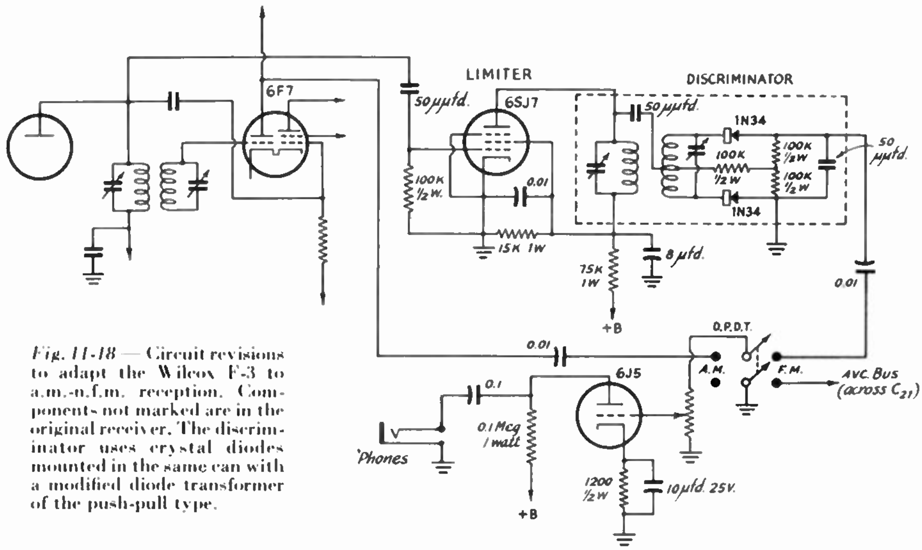


Fig. 11-18 — Circuit revisions to adapt the Wilcox F-3 to a.m.-n.f.m. reception. Components not marked are in the original receiver. The discriminator uses crystal diodes mounted in the same can with a modified diode transformer of the push-pull type.

signal frequency. This gives an i.f. of 4.3 Mc. (This frequency was used here because the existing converter had been built for use with a 4.3-Mc. wide-band i.f. for f.m. broadcast reception.) This i.f. is high enough to provide good image rejection but still low enough to have good gain. The converter was placed on 235 Mc. and its oscillator did not pull, so it was a natural conclusion that the unit would be just as satisfactory on the 28-, 50- and 144-Mc. amateur bands. It works beautifully on the forestry stations in the 74.5-Mc. region!

N.F.M. Reception

To make the unit function as an n.f.m. receiver, the 6C8 tube is removed and with it all of the socket wiring with the exception of the heater leads. This tube, formerly used for squelch and audio, is replaced by a 6SJ7, used as an f.m. limiter. Fig. 11-18 shows the revised circuit. Do *not* remove resistors R_{14} and R_{15} of the original circuit diagram shown in the book of directions. These resistors are necessary for the correct operation of the a.v.c. amplifier.

Next, remove the small coverplate beside the ex-6C8 socket. This will expose two knockouts, one for a tube and the other for an i.f. can. The tube cut-out should be fitted with an octal socket and wired for the 6J5 audio stage shown in Fig. 11-18. The i.f. cut-out may be used for the discriminator transformer, a modified full-wave diode i.f. transformer. The modification is simple: take the transformer out of the can, then remove the two diode plate leads and mount a three-lug tie point at the bottom of the wood dowel by a small wood screw. Then solder a 1N34 to each end of the secondary winding where the ends are attached to the trimmer lugs, with the negative terminal of the 1N34 at the coil. The other terminals of the 1N34s are soldered to two of the lugs at the tie point. As shown in Fig. 11-18, two 0.1-megohm resistors are connected in series between the same lugs, and a 50-μμfd. condenser is also connected between the same two points. One lug is grounded and the other lug is the connection for the audio output. A 0.1-megohm resistor and a 50-μμfd. condenser are connected to the center tap of the secondary winding, as shown in the diagram. The other terminal of the resistor goes to the common connection between the two 0.1-megohm resistors while the other terminal of the condenser goes to the plate end of the primary winding. This gives a well-shielded and compact discriminator assembly.

The 6J5 audio stage shown in Fig. 11-18 is resistance coupled for working into an external audio stage to drive a 'speaker.

Alignment of the i.f. is easy using a signal generator and output meter for the a.m. section. The f.m. discriminator may be lined up by using a high-resistance meter or a vacuum-tube voltmeter connected across the discriminator output. The bandwidth with the f.m. section in use very nicely handles the 30-kc. swing used commercially in the 30- to 42-Mc. band. On a.m. the bandwidth is narrow enough for good selectivity, but wide enough to take care of signal drift when using the receiver on 2 meters.

One word of caution: Be careful not to mess up the a.v.c. circuit; it uses an a.v.c. amplifier operating from negative voltages developed across the lower end of the voltage-divider string. Also, when taking the limiter input from the i.f. amplifier-stage output transformer, connect to the primary rather than secondary. This avoids loading the secondary and gives a better peak on a.m. reception, but does not affect the f.m. performance.

After using the unit on n.f.m. on 10 meters, especially on a signal that really saturates the limiter, you will definitely come to the conclusion that n.f.m. is not just something to read about — or to cuss about!

— *John A. Dinter, W8OAP*

ADDING A BC-453-A "Q5-ER" TO THE COMMUNICATIONS RECEIVER

Connecting the BC-453-A "Lazy Man's Q5-er" to the tail end of your receiver (provided its i.f. is within the tuning range of the BC-453) is as painless an operation as you'll encounter in any surplus deal. All you need is 24 volts a.c. at 0.45 ampere, and 250 volts d.c. at about 40 ma. These voltages are fed to the three pins on the top rear of the receiver, where the generator was mounted. The connections are shown in Fig. 11-19. If you're lucky, you'll be able to scare up a small control panel (designated FT-260-A) that plugs in at the front of the receiver. However, lacking the control panel, all you have to do is solder a few wires to the socket pins at the rear of the set, for leads to the audio output, gain control and b.f.o. switch. These connections are also shown in Fig. 11-19. You can mount the gain control and b.f.o. switch any place you want to, and if you want to keep the unit compact, you can make a small panel for the front, if you can't get an FT-260-A. The proper connections for this panel are also shown in Fig. 11-19.

The receiver has no a.v.c., but it wouldn't be too difficult to wire it in. The b.f.o. adjustment is a screwdriver one on the side of the set. When you get the receiver, unscrew the caps from the i.f. transformers and pull out the fiber pins — they'll move about 1/4 inch — to loosen the coupling to the "sharp" position. The coupling will already be loose on the center i.f. transformer, but tight on the other two. The audio output is not too great, but it is certainly adequate to run a small 'speaker.

Now that you have the power and controls to the BC-453-A, all that is left is to tie it in to the receiver. Even this is painless. If your receiver i.f. amplifier uses double-ended tubes, you can wrap an insulated wire around the grid lead to the last i.f. tube, and run the wire out a louver of the receiver. If your receiver uses single-ended tubes, pull out the second-detector tube, wrap an insulated wire once or twice around the diode plate pin, and put the tube back in the socket. Run the wire out a louver. Place the BC-453-A on top or alongside your receiver, connect the wire from the i.f. amplifier to the BC-453-A antenna binding post, and turn on your receivers. Peak a signal on the regular receiver, as indicated by the S-meter, and then tune it in on the BC-453-A. You're all lined up and in business!

— *W5KWI, W6OZB, W1DX*

GREATER SELECTIVITY WITH THE LAZY MAN'S "Q5-ER"

The advantages of low-frequency high-Q i.f. stages obtained from the now-famous Q5-er are many, but the selectivity is still not as great as it could be. A marked increase in selectivity was obtained by further increasing the separation between the i.f. coils in the BC-453 unit. This is done by removing the plug-in i.f. transformer, opening up the can, and removing the bottom coil and its form. Saw off the lower half inch of the form, and reassemble, cementing the coil in place.[1] Don't try to slide the coil down on the form, because it is impossible to do so without wrecking things!

Selectivity is increased to the point where the b.f.o. in the first receiver is almost useless. The critical test, digging for DX on 40 meters, was passed with flying colors. I estimate the effective bandwidth to be about 500 cycles, which is sharp enough to keep almost anyone happy. I can't recall having gotten more return for less effort in a long time.

— *Maynard B. Chenoweth, W8CUS, ex-W2GCC*

[1] In some units the coil forms are ceramic, which makes this a pretty tough job, but in many units the forms are mica-filled bakelite, which makes it a snap. — *Ed.*

PUTTING THE BC-457-A ON 7 AND 14 MC.

The electrical design of the 274-N is obviously unsuited for 14-Mc. operation, but, on the other hand, the construction of the 274-N units is above anything that the average ham can equal. In addition, it has a directly-calibrated dial. In other words, it is a good basic design to modify for general ham use. If we can keep the excellent mechanical features and modify the circuit to eliminate the above-mentioned difficulties we should have an excellent low-power transmitter.

For 7- and 14-Mc. output, a low-frequency unit, such as the BC-457-A (4-5.3 Mc.) or the BC-696-A (3-4 Mc.) should be used. The BC-457-A unit is the least expensive and the dial cali-

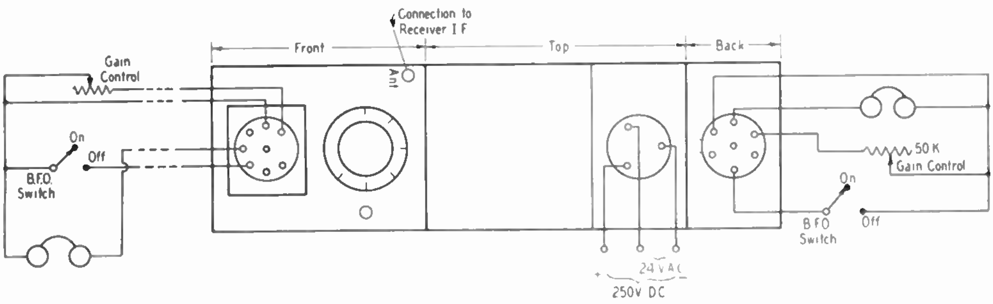


Fig. 11-19 — Pin connections for the terminals on the BC-453-A receiver, and suggested wiring of the controls. All connections are as viewed from the outside.

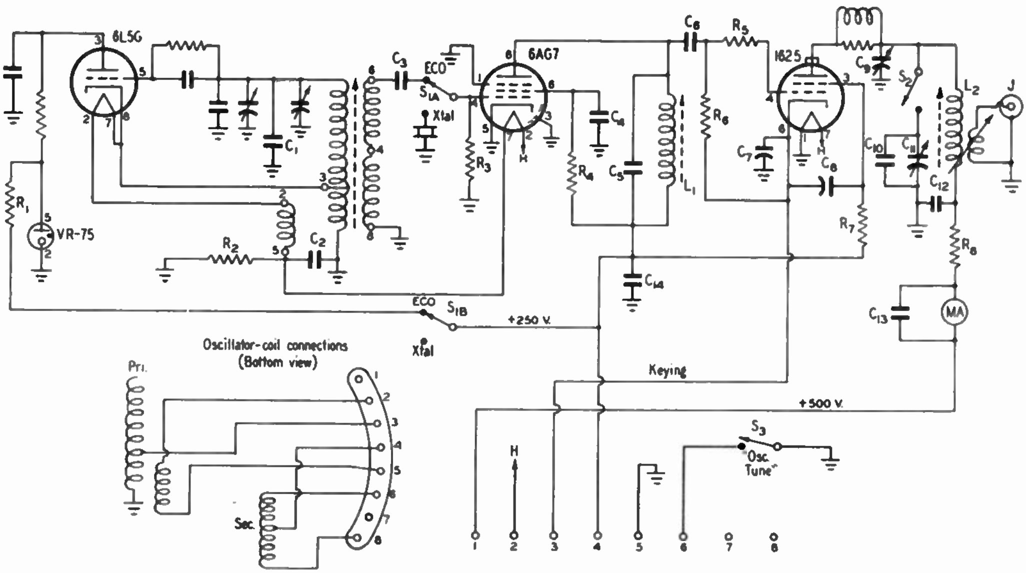


Fig. 11-20 — Schematic diagram of the SCR-274-N transmitter revamped for 7- and 14-Mc. operation. All parts not listed below are in the original unit, and are not changed.

C_1, C_5, C_6 — 100-μμfd. zero-drift ceramic.
C_2 — 0.0047-μfd. 600-volt mica.
C_3 — 100-μμfd. 600-volt mica.
C_4 — 0.0022-μfd. 600-volt mica.
C_7, C_8 — 0.02-μfd. 600-volt paper.
C_9 — 25-μμfd. midget variable, double-spaced.
C_{10} — 150-μμfd. zero-drift ceramic.
C_{11} — 50-μμfd. midget variable, double-spaced.
C_{12}, C_{14} — 0.01-μfd. 600-volt mica.
C_{13} — 0.006-μfd. 600-volt mica.
R_1 — 10,000 ohms, 10 watts.
R_2 — 12.6 ohms, 5 watts.
R_3 — 0.1 megohm, ½ watt.
R_4 — 10,000 ohms, 1 watt.
R_5, R_8 — 47 ohms, ½ watt.
R_6 — 33,000 ohms, 1 watt.
R_7 — 33 ohms, ½ watt.
L_1 — Permeability-tuned coil, National XR-50 form, 18 turns No. 22 enam. wire.
L_2 — See text.
J — Coaxial connector, Amphenol SO-239.
MA — 0-100 ma. d.c. meter, 2½-inch diam.
S_1 — D.p.d.t. rotary switch.
S_2 — S.p.s.t. ceramic rotary switch.

bration may be used for 14 Mc., as described below. However, either unit will work.

In order to achieve a driftless, chirpless signal, the following modifications to the unit are made:

1) A 6L5G low-filament-current triode is used as an oscillator. The oscillator circuit is padded down to 3.5 Mc. by means of additional zero-drift condensers.

2) A 6AG7 is added as a 7-Mc. doubler/crystal oscillator.

3) One of the 1625s is removed, and the remaining one is used as a 7-Mc. amplifier or as a doubler to 14 Mc.

4) The unit is rewired for 12-volt filament operation. Since 1625 tubes can be bought for about two bits and a 12-volt filament transformer for a buck, it pays to use the 1625 instead of an 807. In addition, it saves some nasty socket substitution along the way!

5) Some plates are removed from the oscillator and amplifier condensers to allow better spread of the 14-Mc. band on the dial. Now if we are foxy, and take out just the right number of plates, the dial calibration may be used directly on 14 Mc. (e.g., 4.0 on the dial is 14 Mc., 4.1 is 14.1 Mc., and so on).

These modifications entail a certain amount of labor but they will take only a few evenings, and the results are well worth the effort. When the job is finished you will have a 25-watt VFO/transmitter that will be hard to beat. It will have chirpless keying and practically *no* drift. (My modified unit has a measured warm-up drift of 400 cycles and a transmission drift of about 30 cycles on 14 Mc.) Interested? Well, then, hook up the soldering iron and let's go!

The first step is to remove all the unused components and wiring from the unit and to "strip it for action." The following should be removed:

From the top of the BC-457-A: the antenna relay, antenna loading coil, brackets and sliding arm, and antenna binding post. Take off the celluloid window and drill out the two little support pins. Also remove the frequency chart in the top right corner of the front panel. Oh, yes, you can toss the 1626 and 1629 away, too. Finally, clip out the plate lead of the *left-hand* 1625 (looking at the unit from the front). Also remove the free parasitic choke from the coil form.

From the bottom of the BC-457-A: (If you have gone this far you had better continue, 'cause the transmitter is no good now!) Turn it over and from the bottom take out the cathode relay and associated resistor, the plate choke between the two 1625 sockets, the 1625 screen by-pass condenser, the neutralizing condenser, the variable padding condenser for the 1625 plate tank, resistor *7101* on the back of the chassis and its holder, and finally the crystal socket. Now clip out all the wiring from the 1625 sockets to the rear power plug. This sounds like a major project, but all the above will take only ten minutes with a screwdriver and a pair of wire cutters.

The last bit of major overhaul is to remove the 1625 socket. (Looking at the bottom of the chassis, it is the socket that was next to the cathode relay that you just removed.) This operation can best be done with a screwdriver and a light hammer. Using the screwdriver as a chisel, tap around the turned edge of the socket on top of the chassis and the whole assembly will drop out. While you are about it, remove in the same fashion the power plug from the rear apron of the chassis and in its place put an Amphenol 88-8 octal socket.

Now, with a pair of long-nosed pliers, carefully flex one rotor plate at a time in the ganged oscillator tuning condenser until it can be lifted out. Remove seven plates this way. Be careful, or you might wrench the rotor out of the ball-bearing sockets. Be gentle but firm! It's easy once you get the hang of it! Now remove all but two plates in the ganged amplifier condenser. The circuits will now track roughly, and just need a little touching up for excellent tracking. More of that later.

That's all there is to it! Now comes the easy job — getting everything back together again.

Assembly

First of all, mount a plate over the 1625 socket hole and mount an octal socket for the 6AG7 on that plate. The 6AG7 slug-tuned plate coil is mounted in front of the socket. A vertical shield is placed one inch behind the front tuning gang to support the crystal-oscillator switch and also to act as a shield between the output condenser and the 1625 grid components. Between the shield and the ganged condenser is placed the filament ballast resistor, R_2. A coaxial plug is mounted on the rear chassis wall next to the octal power plug. The 7-Mc. crystal socket is mounted against the shield next to the rotary "e.c.o./crystal" switch. An extension shaft is used to bring this switch out to the front panel. A tuning switch, S_3 in Fig. 11-20, is mounted to the right of the main tuning dial above the chassis. Finally the gaping hole left by the removal of the celluloid window is covered with a thin strip of dural. On this plate are mounted a 0–100 ma.d.c. meter and C_9, the amplifier trimming condenser.

Bandswitching in the 1625 Stage

It is possible to pad the 14-Mc. plate tank of the 1625 so that the tube operates as an amplifier on 7 Mc. A ceramic switch, S_2, a ceramic padding condenser, C_{10}, and a small variable condenser, C_{11}, are all mounted on the top of the shield cover and a flexible lead is run from the switch to the top end of the 1625 plate coil. After the unit is tuned up on 14 Mc., the switch may be thrown and the variable padder adjusted to resonate the plate circuit to 7 Mc. with the same setting of the panel-controlled plate condenser. Thus a shift from 14 to 7 Mc. may be made by merely turning the switch. The 1625 stage remains stable without neutralization on 7 Mc. To determine the operating frequency, the dial readings will have to be divided by two. If 7-Mc. output is not desired, the above components may be omitted.

Wiring

The unit is now ready for wiring. All the usual tried-and-true remarks about direct leads, good insulation and parts placement apply here. See the sketch at the bottom of Fig. 11-20 for the connections to the oscillator coil. The under-chassis wiring should not take more than two hours. When all the wiring is checked, the top coil shield should be removed and C_1, the oscillator padding condenser, added to the circuit. It should be placed atop the variable condenser.

The 1625 plate coil should be rewound with eight and one-half turns, using the same wire that was removed, and spacing the wire every other groove on the coil form. The variable-link winding is attached via a short piece of RG-58/U coax to the fitting on the rear of the chassis.

All wires other than r.f. leads should be laced and firmly fixed in place to prevent any frequency change because of movement. All r.f. leads should be made of bare No. 18 wire.

Testing the Unit

To test the unit, the 6L5G, 6AG7 and VR-75 tubes should be plugged in and a power supply such as shown in Fig. 11-21 connected. A potential of 12.6 volts should be applied to the filaments and the voltage on the 6L5G and 6AG7 measured. It should be 6.3 volts on each tube. Now the B-postive lead to the 6AG7 should

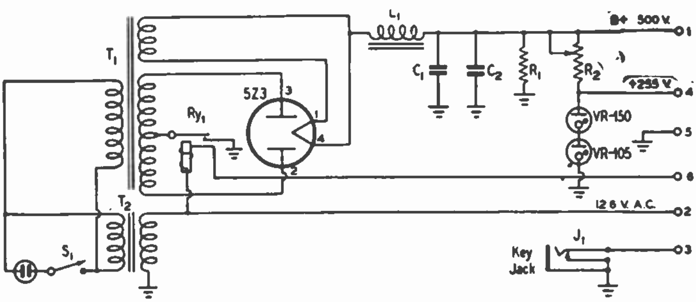


Fig. 11-21 — A suitable power pack for the rebuilt SCR-274-N transmitter.

C_1, C_2 — 8-μfd. 600-volt oil-filled.
R_1 — 0.1 megohm, 2 watts.
R_2 — 10,000 ohms, 50 watts, with slider.
L_1 — 20-hy. 150-ma. filter choke.
J_1 — Closed-circuit jack.
R_{y1} — 12-volt s.p.s.t. relay.
S_1 — S.p.s.t. toggle switch.
T_1 — 650–0–650 v. a.c., 150 ma.; 5 v., 3 amp.
T_2 — 12.6-volt 2-amp. filament transformer.

be removed temporarily and we are ready to align the oscillator stage.

A receiver and a 100-kc. frequency standard are needed to adjust the oscillator. First of all, the oscillator padding condenser in the top coil can should be set so that the oscillator tunes to exactly 3500 kc. with the main tuning dial set at "4 Mc.," and the oscillator slug set about half-way into the coil. Now tune the receiver to 14 Mc. and listen to the fourth harmonic of the oscillator. It, of course, should fall at 14 Mc. Now tune the main dial of the ECO (we can call it an "ECO" now, you're almost finished!) to 4.4 Mc., and see if the fourth harmonic falls at 14.4 Mc. If not, a little plate bending in the oscillator condenser gang is in order. One of the rotor plates of this condenser is slotted and may be used to correct the calibration. If the dial is calibrated at 4 Mc. and if 4.4 Mc. on the dial falls short of 14.4 Mc. on the receiver, for example, say 14.38 Mc., then the variable condenser is tuning too slowly and the variable plate should be bent *in*. By bending this plate and rechecking the calibration, the 4- and 4.4-Mc. marks may be made to fall exactly on 14 and 14.4 Mc. When this is accomplished, the oscillator will be actually tuning from 3500 to 3600 kc. Now the dial will track within one or two kilocycles across the whole 14-Mc. band. For the 7-Mc. band, the dial readings may be divided by two. Above 14.4 Mc., the calibration gets progressively worse, so if this unit is used for 28 Mc., and better tracking is desired, more time will have to be spent with the oscillator condenser. Believe me, it is an easy job, and the trouble is well worth the satisfaction of having a directly-calibrated dial.

Buffer and Final-Amplifier Alignment

Regulated plate voltage should be applied to the 6AG7 buffer and the "e.c.o./xtal" switch set to the e.c.o. position. The plate-coil slug should be tuned for resonance at approximately 7 Mc. When the "e.c.o./xtal" switch is thrown to *xtal* the plate slug may be adjusted slightly to allow the crystal to oscillate easily.

Nothing need be done to the amplifier ganged condenser. This stage tunes broadly so that no adjustment need be made to make it track after the necessary number of plates is removed from the condenser.

The 1625 should be plugged in its socket and the plate-tuning slug of the 1625 should be adjusted to resonate the coil to 14 Mc. with the amplifier trimmer, C_9, set at midcapacity. The plate current should dip to about 15 ma. when the 1625 is correctly tuned to 14 Mc. The ceramic plate switch should now be thrown to the 7-Mc. position, and the auxiliary padder set for resonance on this band. Now you are all set and ready to go!

The ECO unit will track across the 7- and 14-Mc. bands without any adjustment. The amplifier trimmer, C_9, need only be set to compensate for reactive loads on the 1625 plate circuit and then may be ignored. The modified unit will deliver 25 watts on both bands with crystal stability and excellent keying characteristics.

So there it is, a good VFO for a few dollars and a few hours' work. Not bad, eh?

— *William I. Orr, W6SAI*

14-MC. OUTPUT FROM THE BC-459-A

THE BC-459-A, originally designed for output in the 7-Mc. range, may be used to provide output in the 14-Mc. band with slight modification of the *LC* circuit in the amplifier stage. Fig. 11-22 shows one method by which this may be

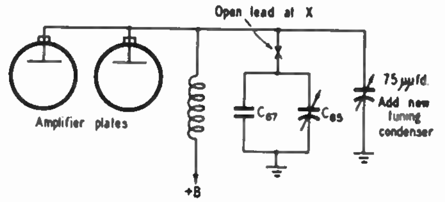


Fig. 11-22 — Substituting a 75-μμfd. condenser for the original components permits the amplifier tubes in the BC-459-A to work as doublers to 14 Mc.

accomplished. The original condensers, C_{67} and C_{65}, are cut loose from the coil, and a 75-μμfd. variable is substituted in their place. This, of course, will not be ganged to the oscillator tuning condenser, but it can be resonated separately without undue inconvenience.

— *John T. McIntosh, W8ZGO*

IT is possible to obtain 14-Mc. output from the BC-459-A and at the same time retain the gang-tuning feature. Amplifier padding condenser C_{67} (the one with the locked shaft) is removed, and ten rotor plates are removed from the other main tuning condenser. The plate coil is then pruned down to 5½ turns, and the tuning slug is removed. A 35-μμfd. padder is substituted for C_{67}, mounted with its a shaft projecting

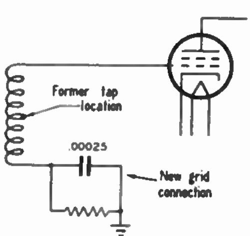


Fig. 11-23 — The revised grid circuit used when the BC-459-A is used for 14-Mc. output.

through the side of the chassis. Plate-circuit tracking is then adjusted by means of the new padder condenser and the top turn on the coil. The position of this turn can be adjusted to bring the tracking error to a minimum.

To obtain greater r.f. voltage for the final amplifier (to increase its doubling efficiency), the tap at which the grid leak R_{74} and the grid by-pass condenser are connected is moved down to the bottom of the coil as shown in Fig. 11-23. The value of the grid by-pass condenser, C_{58C}, is changed to 0.00025 μfd. from the 0.05-μfd. value originally in the circuit. This change was necessary to reduce the amount of chirp encountered in keying. The fixed neutralizing condenser, C_{62}, which was connected from the cold end of the grid coil to the plate circuit, was removed, as it is no longer needed.

— *W1DX*

MAKING USE OF THE ARC-5 TUNING EYE

The BC-457 and BC-459 transmitters were designed to work from a 24-volt d.c. supply. Under these conditions, the 1000-ohm resistor between the 24-volt d.c. line and the cathode of the "magic-eye" tube develops the correct bias for proper operation of the tube in conjunction with the built-in crystal calibrator.

Most hams revise things so that the filament circuits operate from a 24-volt a.c. source. With a.c., the magic eye will not react. This can be corrected easily, however, by the following method: The 1000-ohm resistor is removed from the cathode circuit of the magic-eye tube, and a 15,000-ohm 2-watt resistor is connected between the cathode and the B-plus line as shown in Fig. 11-24. (This assumes that the oscillator and the screen grids of the amplifier are being supplied from a 200-volt source.) With this small

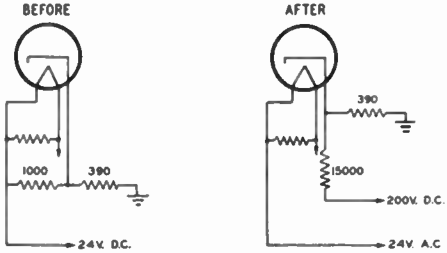


Fig. 11-24 — Simple change required to permit use of the tuning eye when a.c. is used on the filaments of an ARC-5 transmitter.

change the resonance indicator will give a very clear and definite shadow when the oscillator is tuned through the crystal frequency. Note that the 390-ohm resistor that is connected from the "magic-eye" tube cathode to ground is left in its original position.

— *F. W. Wright, jr., W2UWK*

CURING CHIRP IN COMMAND TRANSMITTERS

My BC-459-A chirped, and from what I've heard on the air, most everybody else's does, too. I tried various methods of keying, and extremes of voltage stabilization, but the chirp persisted.

Checking with a good v.t.v.m. showed 12.6 volts on the filaments with the key up, but from 18 to 22 volts when the key was closed! The added voltage was r.f.

To remedy this situation, shielded filament wire was substituted in the rig, with by-passes at each end of the wire. Old microphone cable (with high r.f. losses) seemed best. A heavy copper strip was run across the chassis, and the "cold" ends of the 1625 filaments and the cathodes were connected to it to get a good ground. This change resulted in chirpless keying for me, and has done the same for all the others to whom I have passed this hint.

— *Alfred Scott Cline, W6LGU*

N.F.M. ADDED TO THE BC-459-A

If you are using a 40-meter ARC-5 transmitter (BC-459-A) as the VFO in your 28-Mc. 'phone rig, don't overlook this simple method of using it also as a narrow-band f.m. exciter. All that you

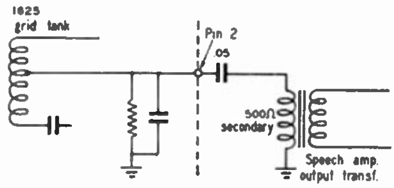


Fig. 11-25 — A simple method of using the BC-459-A as an exciter for n.f.m. work.

need is the ARC-5, your present speech amplifier (assuming that its output transformer has a 500-ohm tap on its secondary), and a 0.05-μfd. paper condenser.

The connections are made as shown in Fig. 11-25. The audio voltage is fed to the grids of the amplifier tubes in the BC-459-A through Pin 2 on the 7-pin power connector. (They are already connected to this pin in most units.) The effect of the fluctuating bias produced under modulation is to vary the frequency of the oscillator slightly. Not much power is required, and any amplifier capable of delivering between 3 and 8 watts should do the job. The setting of the audio gain control can be determined by trial. Too much audio will cause distortion and fluctuation in the meters. The proper setting can be determined by testing with other stations. Some have called this grid modulation, but tests made with an oscilloscope prove it to be f.m. While some a.m. is present at the output of the BC-459-A the action of the following doubler stages, operating Class C, washes out the a.m., leaving only f.m.

Reports obtained with this set-up on the air have been excellent. The audio level is high, and the signal is easy to tune. It makes a swell addition to any station, especially where BCI problems have been encountered.

— *Don Imhoff, W8YFS*

A MODIFICATION OF THE BC-610 EXCITER UNIT

A great many of the famous BC-610 transmitters, used extensively by the services in the war, have found their way into ham shacks, via the surplus market. While these rigs performed ably, they have certain shortcomings that can be corrected with a minimum of effort. The principal objection is to the crystal oscillator-

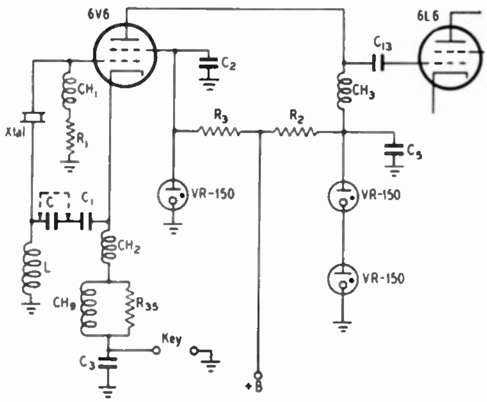


Fig. 11-26 — The original circuit of the oscillator and doubler portions of the BC-610 exciter unit.
C_1, C_2, C_3 C_5 — 0.006-μfd. mica.
C_{13} — 150-μμfd. mica.
R_1 — 33,000 ohms, 1 watt.
R_2 — 5600 ohms, 20 watts, wire-wound.
R_3 — 15,000 ohms, 20 watts, wire-wound.
CH_1, CH_2 — 1-μh. r.f. choke.
CH_3 — 2.5-mh. r.f. choke.
CH_9 — 10-mh. r.f. choke.

"MO" circuit. The crystal-oscillator circuits do not provide much in the way of operating flexibility, and the chirp of a BC-610 operating on "MO" was a distinguishing feature of our wartime radio circuits.

The modifications described here involve complete elimination of the "MO" circuits, and revision of the crystal oscillator to the highly-flexible Tri-tet circuit, arranged so that it may also be driven as a doubler by a VFO of suitable stability. In addition, one of the tuning units is modified to provide output from the exciter in the 28-Mc. range.

At W4CT only the exciter portions of the BC-610 are used. These were obtained in the surplus market at reasonable prices, and were used as the foundation for a 100-watt unit that is used to drive a push-pull 100TH kilowatt final operating in the 7-, 14- and 28-Mc. bands. The original circuits of the exciter were retained wherever possible. Thus, the modifications described here apply equally to complete BC-610 units.

The physical arrangement is shown in the photograph. The exciter deck ($11.95) was mounted on a 17 × 13 × 1-inch chassis. An aluminum panel was then made with a cut-out through which the tubes and the three plug-in tuning units ($1.25 each) could be removed. A 200-volt bias pack and a 600-volt 200-ma. plate supply were built on the rear of the exciter chassis. Metering was accomplished through a 0–200 ma. panel meter, arranged so that it could be switched to the desired circuits. Advantage was taken of the fact that the exciter deck was already wired for reading current in the 6L6 and 807 stages. A closed-circuit jack was installed on the panel for keying.

In the original 610 circuit, the parallel 807s

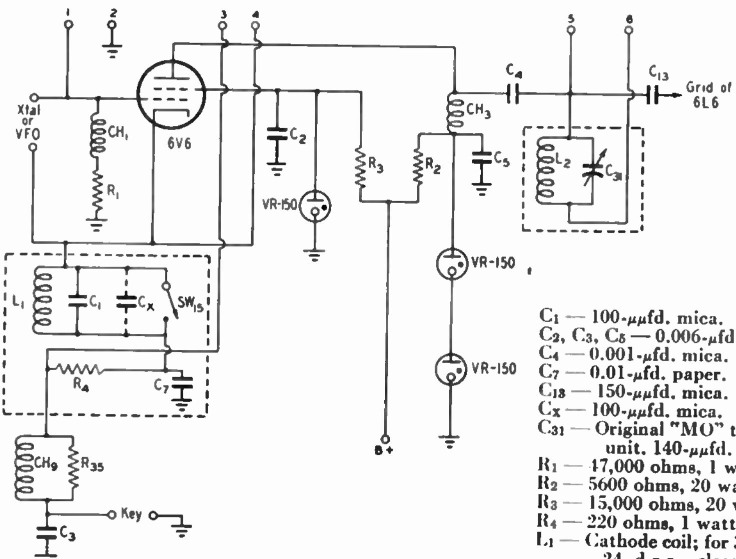


Fig. 11-27 — Schematic diagram of the revised oscillator circuit for the BC-610 exciter unit. A Tri-tet circuit is used, with provisions for connection of an external VFO. The components enclosed in dotted lines are mounted within the individual tuning units. All others are on the exciter deck. Terminal connections at the top of the diagram represent the pins on the tuning units through which the individual connections are made, and are included for reference only. See Figs. 11-29 and 11-30 for actual connections.

C_1 — 100-μμfd. mica.
C_2, C_3, C_5 — 0.006-μfd. mica.
C_4 — 0.001-μfd. mica.
C_7 — 0.01-μfd. paper.
C_{13} — 150-μμfd. mica.
C_x — 100-μμfd. mica.
C_{31} — Original "MO" tuning condenser from tuning unit. 140-μμfd. variable.
R_1 — 47,000 ohms, 1 watt.
R_2 — 5600 ohms, 20 watts, wire-wound.
R_3 — 15,000 ohms, 20 watts, wire-wound.
R_4 — 220 ohms, 1 watt.
L_1 — Cathode coil; for 3.5-Mc. crystals: 9 turns No. 24 d.c.c., close-wound on 1½-inch diam. form; for 7-Mc. crystals: 6 turns No. 22 d.c.c., ⅝ inch long, on 1½-inch diam. form.
L_2 — Oscillator plate coil — 3.5 Mc.: 85 turns No. 26 d.c.c. close-wound; 7 Mc.: 40 turns No. 24 d.c.c. close-wound; 14 Mc.: 25 turns No. 18 d.c.c. close-wound. (All wound on 1-inch diam. forms from tuning units.)
CH_1 — 1-μh. r.f. choke.
CH_3 — 2.5-mh. r.f. choke.
CH_9 — 10-mh. r.f. choke.
SW_{15} — D.p.d.t. toggle switch (one section unused).

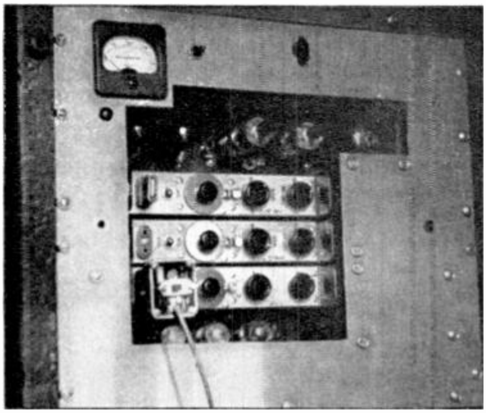


Fig. 11-28 — **Front-panel view of the revamped BC-610 exciter unit in use at W4CT.**

are operated as doublers whenever used to obtain output at 14 Mc. and above. We desired to avoid this wherever possible to take advantage of the additional output obtainable when they are operated straight through. With the revised oscillator circuit, this is possible except when output at 28 Mc. or higher is required. Tuning Unit TU-52 (original range 6.35 to 8 Mc.) was selected for 7-Mc. output. For 14-Mc. output, TU-54 (12 to 18 Mc.) was selected. Another TU-54 was revamped for 28-Mc. output.

The original circuit diagram is shown in Fig. 11-26, and the revised circuit in Fig. 11-27. The modifications are simple to perform.

After removal of the covers of the tuning units, all of the master-oscillator and crystal-oscillator circuit components were removed except the crystal socket, the d.p.d.t. toggle switch and the 140-$\mu\mu$fd. variable condenser. The units were then rewired as shown in Fig. 11-29, suitable coils, as specified below Fig. 11-27, being used to produce output in the desired range.

The changes required in the exciter-deck wiring are few. Sections 1 and 2 of band-selector switch SW_{11} were rewired as shown in Fig. 11-30. In addition, C_1, the 0.006-μfd. condenser in the original cathode circuit, was removed and the cathode of the 6V6 oscillator was tied directly to the rotor arm of $SW_{11\text{-}2}$. Choke CH_2 was also removed from the cathode circuit, and although this is not essential, its removal results in crisper keying. A 0.001-μfd. mica condenser, C_4 in Fig. 11-27, was connected from the plate of the 6V6 so that it would be in series with C_{13}. The junction of these condensers serves as the "hot" end of L_2.

In this particular application, as mentioned above, the exciter deck was used to drive a separate final amplifier, instead of being capacity-coupled to the single-tube amplifier built into complete 610 units. To accomplish this, it was necessary to wind output links on the 807 plate coils, and then to switch the links through an added double-pole three-position ceramic switch, as shown in the diagram. In cases where the original capacitive coupling is to be retained, this switch will not be needed, and the link windings on the plate coils may be omitted.

Millen 1½-inch diameter coil forms were used for the 6V6 cathode coils, although they might well be wound on the ceramic form that was removed from the tuning units during modification. Plate coils for the 6V6 stage were wound on the ceramic forms that were originally used as the master-oscillator coils. These are about 1 inch in diameter, and are identified as L_{13} in TU-52, and as L_{35} in TU-54. Winding details are listed below Fig. 11-27. The original "MO" tuning condenser is used in the 6V6 plate circuit, the rotor being grounded to the metal shield can. One section of the d.p.d.t. switch SW_{15} is used to short the cathode coil when operation at the crystal fundamental is desired. C_X is required with 3.5-Mc. crystals.

To modify TU-54 for 28-Mc. output, it is necessary, in addition to the changes described above, to rewind the 807 plate coil so that the desired range may be tuned with the existing tuning condenser. Half the number of turns, wound in exactly the same space occupied by the original coil, does the trick nicely.

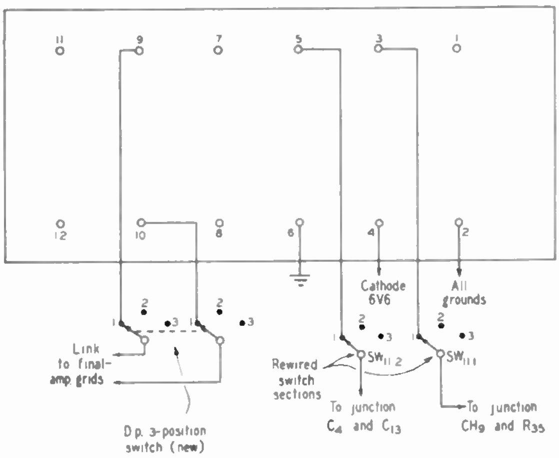


Fig. 11-30 — **Revisions required in the wiring at the sockets for the tuning units. Only those connections which are changed from the original circuit are shown.**

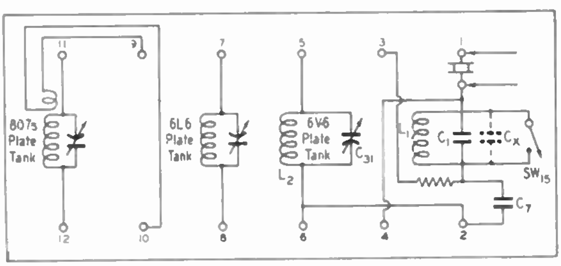


Fig. 11-29 — **Connections to the terminals within the revised tuning units. All grounds are consolidated at Terminal 2.**

Results with these changes have been very satisfactory. TU-52 is used for 7-Mc. output with either 3.5- or 7-Mc. crystals, or with a 3.5-Mc. VFO. TU-54 is used for 14-Mc. output with either 7- or 14-Mc. crystals, or a 7-Mc. VFO. The 6L6 stage and the 807s are operated straight through in some conditions, yet no self-oscillation has occurred, even though neither stage is neutralized. For 28-Mc. operation, the revamped TU-54 is used with 7- or 14-Mc. crystals, or a 7-Mc. VFO. In this unit, it was found better to operate the 6L6 straight through, doubling in the 807 stage.

If desired, the 3.2- to 4-Mc. tuning unit (TU-49) may be modified along similar lines to obtain 3.5-Mc. output from 1.75- or 3.5-Mc. crystals, or a 1.75-Mc. VFO, although this was not attempted.

Adequate drive for either c.w. or a.m. 'phone operation of a pair of 100THs running at 900 watts input is obtained on all bands with the modified exciter. Keying, when using crystal control, is perfect, and equally satisfactory results have been obtained using a Millen VFO, connected to the 6V6 grid by means of an old crystal holder plugged into the crystal socket.

Owners of complete BC-610 units can benefit from these modifications, and the result will be a rig with considerably greater flexibility than the original. Any of the other tuning units may be modified along the same lines.

— *Lt. Col. C. R. Offringer, USAF, W4CT*

CURE FOR "TALK-BACK" IN THE BC-610

In most instances where serious "chatter" or "talk-back" is experienced when the BC-610 is used on 'phone, the trouble is caused by the overload relay, *RY-5*, and not by the modulation transformer, as is commonly supposed. The cure is effected by connecting a large capacity, 30 to 50 µfd., across the relay. This may be done simply by connecting the condenser, which should be rated at 150 volts or more, from the center tap of *T-6* to ground.

J. K. Hall, jr., W4KCT

A "BANTAM ONE-WATTER" FROM THE BCR-746-A TUNING UNIT

A bantamweight "peanut-whistle" rig can be built for a few dollars by using a surplus BCR-746-A tuning unit as a foundation kit. Fig. 11-31 is the wiring schematic of such a transmitter; most of the components shown will be found in the unit. A 1S4 is used as the crystal oscillator, being powered by a 1½-volt "A" cell and 30 to 90 volts of "B" batteries. Connections to the antenna, key and batteries are brought out to the pin jacks in the fiber bottom plate of the unit. The schematic diagram shows link coupling to the antenna but a single-wire antenna could be tapped in at point *X* and worked against ground.

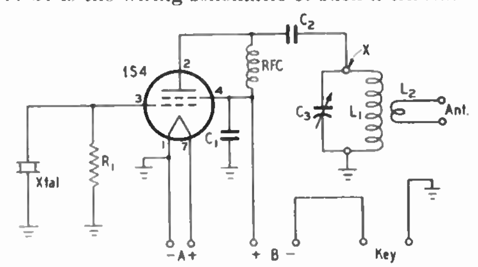


Fig. 11-31 — C_1, C_2 — 0.0047-µfd. mica; C_3 — 140-µµfd. midget trimmer; R_1 — 47,000 ohms; L_1, L_2 — depend on band and XTAL used (3.5 Mc.: L_1 43 t., L_2 4 t., No. 30 d.s.c. on ¾-inch diam. plug-in form); *RFC* — 2.5 mh.

In on-the-air tests, distances up to 400 miles have been covered with this rig. An 80-meter crystal was used, and the input was 0.8 watt!

— *Ernest B. Lindsey, W4BIW*

BETTER RESULTS ON 144 MC. WITH THE SCR-522

Here is a complete conversion process which should help 522 owners to get more out of their equipment, both transmitting and receiving.

Stepping Up the Receiver Sensitivity

A considerable improvement in receiver sensitivity can be achieved by substituting 6AK5s for the 9003s used in the r.f. and mixer stages. Stepping up the r.f. gain introduces complications, however. The 6AK5s show marked tendencies toward self-oscillation, correction of which required extensive experimentation with grounds and by-passes. It is often not appreciated that high S-meter readings and lots of receiver noise do not necessarily mean high sensitivity. In the case of the much-converted 522s worked on here, we found that each of the steps enumerated below tended to "cool down" the receiver, reducing the noise, but improving the signal-to-noise ratio. The improvement was such that signals which are completely inaudible on a 522 in its original form are copied solidly with the converted jobs.

Insofar as possible, the part numbers used in the service manual are used in the conversion process detailed herewith, and the parts to be changed are also described in sufficient detail to permit following the process even if no schematic diagram is available. First, remove the r.f. and harmonic-generator sections. Change the r.f. amplifier grid and plate coils and the mixer grid coil from two to three turns, copying the general size and shape of the original coils otherwise. These coils are numbered on the schematic diagram as *222*, *223* and *224* respectively. Remove the r.f. amplifier grid coupling condenser, *201*, and the grid resistor, *251*. Replace *201* with a 30-µµfd. ceramic condenser, and connect the 0.47-megohm resistor, formerly *251*, across it. Connect this combination from the hot coil support to the 6AK5 grid terminal as directly as possible. This cuts down the capacitance to ground considerably in comparison to the original arrangement. Be sure to include the resistor, however; otherwise the r.f. tube may be destroyed when the transmitter is operated. Replace the r.f. amplifier screen resistor, *267-8*, originally 0.1 megohm, with a 15,000-ohm ½-watt resistor. Add a by-pass (680-µµfd.) at the un-by-passed cathode terminal, Pin 2, and a 500-μμfd. silver-mica button-type by-pass at the cold end of the r.f. plate coil to ground. Add a ground lead at the left side of the r.f.-grid stator terminal and at the left side of the mixer-grid stator terminal, as viewed from the bottom of the condenser assembly with the front end at the left. The purpose of these ground connections and by-passes may not be clear to one who has not had extensive v.h.f. receiver experience, but rest assured, they *are* necessary. Though the points in question are already "grounded" in the conventional sense, it is only through leads or framework of appreciable length. These relatively long paths to ground provide common coupling for the input and output circuits of the r.f. stage, with a resulting tendency toward self-oscillation. Their positions are shown in Fig. 11-32.

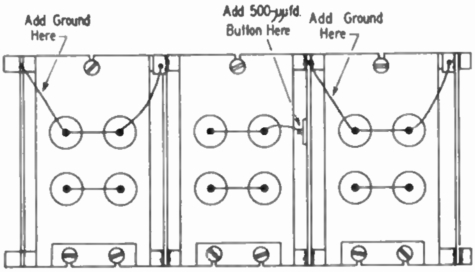


Fig. 11-32 — **Sketch of the bottom of the tuning condenser for the r.f. section of the 522 receiver, showing placement of grounds and by-passes needed when 6AK5s are substituted for 9003s. The front end of the tuning-condenser assembly is at the left.**

The antenna coupling coil should be increased to 2 turns, or possibly 3, if 300-ohm transmission line is to be used. The tendency to regeneration, which develops when the 6AK5s are used, is reduced by tighter antenna coupling than the original arrangement provides. This is shown by the reduction in noise level which takes place when the antenna coupling is increased. The correct spacing for the 2-turn coil is approximately 3/16 inch from the r.f. coil, when 52-ohm coaxial line is used, though this should be adjusted for optimum results with the particular antenna system used with the receiver.

Moving to the mixer stage, ground both cathode leads. Replace the mixer grid condenser, *203-1*, with a 30-μμfd. ceramic. Remove the 1.8-megohm grid resistor, *255-1*, and connect it across this condenser. Remove the 60-μμfd. mica condenser from the mixer plate coil in the i.f. transformer and connect it right at the mixer plate terminal to ground. The plate potential on the 6AK5s must be dropped to 150 volts, approximately. This is done by changing the resistor *263-1*, in the mixer plate lead, from 4700 to 20,000 ohms, 2 watts. The lead from this resistor to the r.f. section should be removed from the top of the resistor and reconnected on the bottom. This allows it to serve as a dropping resistor for the mixer stage and r.f. plates and screens.

Next the bandspread is increased by removing plates from the variable condensers. The rotor plates should all be removed except the center one in each section, being careful not to break the ceramic shaft. From our own sad experience, we know that these shafts break *very* easily! In modifying the stators, remove three plates from each side. Unsolder the tie strap at the top of each section, remove the two middle plates, and resolder the tie strap. This results in a triple-spaced condenser of three plates, which provides a tuning range of approximately 143.5 to 148.5 Mc.

Now we turn to the oscillator harmonic-amplifier section, from which we remove the crystal sockets, crystal switch, slug-tuned plate coils *227-1* through *227-4*, and the condensers and resistors in the harmonic-generator grid and plate circuits, numbers *204*, *205*, *262-1*, *202-15*, *261*, *203-2* and *255-2*. Make a four-turn coil and install it in place of *226* in the 9002 plate circuit. Ground the cathode terminal. Shift the plate lead to the opposite condenser terminal. Insert a 50-μμfd. ceramic condenser between the 9002 grid terminal and the condenser terminal where the plate was formerly connected. Remove the two by-passes, *202-13* and *202-14*, from the point where the B-plus is fed into the coil through the 27,000-ohm resistor, *260*. Connect a 22,000-ohm resistor from the 9002 grid to ground. This converts the 9002 into an oscillator stage. The following stage operates as an amplifier, as previously.

Remove resistor *255-2* and condenser *203-2* from the isolating-amplifier grid lead and put in a one-turn coil to ground from the 9003 grid, for coupling output from the oscillator to the amplifier grid. The isolating-amplifier plate coil should be two turns, 1/2-inch diameter, positioned as the original was, to couple the injection voltage into the mixer grid coil. This coil should be loaded with a low-value carbon resistor, the actual value of which may have to be determined by experiment. We have found various values from 270 to 500 ohms to be optimum in different receivers. The spacing will be about 1/4 inch between the two. Isolation is very good with this arrangement

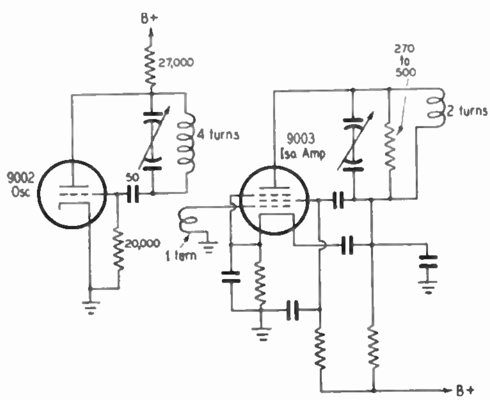


Fig. 11-33 — **Schematic diagram of the oscillator and isolating-amplifier circuits which replace the harmonic-amplifier stages in the 522 receiver.**

and there is no oscillator pulling. Injection voltage, measured across the mixer grid resistor with a vacuum-tube voltmeter, should be about 1.2 volts.

The plates in the tuning condensers in this section should be cut down in the same manner as for the r.f. section. The process will be similar, except in the case of the oscillator condenser which has one more rotor and one more stator plate than the other condensers. The end result should be the same, however: a triple-spaced condenser with two stator plates and one rotor plate in each section. The oscillator tuning range will be approximately 131.5 to 136.5 Mc. This circuit is shown in Fig. 11-33.

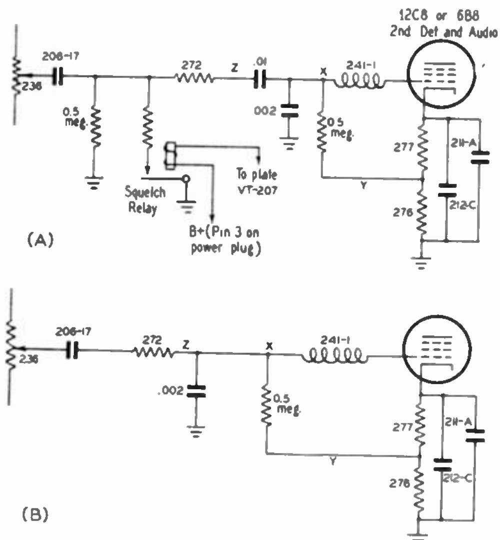


Fig. 11-34 — **Suggested circuit for first audio stage in the 522 receiver, replacing the transformer coupling. Circuit A should be used if the squelch circuit is retained.**

In the audio system the transformer (*295*) between the diode and the first audio should be removed and replaced with the coupling circuit shown in Fig. 11-34. Tie a 680-μμfd. mica condenser between the plate side of the first-audio load resistor, *266-3*, and ground. This reduces receiver noise which was apparently the result of r.f. from the front end of the receiver getting into the audio system. This is further reduced by inserting a shield plate between the r.f. section and the audio portion of the receiver. This shield, an aluminum plate about 1¾ by 4 inches in size, is mounted between the r.f. section and the terminal strip at its right, when the receiver is viewed from the bottom with the r.f. section at the left. Prior to the installation of these by-passes and the shield, the set noise increased more rapidly than the signal as the audio gain was turned up.

An increase in i.f. gain can be effected by decreasing the value of the third i.f. cathode resistor, *270*, to 200 ohms. The receiver is now ready for tuning up, unless it is to be converted to 6-volt operation, in which case the miniature tube sockets should be rewired for parallel connection. The tube line-up, for 6-volt service, is as follows: r.f. and mixer, 6AK5s; oscillator, 9002; isolating amplifier, 9003; 1st, 2nd and 3rd i.f., 6SG7s; 2nd detector, a.v.c. and 1st audio, 6B8; 2nd audio, 6J5.

Converting the Transmitter

Working over the transmitter is a much simpler process. Many are used in exactly the original form, but improvements in both the quality and quantity of the signal may be made by the following simple changes:

Remove all relays. Tie the grid leads which come down through the shield together. Ground the loose volume-control lead (bare) wire. Remove the feed-back circuit on the terminal strip at the audio end of the chassis, unless use of the tone modulator is desired. This consists of three 0.5-megohm resistors, *140-2*, *140-3* and *140-4*, two 0.001-μfd. mica condensers, *105-3* and *105-2*, and one 5000-ohm resistor, *142*. Cut down the oscillator plate condenser by two plates on each side, and the first multiplier by four plates on each side. The second-multiplier and amplifier condensers should have only one stator plate on each side left. These reductions in tuning range are merely for greater ease of adjustment. Remove the flexible plate leads from the 832s and substitute strips of silver or copper ribbon. This makes a considerable improvement in the efficiency of the two 832 stages.

In its original form the 522 transmitter has modulation applied to the screens of the 832 tripler, along with the plates and screens of the final. The quality can be improved considerably by removing the modulation from the tripler screens, which can be done by lifting the yellow shielded lead from the junction of the two 40,000-ohm resistors, *133-1* and *133-2*, and reconnecting it on Terminal 2 on the modulation transformer, *160*. The blue wire on the resistors should be left

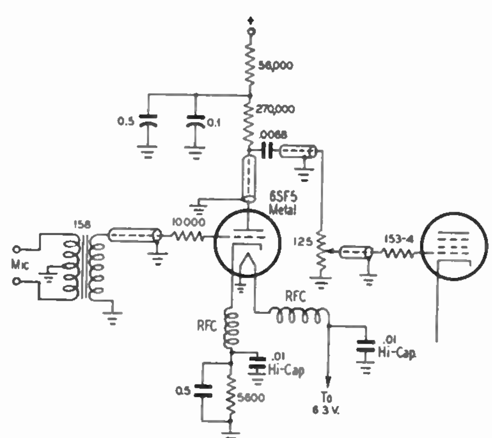


Fig. 11-35 — **Schematic of the additional speech stage for use with dynamic microphones. The r.f. chokes in the heater and cathode leads are approximately 20 turns of No. 28 wire on a 1-watt resistor.**

in place, as it supplies modulation to the power-amplifier screens. An additional audio stage can be added if more gain is needed, for use with crystal or dynamic microphones. The circuit used here with a Turner 101B microphone is shown in Fig. 11-35. Considerable care is required to prevent r.f. feed-back troubles, when this amount of gain is used. The r.f. chokes and the 10,000-ohm resistor should be placed right at the tube socket. Other compounds may be mounted on the terminal board formerly used for the tone-modulator components, making a neat and professional-appearing job. The tube should be the metal type, only, and the by-passes should be of good quality. Shielded leads should be installed as shown. The by-passes below the chokes in the cathode and heater leads may not always be necessary. Some units have worked OK without them.

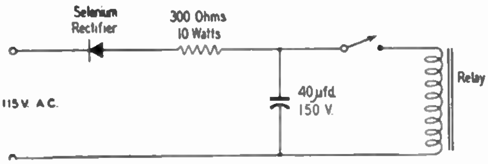


Fig. 11-36 — **Rectifier circuit for operating the 522 send-receive relay on 115 v. a.c.**

Miscellaneous Tips

There is a world of difference in tubes at 144 Mc. Don't rely on a tube tester — try out individual tubes, one at a time, while listening to a weak signal. Tubes that are OK on a tube tester may be completely useless on 2 meters.

The racks which hold the two units may be connected together in any way one chooses, but leave the antenna and B-plus switching arrangement as is; otherwise the receiver will come to life slowly when going from transmit to receive. Separate power supplies are the answer.

The transmit-receive relay can be operated from the 115-volt line by using the simple arrangement shown in Fig. 11-36. The 40-µfd. electrolytic charges up when the circuit is open and really snaps the relay shut when the switch is closed.

The stability of the receiver oscillator is quite good after about a 10-minute warm-up. If there is trouble with drift or frequency shift after this time, try another 9002. In one location here where the line voltage is very erratic it was necessary to use voltage regulation on the oscillator, but it is not ordinarily required.

On later units having the noise silencer it is necessary to remove resistor *254-3* from the hot filament lead of the 12H6 diode to the cathode of the a.v.c. clamper diode, or the a.c. will get into the a.v.c. line.

When removing the diode coupling transformer, *295*, also remove the two short shielded leads going to the plug on the front of the receiver, the two 0.47-megohm resistors on the power plug, *275-2* and *275-3*, mica condenser *214* on the transformer, the 0.56-megohm resistor *262-2*. The black wire with the green tracer at the junction of *275-2* and *275-3*, the yellow wire from *295*, and the green wire from *295* in the shield should be traced and pulled clear. The green wire is the grid lead, point *X* in Fig. 11-34. The black wire with green tracer is point *Y*, and the yellow wire is point *Z*.

The a.v.c. line should be disconnected from the r.f. stage when a 6AK5 is used. This is done by removing the glass-insulated lead from decoupling resistor *267-1*, in the first i.f. grid lead, and resistor *252* in the r.f. section.

The writer wishes to thank Clayton Paulette, W1IT, for the many hours of effort he has contributed to this conversion project.

— *Robert E. Fairbrother, W1PYO*

A B.F.O. FOR THE SCR-522 RECEIVER

With the increased use of c.w. on 144 Mc., the users of 522 receivers are at some disadvantage in having no beat oscillators. And even if the operator is one of those who is allergic to c.w. as a mode of communication, the b.f.o. is still a mighty handy article in combing the band for the weaker sigs. W0CCY, Council Bluffs, Iowa, uses the crystal-controlled b.f.o. shown in

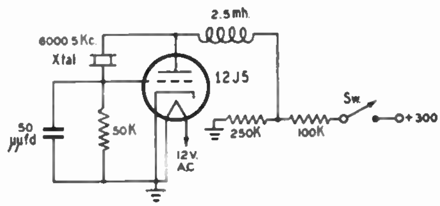


Fig. 11-37 — **Schematic diagram of the Pierce oscillator used as a b.f.o. in a 522 receiver by W0CCY. Values are not critical, and no injection coupling is required.**

Fig. 11-37. The complete story is on the diagram, and values are not critical. No injection coupling was needed in his case, the second harmonic being strong enough for b.f.o. purposes with no more coupling than that afforded by the receiver wiring.

GETTING ON 28 AND 50 MC. WITH THE SCR-522 TRANSMITTER

The SCR-522 is known to all v.h.f. enthusiasts as the unit that transformed the 2-meter band almost overnight, but most hams have not realized that the transmitter portion (BC-625) can be made to work on other frequencies. Two different methods of conversion for 10-meter operation are given below, and either process might be followed for use of the unit on 50 Mc. as well. — *Ed.*

—•••—

In getting the 522 to work on 10 meters it was first decided to check its operation on the frequency range for which it was intended; namely, 100–156 Mc. The conversion process outlined in *CQ* for July, 1947, was followed to attain this end. The following changes were then made to obtain 10-meter output:

1) Add a 3–13 μμfd. trimmer condenser across the 12A6 tank coil (*119*). This trimmer will be set at approximately 8 to 10 μμfd. to tune this tank to 10 or 11 meters.

2) Replace the v.h.f. r.f. chokes (*127-1, 127-2, 127-3, 127-4*) with 2.5-mh. chokes. These are the r.f. chokes in the grid circuits of both 832 stages.

3) Replace the 2-meter hairpin loop (*120*) in the first 832 plate circuit with a 10-meter coil consisting of 12 turns of No. 14 wire, ¾-inch diameter, 1¼ inches long. Connect the coupling condensers (*109-1* and *109-2*) four turns in from each end of the tank coil. If these condensers were connected at the ends of the coil it would result in excessive grid current in the final 832 stage.

4) Replace the final grid coil with another consisting of 14 turns of No. 14 wire, ¾-inch diameter and 2¼ inches long, with a ⅜-inch space at the center for the link, which consists of 5 turns of No. 14 wire of the same diameter as the tank. If it is desired to tune both 10 and 11 meters it will be necessary to add a 15-μμfd. air padder in parallel with the final tank condenser.

Crystals in the 7-Mc. range are used in the oscillator, doubling to 14 Mc. The second stage doubles to 28 Mc. Both 832s operate as straight amplifiers on 28 Mc. Substituting 50-Mc. coils in the 832 plate circuits, and operating the second stage as a tripler, should make it possible to obtain 50-Mc. output as well. In this case, crystals between 8334 and 9000 kc. would be employed.

— *Leonard H. Smeltzer, W4KZF*

In coverting the BC-625-AM to 28 Mc. it was thought that operation of the relays was a desirable feature, and since the d.c. supply presents no very great problem, changes were made only in the r.f. circuits, leaving the control circuits intact. This conversion process utilizes the first 832, eliminating the second, which may then be used for other purposes.

The final 832, its socket, the final coil and antenna coupling, and the tripler hairpin and its associated components are first removed. In taking out the final 832 socket remove the condenser between Pins 1 and 7 carefully, reconnecting this condenser between the now-free heater wires and ground.

Remove the 832 tripler tube from its socket, and wire a 100-μμfd. variable condenser in parallel with the butterfly condenser in the plate circuit of the first-harmonic-amplifier stage. The purpose of the additional capacitance is to change the stage from a tripler to a doubler. Running this extra condenser all out will permit the stage to operate on 50 Mc., when suitable crystals are used, the stage then operating as a tripler, in the original fashion.

Next a 75-μμfd. air padder is wired across the plate butterfly of the first 832 stage. The plate coil for this stage should have seven turns of No. 12 wire, each side of center, ⅝-inch diameter, with a ⅝-inch space at the center. The over-all length of this coil will be about 2½ inches. It should be soldered in place on the 832 butterfly condenser so that it projects over the hole which formerly housed the final 832 socket. Loop the lead that formerly carried the modulated B-plus to the final back under the chassis and connect it through the r.f. choke (previously removed from the final) to the center tap of the new plate coil. The first 832 now serves as the final stage for 10-meter work.

A three-turn loop of No. 14 wire, for antenna coupling, is connected by a short length of 300-ohm line to the two antenna terminals at the top of the transmitter. After removing the original link, a lucite rod was used as a support by inserting it through the two lower ventilating holes, and a piece of 300-ohm line was used to connect it to the antenna terminals.

Normally this completes the conversion process. Care must be exercised in tuning up the rig, and the harmonic amplifier, particularly, should be checked to see that it is operating on the correct frequency. The oscillator uses 7-Mc. crystals, doubling to 14 Mc. The two parallel capacitors added in the conversion process may be set at a point where tuning from one frequency to another may be accomplished with the regular butterfly tuning condensers.

— *Bertram D. Aaron, W4JXH; Clyde E. Clark*

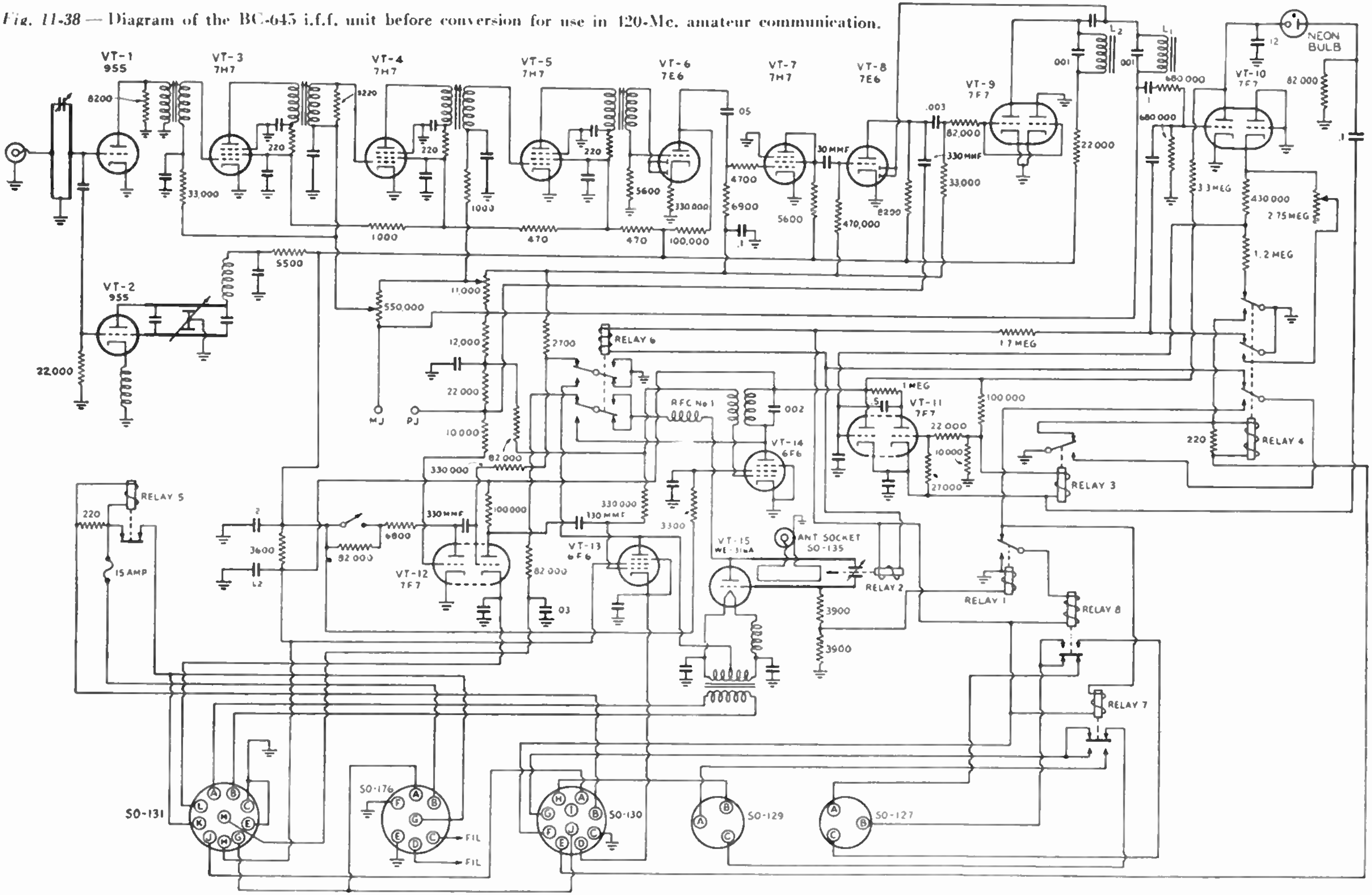
OPERATING THE BC-645 ON 420 MC.

In modifying the BC-645 for operation on 420 Mc., the basic thought in mind was to make the conversion with a minimum of changes in components and wiring from the original set. Improvements and refinements can be made in layout and circuit components for maximum performance in this new application at the expense of complicating the conversion.

Before proceeding with circuit rewiring, particularly in the receiver audio section and the transmitter modulator section, it was felt advisable to remove excess components and relays. All relays except Relay 3, all potentiometers, the small two-position switch accessible from the front of the case and shown just to the left of *VT-12* in the schematic, the 30-kc. oscillator coil and the fuse strip in front of the frequency-change relay were removed. This provided less congestion in which to work and left a neater chassis when the job was completed.

Conversion of the receiver required that the gain-control system be revamped and an audio system added which would be suitable for operation of a 'speaker or headset. In addition, it was necessary to make changes to enable one to tune to the 420–450 Mc. amateur band. The diode-detector circuit was altered to provide a source of a.v.c. voltage and to decrease loading on the last i.f. transformer. Grid-return leads of the i.f. amplifiers were lifted from ground and returned to the a.v.c. line. Since it appeared that this

Fig. 11-38 — Diagram of the BC-645 i.f.f. unit before conversion for use in 420-Mc. amateur communication.



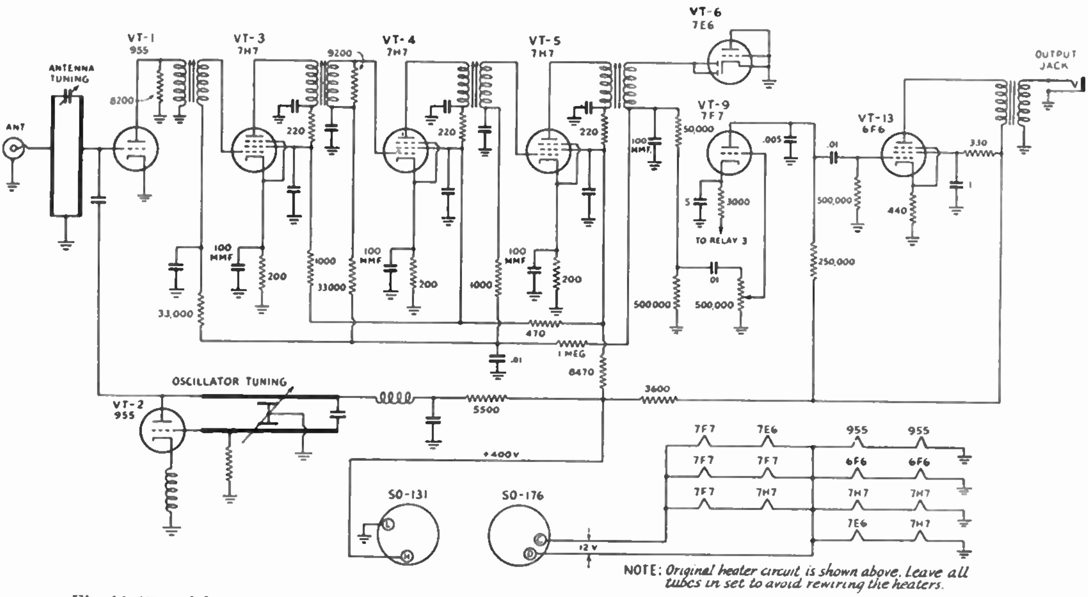


Fig. 11-39 — Schematic of the receiver as converted for 420 Mc. Two stages of audio, employing tubes already in the unit, have been added. The oscillator lines are lengthened and a.v.c. is incorporated.

equipment would find its greatest usefulness in 'phone work, no provision was made for an r.f. gain control or operation without a.v.c. The schematic diagram of the converted receiver, Fig. 11-39, shows the addition of cathode biasing resistors to provide initial bias for the i.f. amplifier tubes; however, operation was satisfactory without this initial bias. Although some improvement in residual noise is gained by biasing these tubes, the omission simplifies the conversion.

The range of the tuning condenser across the end of the antenna tuning stub was sufficient to cover the lower range to 420 Mc. and no changes were necessary here, but an increase in the length of the local oscillator lines was required. The 955 oscillator socket and tuning assembly were removed as a unit by taking out the four screws holding the assembly to the chassis and unsoldering the six leads going into the set proper. The line-shorting condenser, grid leak and plate choke were removed from the end of the line, the ends of the rods were drilled and ½-inch extensions were soldered in place, after which the components were replaced in the same relative position as in the original set.

The audio section following the detector may be as extensive as desired, with a selection of tubes for the purpose from which to choose (*VT-7, VT-8, VT-9, VT-10, VT-12* and *VT-13*). In the sets converted by the authors, one-half of *VT-9* and *VT-13* were used and gave ample gain and power output. An output transformer was added for 'speaker operation, and is recommended for headset operation although satisfactory headset volume may be obtained by resistance-capacity coupling to the first a.f. or output plate circuits.

Shifting the transmitter frequency down to the 420–450 Mc. amateur band involved removing frequency-shifting Relay 2 and adding a capacitor of the circular neutralizing type across the ends of the oscillator line. The condenser was made by soldering No. 8 flat-head screws to two ⅞-inch diameter copper disks. The extensions of the oscillator line consist of two metal strips approximately one inch long and ⅜ inch wide soldered to the capacitor ends of the original line so that the strips extend ⅝ inch

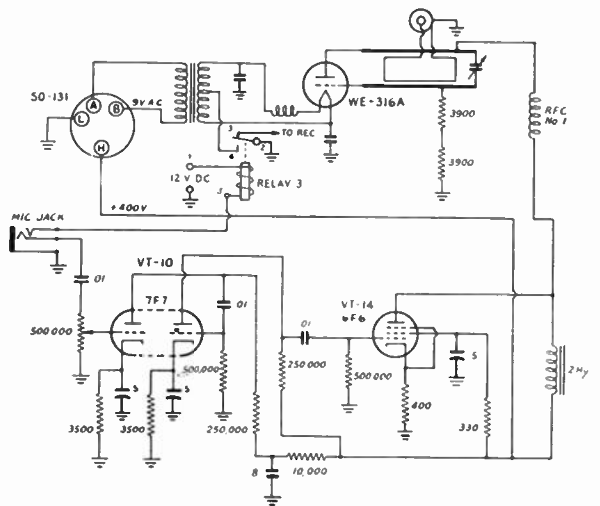


Fig. 11-40 — Wiring diagram of the oscillator, modulator and speech amplifier used in the converted BC-645. Like other portions of the conversion job, these changes involve the use of tubes already in the unit.

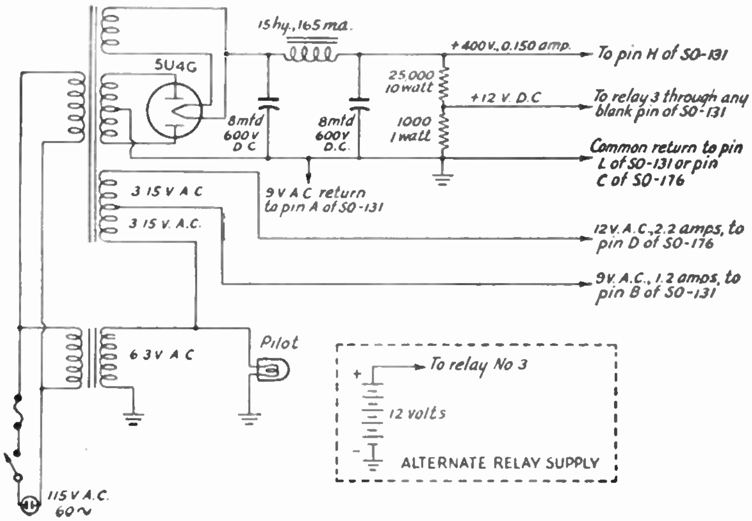


Fig. 11-41 — Diagram of the power supply used for a.c. operation of the BC-645. Two 6.3-volt windings are used in series to obtain the 12 volts required for the filament circuits. The transmitter oscillator filament transformer is supplied from one 6.3-volt winding and half of another, connected in series. Voltage for operation of Relay 3 is taken from a bleeder tap.

beyond the ends of the line rods. At 3/16 inch from the end of these strips a tapped hole was provided for the screws of the capacitor plates. The ends of the screws were slotted and screwdriver clearance holes drilled in the side of the case for access to the slotted ends of the screws. Circuit details of the transmitter section are shown in Fig. 11-40.

The modulator system is of the Heising constant-current type, using a single 6F6 as the modulator tube. Since power obtained from the 6F6 is not sufficient to modulate the carrier oscillator completely, this is one of the most inviting sections for the aforementioned improvements and refinements. However, results obtained in tests were quite satisfactory using this set-up. The speech amplifier ahead of the modulator was arranged to handle a crystal or dynamic microphone, but a carbon microphone may be used by adding a microphone transformer and a source of d.c. for microphone current. The Army T-17 microphone has been used by the authors and proved entirely satisfactory. A push-to-talk switch on the microphone is used to place the

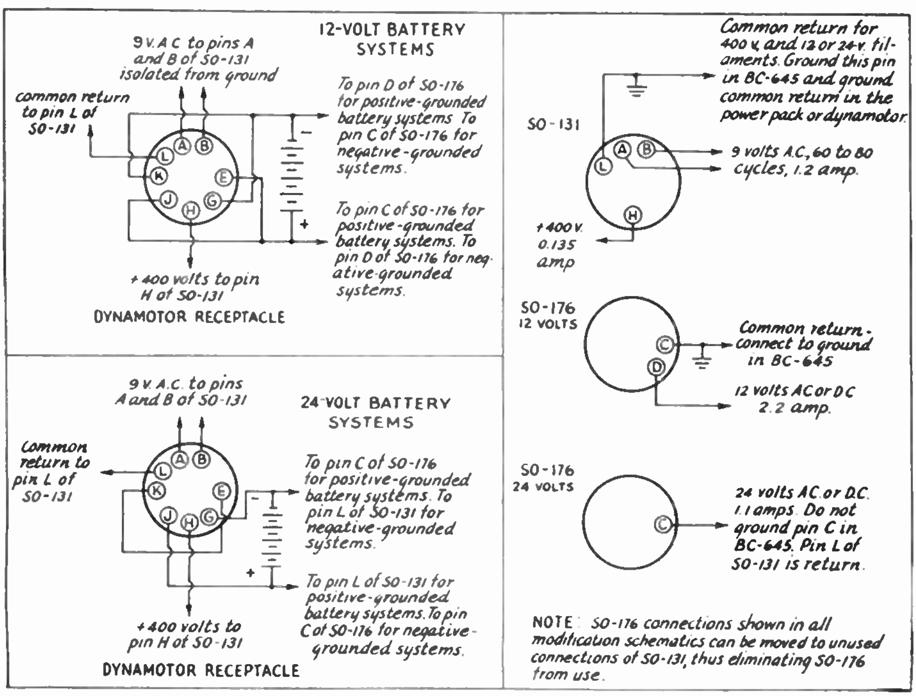


Fig. 11-42 — Power connections for the converted BC-645. At the left are the connections used for 12- and 24-volt battery operation. At the right are the connections used in a.c. operation.

transmitter in operation and render the receiver inoperative when transmitting by opening the cathode circuit of the first a.f. stage.

For mobile operation, a dynamotor supply capable of delivering 400 volts d.c. at 150 ma. and 9 volts a.c. at 1.2 amp. is required. In the conversion made and tested by the authors the dynamotor used with the original equipment was employed. Since this dynamotor required 12 volts d.c. input, no changes were made in the filament wiring, and in the design of an a.c. power supply 12 volts a.c. was provided for the filament string in the set. The schematic of the a.c. power supply is shown in Fig. 11-41. Rearrangement of the filament wiring for 6-volt operation will present no problem.

The aircraft antennas intended for use with the BC-645 consisted of vertical quarter-wave faired rods working against the frame of the aircraft; however, any antenna which can be matched to the set at or near 50 ohms should prove satisfactory.

— *John T. Ralph and H. M. Wood*

THE process outlined above is the minimum that can be done and still make the BC-645 work on 420 Mc. If long distances or nonvisual paths are to be worked the following suggestions, contributed by W1HDF, Elmwood, Conn., will make a considerable improvement in the operating range.

In its original form the mixer is operated without plate voltage. Improved performance can be obtained by running the low side of the first i.f. transformer primary to B-plus, through a decoupling network similar to that used on the following stages. A 9002 may be substituted for the 955 mixer if desired, though this requires a socket change. Regeneration may be added to the mixer stage by connecting a 15-$\mu\mu$fd. miniature variable condenser across the 10,000-ohm cathode resistor, which must be added when the B-plus connection is made. Adding regeneration makes tuning more critical, so some convenient method of tuning the mixer line must be added, to maintain sensitivity across the entire band.

Smooth tuning of the oscillator may be accomplished by adding a good-quality split-stator variable across the oscillator line. The National VHF-1D and Hammarlund VU-20 are suitable types. This control should be provided with an extension shaft and a good vernier dial. The added sensitivity resulting from the mixer changes makes some form of i.f. gain control desirable. A 200,000-ohm potentiometer may be used to control the voltage on the i.f. amplifier screens.

If 300-ohm or other balanced line is used in place of coax, hairpin loops should be installed on the transmitter and receiver in place of the unbalanced coupling loops provided.

OPERATING THE APS-13 ON 420 MC.

THE APS-13 is a low-powered transmitter-receiver designed for airborne radar service. Its frequency range covers the 420-Mc. band without alteration of the tuned circuits but, like other units built for radar and allied purposes, it contains many parts which are of no use to the amateur, and its circuits require considerable revision to make the rig useful for communication service.

The APS-13 transmitter section uses a pair of 6J6s in push-pull-parallel. Bias values are set up for pulse operation, and must be altered for continuous service. Frequency control is by means of a shorting bar which is adjusted through the front panel with a screwdriver. The receiver section has a 6J6 oscillator and a 6J6 mixer, the oscillator being tunable in the same manner as the transmitter. The mixer lines are tuned by means of screwdriver adjustment which varies the capacitance across the line. The i.f. system has five stages using 6AG5s followed by a 6AG5 detector and two video-amplifier stages using 6AG5s. Four additional tubes, two 2D21 thyratrons, one 6J6, and one 6AG5 also are in the unit, but these do not enter into use of the outfit for communication purposes, and may be removed. Other surplus components include the 28-volt dynamotor, numerous pulse transformers, a gate-forming line, and a delay line.

If a schematic diagram can be obtained it will be helpful during the conversion process, but it is not absolutely necessary, as each component is plainly marked with its part number and the instructions given below can be followed readily. So, with the screwdriver and cutting pliers handy, let's get to work.

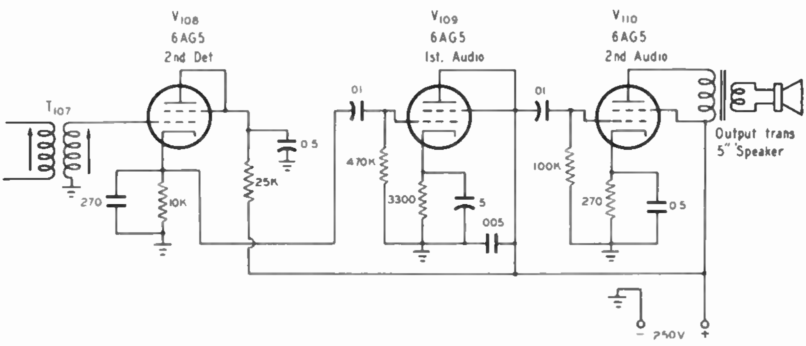


Fig. 11-43 — Revised audio amplifier for the APS-13, using the two video stages. The 0.01-μfd. coupling condensers are those removed from the unit at C_{162} and C_{208}. The 0.5-μfd. by-passes are sections of C_{157} and C_{158}.

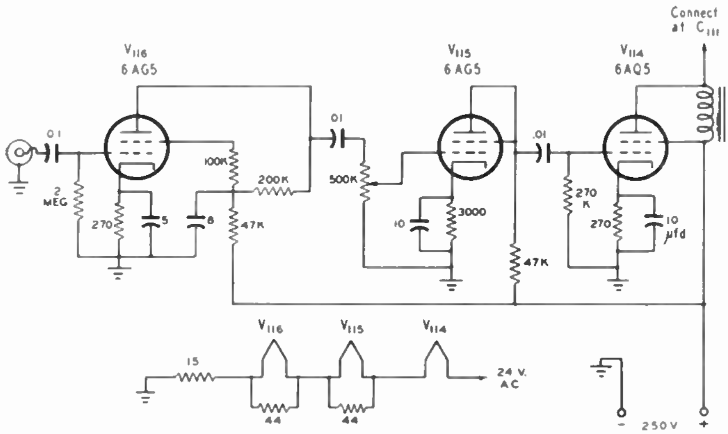


Fig. 11-44 — Speech-amplifier-and-modulator circuit suggested by WØPKD. The three tubes are used in the sockets formerly occupied by V_{114}, V_{115} and V_{116}. The socket for V_{111} is bridged by a 15-ohm resistor. Operation of the heaters is from a 24-volt a.c. source.

Remove the motor generator, D_{101}, and pulse units T_{111}, T_{112}, T_{113}, T_{114} and T_{115}. Remove resistors R_{154}, R_{157}, R_{158}, R_{159}, R_{161}, R_{162} and R_{163}. Replace R_{155} (oscillator grid resistor) with 2700 ohms. Remove R_{165}, R_{171}, C_{207}, C_{160}, and C_{208}, and connect a 47-ohm resistor in place of C_{208}, to provide screen voltage for the first i.f. amplifier, V_{103}. Remove R_{111}, R_{167}, C_{148} and C_{146}. Do not disturb the wiring to T_{116}, but remove the wire from the grid terminal of V_{116}.

Connect the i.f. screens to the output of the regulator tube, V_{117}, and remove resistors R_{142}, R_{143}, R_{144}, R_{147}, R_{148} and R_{173}. Remove J_{101} (power receptacle) and associated wiring. Remove R_{172}. Remove R_{174} from the cathode of V_{103}, the first i.f. amplifier, but leave R_{117} connected as it is.

The second detector and video stages require complete revision, so all wiring except the heater leads should be removed from the circuits between V_{108}, V_{109} and V_{110}, rewiring these stages as shown in Fig. 11-43. This is not an attempt at high-quality audio, but it does have the virtue of using some of the components left over from the removal process outlined above. The 5-inch speaker shown in the schematic diagram of Fig. 11-43 was mounted in the top of the cabinet. If desired, the interstage video transformers T_{108}, T_{109} and T_{110} may be taken apart and the cases used to house the interstage coupling components of the audio stages.

A suggested circuit for use as a speech amplifier and modulator is given in Fig. 11-44. This uses the sockets marked V_{114}, V_{115} and V_{116}, with a resistor substituted for the heater of V_{111}. The space formerly occupied by J_{101} can be used for mounting a gain control, and the adjacent space is sufficient for a microphone jack and a send-receive switch. The gain of the speech amplifier is adequate for a crystal or dynamic microphone.

The receiver gain control is left as it is, except that an extension shaft was added to provide knob control. The same may be done for the receiver and transmitter tuning adjustments. An audio gain control may be installed in place of the regulation potentiometer, if desired.

This conversion was designed to be about the minimum amount of work that can be done on the APS-13 to make it suitable for amateur use. Many refinements are possible, but the procedure outlined will provide satisfactory communication. The large number of these units available, and the low cost at surplus prices, should help to populate the 420-Mc. band in many sections of the country.

— *Joseph W. Addison, WØPKD*

GETTING ON 420 MC. WITH THE BC-788

In modifying the BC-788 for ham use, the following steps are necessary:

A well-filtered power supply capable of 250-300 volts at about 80 ma. must be supplied. Most of the components of the built-in supply will also be used. In the receiver, the high-

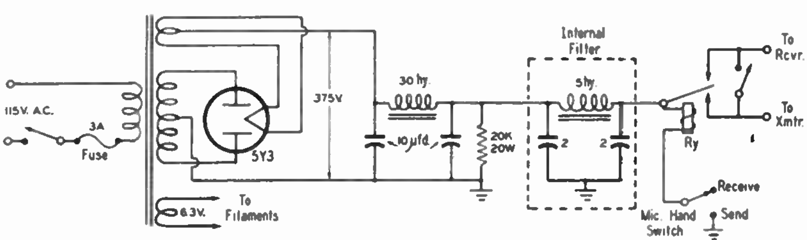


Fig. 11-45 — Power supply and control circuits for use with the converted BC-788.

frequency oscillator must be equipped with a tuning control for convenience of operation. The pulse detector is replaced with an a.m. detector, and an audio stage and loudspeaker are added. A modulator must be built for the transmitter, means provided for switching from send to receive, and (last but not least, as proved by bitter experience) the grid leak of the transmitting tube altered from 500 ohms to something like 10,000 ohms, causing the 6J6 life expectancy to increase from its previous value of about ten minutes!

Most of the conversions have left the original 800-cycle power-supply filter intact for possible use with genemotors in portable applications. An external filter must still be provided, however, as the internal inductance of 5 henrys and the two condensers of 2 μfd. each are inadequate for 60-cycle operation. In some instances improved stability has resulted from the installation of an additional 20-μfd. condenser across the output side of the internal filter.

The center line of equipment on the chassis which contains the pulse modulator, crystal oscillator and power-supply rectifier is all removed except for the rectifier tube socket, power transformer and filter components. Following Fig. 11-45, a change-over relay is provided to switch from send to receive and suitable chassis connectors and a microphone plug are mounted to bring out the external leads. A four-inch p.m. loudspeaker and its matching transformer are mounted on the panel near the left end of the chassis.

Experience has shown that it is not necessary to tune the receiver mixer circuit for ordinary operation over the amateur band. Several ideas have been tried for tuning the oscillator from front-of-panel, ranging from a semicylindrical slug of brass rotated in the field close to the hot end of the tuning line (as used by W6JLE) to the use of a small condenser similar to that on the mixer circuit, and finally to a mechanical extension of the line tuning screw to a knob (as used by W6DSZ, W6QT and others). The latter method gives the full range of tuning of which the unit is capable, but must be applied with care to prevent wearing out the lines. The use of some substance like Lubriplate is essential if noisy operation is to be avoided. A small dial with a geared-down indicator is convenient since about 15 turns of the screw are necessary to tune the receiver over the full range, 8 turns covering the amateur band, although this varies with some receivers. The middle of the band is found with the lines on both receiver and transmitter at about two-thirds of their full length.

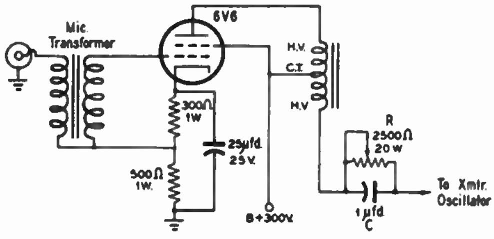


Fig. 11-47 — A suggested modulator for the BC-788.

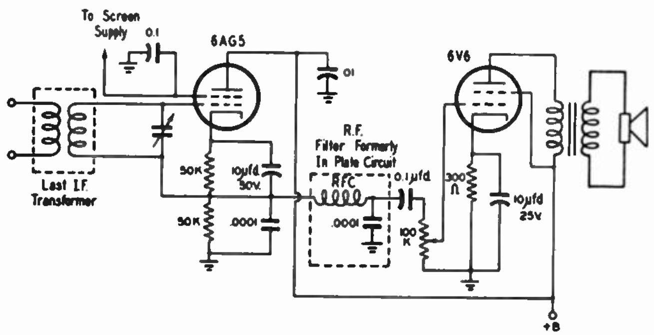


Fig. 11-46 — A simple detector-audio system for use in the receiver section.

Fig. 11-46 shows the detector and audio system used in several of the conversions. The audio output is taken from the cathode of the detector tube to avoid oscillation difficulties encountered when the load was placed in the plate circuit.

The audio output tube is a 6V6. If desired, the modulator tube may be used for receiver audio with suitable switching, but this has been thought inconvenient by most hams, and plenty of room is available for the extra tube. Also, the use of a separate output tube makes it possible to leave transmitter and receiver on simultaneously (by shorting the send-receive relay with the switch in Fig. 11-45).

The old rectifier tube socket is rewired for a 6V6 modulator tube which is driven directly by a single-button microphone as shown in Fig. 11-47. A Heising modulation system is used in which the old power transformer serves admirably as a modulation choke. To reduce core saturation the high voltage is fed in at the center tap and the modulator and transmitter fed from opposite ends of the winding.

The resistor, *R*, and condenser, *C*, are for the purpose of dropping the voltage on the oscillator tube somewhat below that of the modulator, so that the modulator plate voltage does not have to swing to zero for 100% modulation. A drop of 40 or 50 volts in *R* is ample.

The microphone current may be supplied by a small battery, or as shown in Fig. 11-47, by the cathode current of the modulator tube. In spite of the by-passing shown, the latter circuit may oscillate if the transformer is connected in the wrong polarity. In this event, the cure is of course to reverse *one* of the windings.

— *Fred D. Clapp, W6DSZ*

A MODIFICATION OF THE PE-103-A

The PE-103-A dynamotor is designed to provide a 500-volt output with either 6 or 12 volts input. If you are content to operate always from a 6-volt source, the unit can be modified quite simply to deliver 250 volts (for a receiver) and 500 volts (for the transmitter), with change-over controlled by a remote switch. This eliminates the need for a separate power supply for the receiver.

Fig. 11-48 is a simplified schematic of the unit as received, leaving out such items as circuit breakers, field windings, dropping resistors and switch contacts which are not essential to our discussion. The dual-input-voltage requirement is met by using a special three-commutator machine having windings for 6, 12 and 500 volts. Each input commutator is provided with its own starting relay. The change from 6- to 12-volt input is accomplished by a manually-operated switch which applies voltage to the coil of only one starter relay at a time. Other sections on this switch short out filament-dropping resistors, etc. A third relay turns on the heaters and actuates the selected starting relay.

Obviously any scheme which will let us apply 6 volts to the 12-volt commutator will result in an output of about one-half normal, or about 250 volts, and will at the same time reduce the current drain from the car battery tremendously. Before the modifications described here are performed, if we switch the unit to 12 volts and put in only 6, the machine will not run because the relays will not operate.

The first step I took in the modification was to rewind the 12-volt starting relay so it would operate on 6 volts. This is a totally-enclosed relay with the cover spun on like a tin can. The relay can be opened by making hack-saw cuts through the lip of the cover at about ½-inch intervals for about two-thirds of the way around. When the resulting segments are pried up, the cover will come off and the plunger, spring, and contactor disk will fly out. After the terminals and fixed contacts are removed, the coil can be withdrawn. I unwound the coil and folded the same wire double and wound it back on, but it might be easier to wind it with heavier wire. Don't wind the coil too full. It would be satisfactory to replace the 12-volt starting relay with an auto-starter or horn relay.

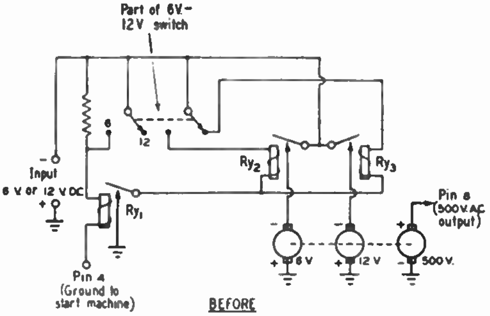


Fig. 11-48 — Simplified schematic diagram of the PE-103-A dynamotor before modification.

In order to obtain remote control of the change-over from 250 to 500 volts, and to provide separate B+ output terminals for the receiver and transmitter, it is necessary to install an additional 6-volt d.p.d.t. relay. I found room for a miniature relay near the old 6-volt/12-volt switch. The original connections to Pins 2, 7 and 8 of the output socket were removed and the new relay wired in as shown, the coil between the common A− (hot) lead and Pin 2, one arm and its associated fixed contacts replacing the section of the 6-volt/12-volt switch which selected the desired starter relay (the normal contact to the rewound 12-volt starter and the off-normal contact to the 6-volt starter relay). The other arm is connected to the +500-volt brush and its normal contact to Pin 7 and off-normal contact to Pin 8. After these changes the terminals on the output socket are as follows:

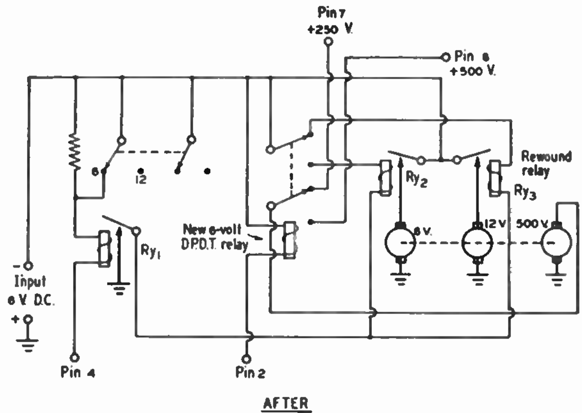


Fig. 11-49 — Rearrangement of the wiring of the PE-103-A dynamotor to permit both 250 and 500 volts d.c. to be obtained from a 6-volt source. Connections to the various terminals shown are explained in the text.

1 — A− (hot), protected by circuit breaker. Turned on all the time.
2 — Ground to transmit.
3 — A− (hot), protected by circuit breaker Controlled by starter relay so it is on only when dynamotor is running.
4 — Ground to start dynamotor.
5 — Ground, A+, B−.
7 — B+ 250 to receiver.
8 — B+ 500 to transmitter.

Thus the transmitter and receiver filaments should be connected to Pin 3, the receiver B+ to Pin 7 and the transmitter B+ to Pin 8, the on-off switch between Pins 4 and 5, and the transmit-receive switch between Pins 2 and 5.

— *William L. Smith, W3GKP*

SUPPRESSION OF ELECTRICAL NOISE FROM PROPELLER PITCH-CHANGING MOTORS

At a Frankford Radio Club meeting, W3GHD demonstrated a means for suppressing propeller pitch-changing motor electrical noise that is so effective, so simple, and so inexpensive

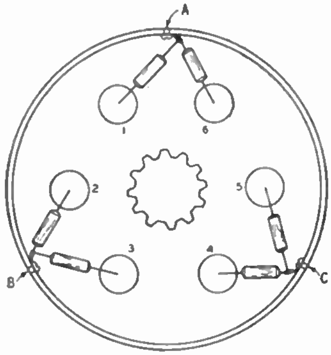


Fig. 11-50 — Noise created by propeller-pitch beam rotators can be eliminated by by-passing the brush holders to the case of the motor as shown. Points *A*, *B* and *C* are grounds made by drilling and tapping the rim of the motor case.

that I wish I had thought of it first. The method is applicable to either the 12- or 24-volt motors, and although it is necessary to remove the motor from the gear box, it is not necessary to remove the entire mechanism from an existing antenna installation.

Materials and tools necessary include six mica capacitors, 0.002 to 0.01 μfd., three 6-32 screws, three shakeproof solder lugs to clear a No. 6 screw, a No. 35 drill, a 6-32 tap, and a husky soldering iron or small torch. The capacitors should be of the smallest possible physical thickness consistent with the requisite capacity. Centralab ceramic "Hy-Kaps" are ideal.

Remove the thin-aluminum motor cover. Most motors are held to the gear box by a threaded ring located at the joint between the motor cover and the gear-box housing, although a few motors are held by cap screws. Loosen the ring or the cap screws, supporting the motor with one hand before disengaging the last few threads. A straight axial pull will disengage the motor from the gears. Looking at the top surface of the motor, you will note six copper-surfaced brush holders symmetrically arranged around the motor shaft and its gear. Clean the top of these brush holders carefully. Midway between brushes *1* and *2*, *3* and *4*, *5* and *6*, counting around the circle from any point, drill three holes through the threaded ring which attaches the motor to the gear box, using the No. 35 drill. Tap these holes for 6-32 screws. Insert the screws with the heads inside, with the shakeproof soldering lugs under the screw heads. Now solder the capacitors between the individual brush holders and the grounds just provided as shown in Fig. 11-50. Thus, each brush holder is by-passed to ground. File the screw points off flush with the threads, taking care not to damage same. Reassemble the motor to the gear box, and go down in the shack prepared for a very pleasant surprise.

— *C. C. Miller, W2RDK*

SPEEDING UP "PROP-PITCH" BEAM ROTATORS

Those who complain that they can grow long white beards while waiting for their beams to turn around toward a choice piece of DX can heave a sigh of relief. No, you don't do it with external step-up gears, "V" belts, or by speeding up the motor until it burns out! Here's how it is done. Remove:

1) the bevel gear;
2) its thrust-bearing plate;
3) the upper case of the speed-reduction unit housing;
4) the large ring gear with the spline on it.

This last item is the first thing you will see upon removing Item 3, and is illustrated in Fig. 11-51, where it is resting to the right of the assembly, in front of the upper gear case.

Grind the teeth off the hardened splined ring gear. (Not off the splined portion, but off the *inside* of the ring!) Next drill and tap four holes in the gear carrier over which the ring gear was placed. Line the holes up with the holes that already exist in the face of the ring gear, and bolt the two together. Reassemble the whole thing and refill it with oil. You can now turn your beam at 4 or 5 r.p.m. if you want to. To reduce this

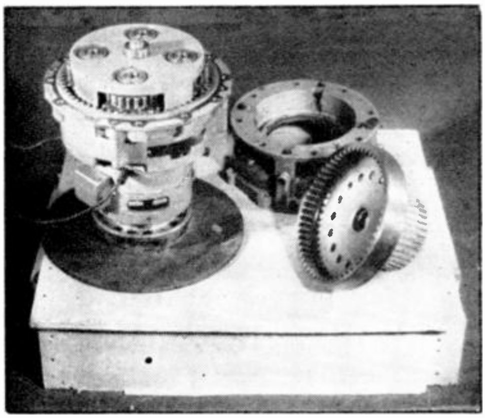


Fig. 11-51 — The "works" inside a propeller-pitch beam rotator. The ring gear mentioned in the text is shown at the right, in front of the upper gear housing. The gear carrier, which is to be drilled and tapped, is still fastened to the top of the assembly. After modification, rotation speeds up to 5 r.p.m. may be obtained with these motors.

to a more-comfortable 2 r.p.m. it is only necessary to reduce the voltage applied to the motor. Don't worry about the slight reduction in power caused by "short-circuiting" one of the several planetary-gear sets. It will still have enough steam to "rotate the house should the beam get stuck."

— *David G. Vanderhoek, W2VLL*

VOLUME FIVE

Hints and Kinks

for the Radio Amateur

WORKSHOP

RECEIVER

TRANSMITTER

'PHONE

POWER SUPPLY

KEYING

V.H.F.

ANTENNA

MOBILE

TEST GEAR

SHACK

. . . 333 Practical Ideas for the Station and Workshop with Ready-Reference Index

$1

PUBLISHED BY THE AMERICAN RADIO RELAY LEAGUE

VOLUME FIVE

Hints and Kinks

for the Radio Amateur

. . . . A Symposium of 333 Practical Ideas for the Radio Amateur's Workshop and Station

PUBLISHED BY

THE AMERICAN RADIO RELAY LEAGUE, INC.

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Foreword

THE SUCCESSFUL RADIO AMATEUR is, by nature, an ingenious fellow. Without a high order of resourcefulness and an ability to improvise he could never overcome the ever-present problem of inadequate workshop equipment and the equally common handicaps of insufficient apparatus and money. Evidence of this inherent ingenuity is to be seen on all sides. One cannot visit any good amateur station without finding clever improvisations, either in the construction of individual components or in the manner in which the whole station is assembled. It may be just a different way to mount a coil, or a scheme for getting a broken antenna halyard back upon the mast, or a fabulous remote-control system. Whatever the idea, it is invariably of value to the rest of us.

With the object of putting the best of these "brain storms" into circulation there has appeared in *QST*, these many years, a department devoted to the general subject of "Hints and Kinks." This department has enjoyed great popularity. The ideas contributed to it by ingenious amateurs have helped us all in our search for ways and means to improve our equipment. Unfortunately this garnered gold of amateur experimentation often has been lost to sight, shadowed by some big article or forgotten in the excitement of some major development. Then, too, there has been the annoying business of vaguely remembering a squib bearing on the problem at hand but being unable to locate it when it is most needed.

These factors led us, in 1933, to publish a collection of the best ideas, schemes and methods offered by *QST* contributors during the three years prior to that date. The first edition of *Hints and Kinks* was well received and established definitely the value of a single grouping of selected "experimental expedients," carefully classified and arranged. In 1937 a second volume of *Hints and Kinks* was published, containing a larger and more comprehensive collection of new ideas. The success of this second edition motivated the publishing of equally-popular third and fourth volumes in 1945 and 1949, respectively.

Since the war — and especially because of the advent of television — much development of newer tubes, circuits and constructional practices has occurred. In addition, amateurs have found wide application in their stations for the large variety of war-surplus equipment which has made its appearance. These trends, of course, have been faithfully recorded in the pages of *QST*. Accordingly, this fifth volume of *Hints and Kinks* has been assembled to correlate in easy-reference form the best of these ideas. The material should suggest many intriguing possibilities for putting back to work older apparatus now gathering dust in cellars and attics. Above all, it should enable each of us, in one way or another, to increase the efficiency of our present-day stations.

We express our thanks to those amateurs whose willingness to offer the result of their efforts to the fraternity as a whole has made this publication possible.

A. L. BUDLONG
General Manager, A.R.R.L.

West Hartford, Conn.

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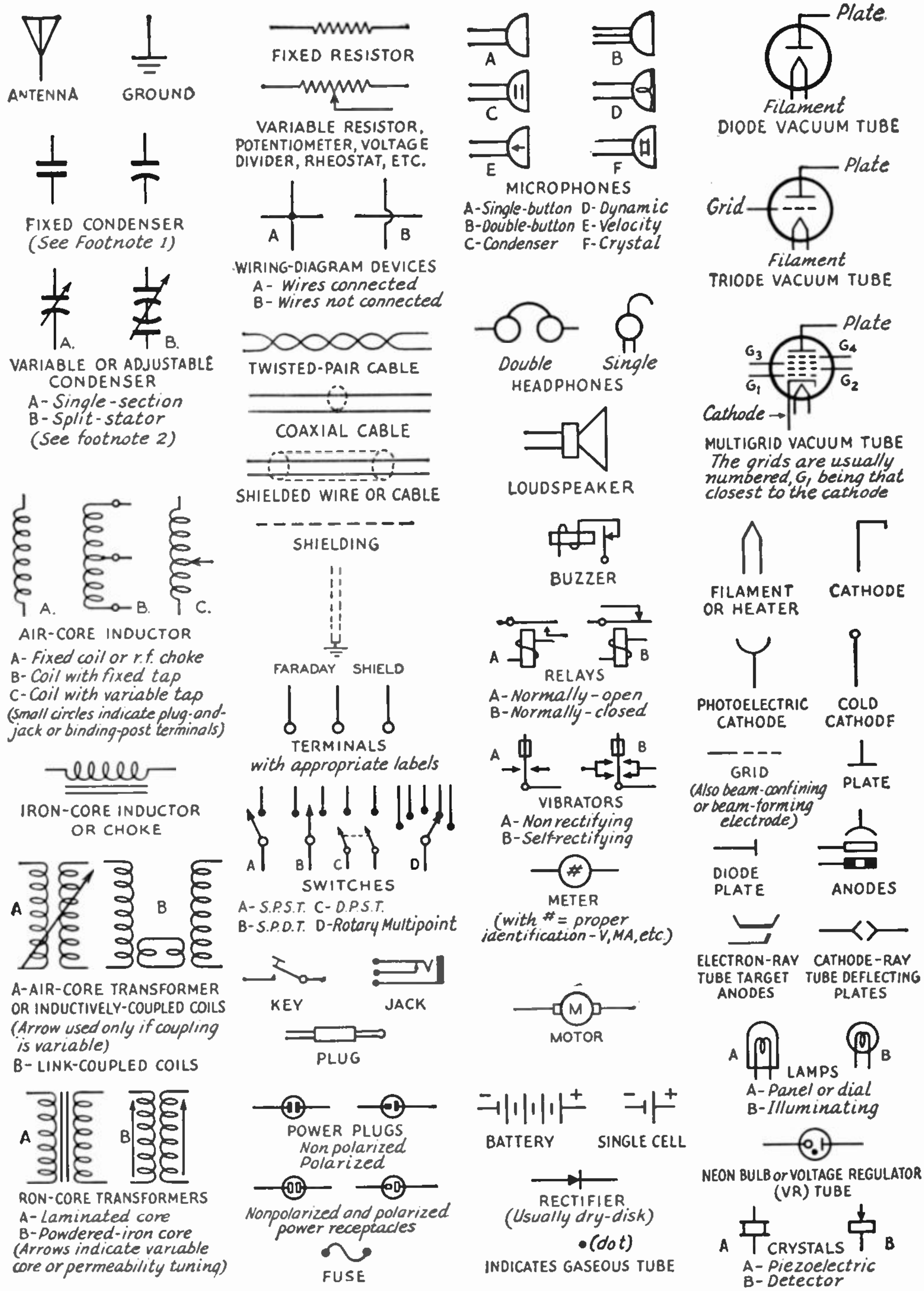
SCHEMATIC SYMBOLS USED IN CIRCUIT DIAGRAMS



[1] Where it is necessary or desirable to identify the electrodes, the curved element represents the *outside* electrode (marked "outside foil," "ground," etc.) in fixed paper- and ceramic-dielectric condensers, and the *negative* electrode in electrolytic condensers.

[2] In the modern symbol, the curved line indicates the moving element (rotor plates) in variable and adjustable air- or mica-dielectric condensers.

In the case of switches, jacks, relays, etc., only the basic combinations are shown. Any combination of these symbols may be assembled as required, following the elementary forms shown.

1. Hints and Kinks . . .

for the Workshop

MAKING INSULATORS FROM SALVAGED MEDICAL GEAR

Your family doctor may be able to supply you with some of the disposable penicillin syringes shown in Fig. 1-1. These units have several salvage possibilities that will appeal to the thrifty

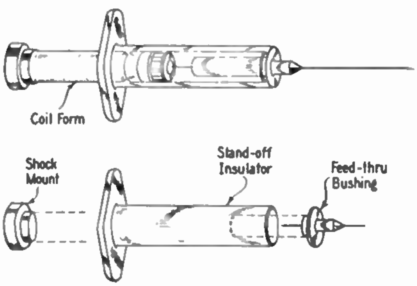


Fig. 1-1 — No, you don't need a "shot in the arm" if you're as ingenious as W9ALU. Here's how he makes feed-through bushings, stand-off insulators, coil forms, and shock mounts from discarded disposable penicillin syringes.

ham. They are made of a brittle plastic, possibly polystyrene, and with a little work with hack saw and file several useful gadgets can be made.

As shown, the end containing the needle may be cut off to make a feed-through bushing suitable for low voltage. After the feed-through is mounted in the chassis, the plastic on the underside of the chassis can be softened by heat and formed into a retaining flange that will hold it in position firmly. A neat stand-off insulator can be made from the remainder of the barrel of the syringe. The inner glass piston which contained the penicillin makes a convenient form for winding small chokes, and the rubber portion of the syringe has possibilities for shock-mounting light gear. There isn't anything left over!

— *Harley L. Christ, W9ALU*

Hospitals throw away the gum tubing used to give patients intravenous feeding. The discarded tubing is just the right size for use as spaghetti insulation covering, is mor flexible than ordinary sheathing, and not particularly inflammable. In addition, it is extremely strong, and less susceptible to damage by heat than many plastics.

— *Joseph R. Lebo, W2OEU*

SHIELDED PLUG-IN COIL FORMS

Shown in Fig. 1-2 is an inexpensive way to build efficient shielded slug-tuned plug-in coils. The base is a male cable connector with shield (Amphenol), and the form is a cut-down slug-tuned unit from surplus radar gear. Almost any small-diameter form will do as well.

A piece of wire is soldered to the shield and connected to one of the pins for grounding. The slug is adjustable through the cable entry bushing at the top of the shield.

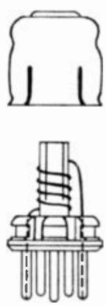


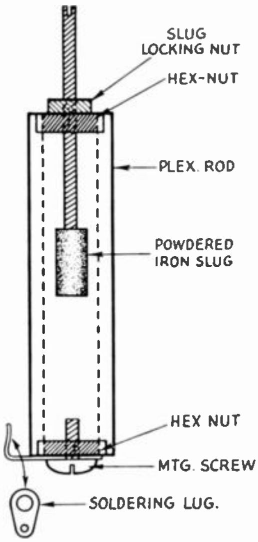
Fig. 1-2 — An ingenious coil form devised by ZS5KU. It uses an ordinary cable connector to make a shielded plug-in coil form with provision for slug adjustment through the top of the shield.

While the commercially-available units probably have lower losses, they are much more expensive. These forms do a fine job for me in a homebuilt "R9-er," and are scheduled for use in a new converter that is now under construction.

— *Jack White, ZS5KU*

HOME-BREWED SLUG-TUNED COIL FORMS

Any enterprising amateur can make his own slug-tuned coil forms for about 15 cents each. Compared with the cost of commercially-available forms, the saving makes the effort worth while. As shown in Fig. 1-3, the form itself is made from a 2-inch length of plastic tubing. If you are lucky you may be able to locate some polystyrene tubing of the desired diameter, but other similar material will do. Powdered-iron slugs, which come with a 6-32 screw molded into them, can be bought for a dime each in the surplus market.



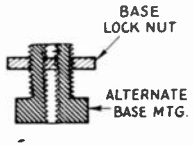


Fig. 1-3 — Method of home construction of slug-tuned coil forms from plastic tubing, hex nuts, and inexpensive powdered-iron slugs.

To mount the slug in the form, heat a hex nut with a soldering iron, and then press one end of the tubing down on it. If enough heat is used, the nut will sink into the plastic with ease, and will be held fast when the plastic cools. A small 6-32 nut is then used to lock the slug in position.

An alternate arrangement that permits the form to be mounted from the adjustment end is also shown. A little "research" through the junk box will probably bring to light a supply of this type of threaded insert. Otherwise, the form must be mounted from the bottom, as shown in the sketch.

— *Lawrence F. Caccomo, WØNMN*

CUTTING "MINIDUCTOR" COILS

I recently had to prune a "Miniductor" to a required inductance. Not wishing to destroy the extra turns which could be saved for later use in another rig, I tried using a heated razor blade to cut the plastic supports. The results were excellent, leaving a clean cut and not disturbing any turns.

The blade, held by a pair of pliers, was heated over a flame until it was red hot. Then, with light pressure, the blade cut through the plastic strip at the required length. It was necessary to reheat the blade after each cut, but even so the time required to do the job was less than five minutes.

— *Norman Schneider, W2KVG*

TAPPING SMALL COILS

Frequently it is necessary to tap a self-supporting coil which is wound with closely-spaced turns of wire. Anyone who has attempted this stunt appreciates how easy it is to short out several turns of the winding while attempting to make contact with a single turn. Connections made with either clips or solder can be handled easily and neatly if alternate turns of the winding are forced down toward the center of the coil by means of a narrow blunt instrument. Ordinarily, coils which require this treatment are ones used at reasonably low frequencies (3.5 and 7 Mc.) and, at these frequencies, neither the *Q* nor the inductance of the coils appears to be affected by the disfiguration.

— *C. Vernon Chambers, W1JEQ*

COIL-TAPPING AID

Finding the correct point for the tap on a small air-wound coil can be greatly simplified by using a paper clip that has been equipped with a flexible wire lead. The smaller paper clips can be easily slipped over turns that usually cannot be gotten at with the regular commercial clips.

— *John J. Schultz, W2EEY*

PLUG-IN COILS FOR THE GRID-DIP OSCILLATOR

An inexpensive set of plug-in coils for the grid-dip oscillator or any other device requiring only two contacts can be made from old octal tube bases. Remove all but two alternate pins and the center guide pin from the base, and wind the coil on the bakelite "form." This arrangement may be plugged into the 19/32-inch ceramic crystal sockets that are commonly used today.

— *E. B. Chapman, W2LDS*

WINDING LARGE-DIAMETER COILS

While casting about for a way to wind a 160-meter coil for my BC-610E, I hit upon the following method which can be applied to other sizes of air-wound coils requiring fairly large physical dimensions.

Select an ordinary tin can with the approximate diameter required. One or both ends of the can may be cut out, but leave the rims intact for support. Next, using a sharp knife, cut a slit from rim to rim lengthwise, and repeat, making three equally-spaced slits. Now wrap the can in waxed paper, tucking the beginning of the wrapping into one slit and continuing around the can until the same slit is reached to hold the end of the wrapping. Punch or drill small-sized holes through both the wrapping and the can to hold the beginning and the end of the coil, and then wind the required number of turns. Coat the whole assembly with coil dope, and allow it to dry for 24 hours. At the end of this time, put the can into a crank-type can opener to remove the two end rims. The remaining three pieces of the can and the wax paper will now come out, leaving the desired coil.

William Ash, W9FIF

LINING UP DECALS

Scotch tape and taut-stretched white thread help W9BTC to line up his panel decals with eye-pleasing accuracy.

COMPACT SINGLE-SLUG COIL FORMS

Inexpensive double-slug TV-type i.f. coil forms may be halved to provide single-slug forms for compact construction.

— *W6HCI*

INEXPENSIVE LOW-LOSS COIL FORMS

If you are looking for an inexpensive source of small-diameter coil forms, try using some of those short lengths of RG/8U cable that ordinarily are thrown away. Cut the cable as shown in Fig. 1-4, after removing the black vinyl covering, the shield braid, and the center conductor. The polyethylene dielectric is a good low-loss material, and it can be mounted easily as shown.

Fig. 1-4 — Cheap coil forms can be made from scrap coaxial cable.

The simplest way to remove the center conductor is to heat it slightly with the tip of a soldering iron, and then pull it out when the polyethylene starts to melt.

— *William B. Desnoes, W2HBC*

COVERING FOR H.V. FEED-THROUGH INSULATORS

Plastic or rubber spark-plug covers make ideal insulated covers for the exposed terminals of small feed-through insulators that carry high voltage. The covers may usually be bought in sets of 6 at a cost of less than one dollar.

— *Charles Wood, W2VMX*

TEMPORARY REPAIR OF WIRE-WOUND RESISTORS

If you're in a tight spot because one of your large wire-wound dropping resistors has opened up, the following method may be used to effect temporary repairs. If the two broken wires are close together (they usually are), take a soft lead pencil and rub it around the break, filling it with graphite. In this way a 50-watt bleeder passing 30 ma. was repaired, and while continued use of the repaired unit is not recommended, it should hold for long enough to keep you on the air until the "crisis" has passed.

— *T. J. Rogers, W5SNG*

VIBRATION CURES

Automobile undercoat compound can be very useful in eliminating certain types of mechanical vibration in ham gear. For example, some low-cost chokes and transformers are often loosely assembled and will "talk back," sometimes causing serious audio feed-back in addition to being just plain annoying. Apply the undercoat in a layer ⅛ to ¼ inch thick to silence these components. The same treatment can also be used to reduce the resonant audio vibration in VFO cabinets.

— *G. P. McCasland, W4NCN*

A sponge-rubber material, known as "Dortite" or "Evrtite," that is supplied in rolled strips makes excellent material for shock mounting light radio gear. It is very easy to apply because one side of it is coated with an adhesive similar to that used in electrician's tape. Merely select the width desired (it comes in widths up to ¾ inch), peel off the coated fabric that covers the adhesive, and press it on. It sticks well to almost any smooth surface. It is usually carried in retail stock by neighborhood hardware stores.

— *R. L. Baldwin, W1IKE*

ANSWERING *LC* PROBLEMS

It is often difficult to determine the resonant frequency of an "unknown" *LC* combination, such as is encountered in surplus i.f. transformers. The following method has been used at W6KEV with success, and requires nothing more elaborate than the ham receiver.

If the unknown is a parallel-tuned circuit, convert it to a series-tuned one, and connect this across the receiver antenna terminals. Tuning across the range in which you expect resonance to occur, signals will be sharply attenuated when exact resonance is found. Provided that the receiver calibration is reasonably accurate, this system is usable with almost any *LC* combination resonant within the tuning range of the receiver.

— *Raymond F. Rinaudo, W6KEV*

A letter that appeared in *QST*'s "Correspondence from Members" urged me to dust off a formula I've used for several years to determine the number of turns required for a coil of given inductance. It originated from the formula given in Circular 74 of the Bureau of Standards. Converting the published formula to inches, and assuming a coil length equal to the coil diameter, the following simple expression results:

$$N = 7.6\sqrt{L/D}$$

where N = number of turns required,
L = inductance in microhenrys, and
D = diameter of coil in inches.

For example: Assume that a coil of 0.119 μh. is required. Its diameter is to be ½ inch, and length the same.

$$N = 7.6\sqrt{0.119 \times 0.5} = 3.7 \text{ turns}$$

The formula may also be modified for use in cases where the diameter is one-half the length of the coil. It then becomes $N = 10\sqrt{L/D}$. For coils in which the length is to be half the diameter, $N = 6.2\sqrt{L/D}$.

— *Keith Rhodes*

RIPPLE FINISH WITH KRYLON SPRAY

A RIPPLE finish that is both durable and professional in appearance may be obtained with the aid of clear Krylon spray. The chassis or panel must first be brush-painted with ordinary black enamel and the spray should then be applied while the enamel is still tacky. The ripple effect will become more pronounced as the thickness of Krylon coating is increased.

— *Ernest Weiss, W2ZDI/5*

FINGERNAIL POLISH A CONSTRUCTIONAL AID

THERE are several ways in which ordinary clear fingernail polish can be used to advantage during your next building project. It can be used to hold a nut in place on the underside of a chassis or on an interior surface of a compartment while a component, cover plate, etc., is being mounted, thus leaving both hands free for the handling of parts and tools. A few dabs of the polish will also serve as a substitute for lacing when a small within-the-chassis cable is made up, and it can also be used to anchor a wire or small cable within a unit. Be sure to apply a small quantity of polish to both the insulation and the metal when one or more wires are to be bonded to the chassis.

— *David G. Kocher, W9PNX*

LIGHTER FLUID AS A RUST SOLVENT

SPRINGTIME repairs on that beam or mast can be made easily if you use cigarette lighter fluid to loosen the rusted studs and bolts.

— *W2MQB*

PANEL-BEARING SUBSTITUTE

A 'PHONE jack that has developed a defect can still be used as a panel bearing for quarter-inch shafting.

— *W9LQE*

RESETTING LOOSE GRID AND PLATE CAPS

WHEN you next run across a loose grid or plate cap on an otherwise perfectly good tube, try an application of Rutland black asbestos furnace cement. After the lead to the center of the cap has been unsoldered, fill the cap with cement and return it to its normal place on the bulb. Now turn on the filament or heater voltage and allow about one-half hour of warm-up time before the cap is resoldered to the lead. When the soldering operation is being performed, leave the iron on the cap long enough to set the cement really hard.

— *W. R. Booher, W9NTI*

TIN-CAN METER SHIELD

THE tin cans that many types of fish, fruit and vegetables are packed in may be reworked for use as meter shields. Fig. 1-5 shows how a panel-mounted meter may be encased in a pair of these containers. Minimum can diameter should allow using the meter mounting bolts to hold the assembly in place. The top of the panel-mounted member must be cut out to clear the meter case and its length should be equal to the depth of the

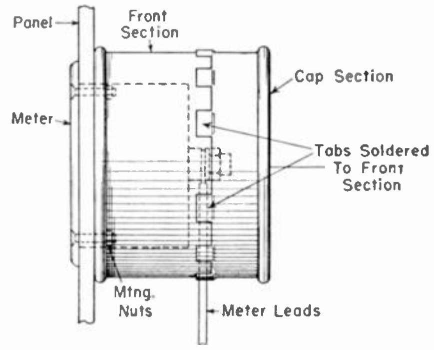


Fig. 1-5 — Tin-can meter shield suggested by W4UAB.

meter. The cap section is cut from a second can, the same size as the first. This cover should have a slot or hole to pass the meter leads and should be equipped with tabs that will force-fit over the front section when the two units are joined together. Solder takes easily to the tin and may be used to complete the bonding between sections.

— *John F. Shumaker, jr., W4UAB*

SOURCES OF SHIELDING

MOST hams are familiar with the fact that aluminum-base transcription disks used in the broadcast field are a very convenient source of aluminum for use around the shack. They are also familiar with the fact that the acetate can be removed from the aluminum by soaking the disk in very hot water. Since 16-inch diameter containers for boiling the disks are not readily obtained, the following method is suggested:

Scrape off the coating all around the edge of the disk with a knife. Then place the disk in the oven for about five minutes. The acetate can then be removed by inserting a knife blade under the scraped edge and peeling it off. Caution: Do not walk away and forget that the disk is in the oven, because the acetate will burn quite readily if overheated.

— *Lynn Stedham, W4HZT*

—•••—

ORDINARY 5-gallon cans make ideal shielding for small transmitters, antenna couplers, etc. Most of these measure approximately 9½ by 9½ by 14 inches, are easy to work with, and take solder readily. The cans can usually be obtained either for the asking or for an exceedingly small financial outlay.

— *James C. Geras, W2MVR*

—•••—

IN the course of debugging some new equipment I felt the need for some shielding in certain spots. My living room shack is not equipped as a sheet-metal shop, so I borrowed some Reynolds Wrap aluminum foil from the supply used by the XYL to wrap food for storage in the refrigerator.

The foil was easily cut to the desired shape and size with scissors, and after determining just what shielding was needed, it was a simple matter to visit the shop of a friend the next day and cut and bend the desired aluminum shield for permanent installation in the rig.

— *John W. Weber, W9BDS*

MANY of us have come to think only in terms of large sheets whenever aluminum is required for a shielding project. These large pieces of material are frequently both difficult and expensive to obtain. One way to beat both the expense and the procurement problem is to make use of ordinary aluminum-chassis bottom covers. Usually, the assortment of sizes stocked by the local ham dealer will permit construction of an enclosure without involving a great deal of cutting and waste material. Of course, the over-all cost of the project will be dictated to some degree by the waste-reduction factor. And if the various pieces purchased are approximately the correct size to begin with, there won't be much left over in the way of scrap.

— *Raymond H. Witt, W1WYA*

LET'S not overlook the corner grocery store as a source of good shielding materials. The 6-ounce cans used for frozen orange juice are just the right size for shielding small coils and tubes. Open them with a wall-type can opener so that the end roll will not be destroyed. Both ends may be removed if desired, and copper screening can be soldered inside one end to provide ventilation where needed. The circular clamps used to mount filter condensers serve as an excellent mounting device for cans of this size.

— *Jack W. L. Koehne, W9PFW*

ONE source of metal boxes is — of all places — the local fish market! The shipping containers for some of the market products are made of completely tinned metal that takes to solder as fish take to water. Various sizes are available — the 40-lb. can is about 7 inches high — and they may be had for practically nothing.

— *Roy L. Gale, W1BD*

MINIATURE LOW-LOSS CONNECTORS

A SET of eight miniature low-loss connectors can be obtained easily and inexpensively by using the plugs and the prongs from an old octal tube and an 8-prong socket, respectively. The plugs can be readily removed from the tube base once the latter has been pried free and the socket clips slip out of place just as soon as the retaining catches are released.

By mating the salvaged components, you have a set of compact connectors that are easy to use, have good mechanical characteristics, and are as low-loss as any obtainable. Naturally, the low-loss feature can be attributed to the absence of dielectric in or around the structures.

— *Bill Pearre, W4TIZ*

PANEL DRILLING TO ALIGN SHAFTS

IF you've ever had trouble deciding just where to drill the panel to pass the shaft of a condenser that is already mounted on the chassis, here's a little trick that may solve your problem.

Take a small plumb bob and drill a ¼-inch hole in its center. Press the bob gently on the shaft and then push it against the panel. The sharp end of the plumb bob will leave a mark on the panel, and it is then only necessary to center-punch and drill the hole. The result — a perfect fit.

— *John J. Towey*

IMPROVED SHIELDING WITH COPPER SCREEN

IN an effort to reduce harmonic radiation from a modified BC-457 transmitter, the rig was shielded with copper window screening, but the results did not come up to expectations. Probing the fields around the case showed that the harmonics were apparently leaking through the screen. The screen, although newly-purchased, showed a slight tarnish, and it was suspected that the screen had lost much conductance between cross-wires, thus acting like insulated wires connected only at the ends and allowing significant leakage. To check this, narrow lines of solder, spaced about 2 inches apart, were added to the screen, as shown in Fig. 1-6. With the en-

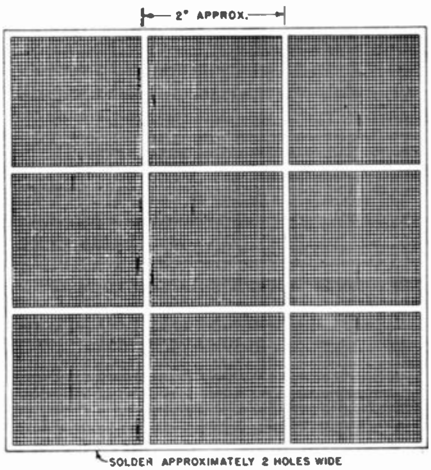


Fig. 1-6 — The shielding properties of copper screening can be improved by running solder lines across the screen at regular intervals.

couragement of T. H. McNary (Boeing staff engineer), measurements were made up to 150 Mc. under identical conditions to the previous tests. They showed an improvement at practically every harmonic, ranging from 4 to 30 db.

A search of the literature shows that this degradation of copper-screen shielding with age is known, but has failed to show previous disclosure of this preventive or repair method.

— *David T. Geiser, WØNZQ*

BASIC TOOL KIT FOR THE BEGINNER

When a newcomer starts out in amateur radio, he soon finds that one of the "must" items around the ham shack is a good set of tools. Whether he is building gear or maintaining his present equipment, there will be special tools, particularly suited to radio work, that he'll be needing in his tool box. He may get by for a while using a pair of scissors for wire cutters, or the family carving knife for wire-stripping, but sooner or later he'll find these makeshift substitutes are inadequate for the job. When that time comes, he is confronted with the problem of exactly what kind of tools he should buy.

The first item on the list should be a soldering iron. The iron to use for general radio work is a 60- or 100-watt job with a 3/8- or 1/4-inch tip (such as the Drake model 400 used in the ARRL laboratory). If you buy an iron with a larger tip, you'll find there will be many places around a chassis you won't be able to reach. Larger-sized irons and tips *are* needed when doing sheet-metal work or when it is necessary to transfer a great amount of heat to the work.

When wrapping wires around terminals or when making connections to points that are difficult to reach, long-nose pliers are a radioman's "must." Long-nose pliers are available with or without wire cutters at the base of the jaws. The cutters are of little help in cutting wires close to sockets or the chassis, but often wires will be easy to reach, and having the cutters on the long-nose pliers will save time. The cost difference between pliers with and without cutters is so slight that it is worth while to purchase those with the cutters.

When wrapping wire around terminals and then soldering, many times there are short lengths of wire protruding that must be snipped off. This is done with a pair of diagonal-cutters. With these it is possible to reach into very cramped spaces and cut wires. The three tools listed, a soldering iron, long-nose and side-cutting pliers, together with a screwdriver, are probably the most important that the amateur uses.

TABLE I-1
Beginner's Tool Kit

Electric soldering iron, 60 to 100 watts
Solder (rosin-core)
Long-nose pliers, 6-inch
Diagonal cutting pliers, 6-inch
Soldering aid (Hytron)
Screwdriver, 6- to 7-inch, 1/4-inch blade
Screwdriver, 4- to 5-inch, 1/8-inch blade
Hand drill, 1/4-inch chuck or larger
Drills, 3/8- and 1/4-inch, and Nos. 18, 28 and 33
Pliers (combination)
Pocketknife
Two large coarse files, one flat, one rattail
Two small files, one flat, one round
Keyhole saw (metal-working)
Hammer
Center punch
1 1/8-inch socket punch
Small paintbrush
Reamer
Carpenter's brace

A cheap paintbrush makes an excellent clean-up tool for removing bits of loose matter from a chassis or for brushing out dirt.

Small holes in metal and some insulating materials are drilled with twist drills and a hand drill. Most hand drills will only take drills up to 1/4-inch diameter and one has to look for other methods if larger holes are involved. For holes up to 1/2-inch, a common method is to start the hole with a small twist drill and the hand drill, and then finish with the large drill held in a carpenter's brace. Another, and perhaps preferable, method, is to use a reamer held in the carpenter's brace. For still larger holes, such as the 5/8- and 3/4-inch holes for miniature sockets and the 1 1/8- and 1 1/4-inch holes for bakelite and ceramic octal sockets, radio chassis punches are recommended. These punch out a clean hole as a bolt is tightened, and they work beautifully in the materials normally used for chassis material.

A hack saw, large coarse flat file, and rattail

Fig. 1-7 — Representative group of the tools needed in a beginner's tool box. They include hand drill, twist drills, knife, scale, screwdrivers, soldering iron, solder, soldering aid, files, hammer, pliers, center punch and brush.

file also are helpful for cutting and enlarging holes on a chassis.

In addition to the tools outlined earlier, Table I-1 gives the contents of a basic tool kit for the ham. An electric hand drill is a luxury unless one is doing considerable work in iron and steel, as in building an antenna tower, where it becomes a "must." However, the tools described will prove to be adequate for most jobs the newcomer encounters.

— *Lewis G. McCoy, W1ICP*

AN INFORMATIVE BOOKLET

Use of tools, Basic Navy Training Courses text, has 258 pages of profusely illustrated information on workshop practices. It is highly recommended to amateurs and should be of great value as a reference work. There are fourteen chapters, each dealing with a specific tool category, plus appended tables and index. It may be procured from the Superintendent of Documents, U. S. Govt. Printing Office, Washington 25, D. C. (Catalog No. N17.25: T61/2/945.)

TOOLS & TRICKS — OLD AND NEW

While the abuse of tools is not a practice to be universally recommended, there are many small jobs that most hams have learned to make easier by using some tools that weren't necessarily designed for the purpose. For instance, if you have to do all your chassis work with a hand drill that won't take a drill larger than ¼ inch, enlarging holes to ½ inch can be a tedious process. But if you have a dime-store carpenter's brace, you can clamp a rattail file (minus the handle) in the brace and do the job easily. Simply turn the brace in a counterclockwise direction and the file will walk through a chassis as though it were cheese. You can get these files up to ½-inch diameter or more. Don't rotate it in the opposite direction, because the file will lock up in the hole and snap off.

If you have a lot of holes to tap in sheet metal, you can speed up the job of threading by using the tap in the hand-drill chuck. You will have to use a little care to avoid snapping off the tap, but if you put a drop of oil on the tap every hole or two, hold the drill steady and back it up whenever it sticks, you shouldn't have any trouble. A two-speed drill at low speed is ideal for this sort of work.

If you are making a metal box, or putting a bottom plate on a chassis, it is seldom that all of the holes in the pieces to be joined will line up accurately, making it difficult to get the screws in place. After the first screw has been started, you can line up the others by jabbing an ice pick through the two holes and prying them into line. If they won't stay in line long enough to get the screw started, use the ice pick in an adjacent hole, prying in the direction that will bring the desired holes into line. The ice pick, as well as a machinist's scriber, is also an aid in steering a nut onto the end of a screw in a place where you can't reach it with your hand. If the scriber is of the type that has one end bent at right angles, you can use the bent end to rescue the nut if it falls off. As simple an item as a pair of tweezers can save a lot of wear and tear on the nerves.

In most dime and hardware stores you can buy very cheaply a cast-iron handle that holds tapered keyhole saw blades. The teeth of the blades are fine enough so that they will cut aluminum quite readily and can be used for cutting out large holes in panels or chassis. If you want to hold the chassis in a vise while you're working on it, place a block of wood a little thicker than the depth of the chassis underneath. The jaws of most vises won't clear the chassis otherwise.

Several manufacturers have recognized the need for special tools of the gadget class in radio-assembly and repairing work. Most hams are familiar with the screw-type socket punches made by Greenlee and also by Pioneer. But perhaps you haven't noticed that they have four marks around the "cup" part that make it possible to center the punch when the pilot hole is much larger than the screw. Just scribe lines at right angles through the center of the hole and match up the centering marks on the punch with the lines on the chassis. This makes it easy to increase the hole diameter to take a five-prong socket, for instance, where an octal socket originally was mounted. The easy way to use these punches is to clamp the head of the screw in a vise and cut the hole by turning the chassis or panel instead of the screw.

Most hams working with tools know about the automatic center punch that eliminates the need for a hammer when making hole centers in metal. Simply press down in the handle and an internal spring gives the punch a kick that will go through thin aluminum if you aren't careful. The tension is adjustable.

Hytron "Soldering Aids" are fast becoming well known as indispensable tools in radio work. In case you haven't seen one, it's a harmless-looking gadget with a metal insert at either end of a wood handle. One end is forked so that it can be slipped over the end of a wire that is to be unsoldered. By guiding the fork up close to the connection you're working on, you can wiggle the wire to loosen it up without burning your fingers. It is especially effective in removing wrap-around connections. The metal fork is coated so that it won't get gummed up with solder itself and the mass is small enough so that it doesn't conduct all the heat away from the joint as a pair of pliers often does. The other end of the tool is a tapered spike that can be used to remove old solder from terminal holes. The "Aid" will be found to have many other uses — in restringing dial cords, for instance.

Most radio-parts catalogs carry a small angle-mounted mirror with a long handle that can be used dentist-fashion to get a peek at some hidden part. Some of these are illuminated with small batteries.

One of the best screw-holding screwdrivers we've seen is a new one called the "Quick-Wedge." A simple slider mechanism, which can be worked by the thumb of the hand holding the screwdriver, serves to distort the blade so that it gets a good firm grip on the screw slot. Not only is this tool ideal for inserting or removing screws in tight places, but you will find that it makes the job infinitely easier when you have a large number of short screws to put in place.

Another of the newer tools on the market is a cheap and simple, but very effective, wire stripper and cutter made by Miller. A simple screw-operated cam sets the stripper for various wire sizes. You can strip the end of the wire with ease in places you couldn't even get near with most other types of stripper. The cutter is shear type that makes a cleaner cut than most other cutters. The tool is made of high-grade steel, so it should last indefinitely even though it can be replaced at very little cost.

How often have you tried to hold a nut with your fingers while you tighten or loosen it with a screwdriver? For 49 cents RCA puts out a set of "Fingertip" socket wrenches. A wrench slips over the end of the most appropriate finger and not only will keep the nut from turning, but it will hold the nut in place while you're trying to get the screw started.

Most of these tools are inexpensive items and are of the sort that can take the cussing out of otherwise awkward jobs. They are well worth adding to the ham's workshop equipment.

— *Donald H. Mix, W1TS*

ALIGNMENT TOOL

Needing a nonmetallic alignment tool in a hurry, W9ROX manufactured one by filing the end of a plastic drink stirring rod.

KNITTING NEEDLE TOOL

A very handy gadget to have around the shop is a large darning needle, or a small knitting needle, with an alligator clip soldered on the blunt end. The sharp end of the needle is perfect for cleaning out the holes in soldered terminals or making room for "just one more wire." The alligator clip is useful for holding small washers, nuts, wires, etc., in difficult places. With a little experimentation with a file, the jaws of the clip can be made to release merely by pulling it straight out.

— *Arthur W. Rash, KL7SO/5*

TIGHTENING HARD-TO-GET-AT NUTS

In tight places, how often has one ended up by using a center punch and hammer to tighten a shaft or mounting nut? Although this system is quite acceptable, it can be improved upon by using a spring-loaded center punch as the driving tool. Just snap the punch on the periphery of the nut and the latter will drive home, tight and quickly. Of course, the use of the spring-loaded job leaves one hand free for holding the object being worked with.

— *C. Deane Kent, W2JFA*

CURE FOR MAGNETIZED SCREWDRIVERS

The annoyance of working with an accidentally magnetized screwdriver may be eliminated easily by following this simple procedure. Place the business end of the screwdriver inside a quarter-pound spool of No. 20 or smaller wire. Momentarily connect the free ends of the spooled wire across a 2- to 10-volt a.c. source and quickly withdraw the screwdriver.

— *Neil A. Johnson, W2OLU*

USING THE NEW SQUARE PUNCHES

I recently purchased one of the new square punches that are now available, and after using it for a time, find the following gadget a very useful addition to my kit of tools. It eliminates the need for spending time laying out all of the various pilot holes that must be drilled whenever a hole larger than the punch is to be cut.

A six-inch square of ½-inch dural was obtained. On it I scribed squares the size of my punch and drilled a 1/16-inch hole through the center of each square. Now when I wish to cut a square hole of any size up to six inches, I merely scribe the lines for the hole on the chassis, fit the dural template over it, and mark the location of the required number of pilot holes through the 1/16-inch holes. Care must be taken, of course, that two edges of the template line up with two edges of the hole to be cut, and that the template does not shift position while the scribing operation is being done.

The template idea is a great timesaver, as anyone who has had to cut a lot of chassis holes with a square punch will agree.

— *S/Sgt. William C. Schaefer*

CENTER GUIDE FOR PAWOOD CIRCLE CUTTERS

When using a Pawood circle cutter try using an ordinary panel bushing as a guide for the center drill of the cutter. If the bushing inserted in the material to be cut has a shaft hole that just clears the center drill, it will act as a bearing during the cutting operation. The cutting of large-diameter holes will be much smoother and the cutting point will have less tendency to bite into the material if center-drill wobble is eliminated by this simple method.

— *C. Deane Kent, W2JFA*

CLEANING LITZ WIRE

It is important, when using Litz wire, that none of the fine individual strands be broken when making a connection and that each strand be cleaned of all enamel so that it may be soldered. The quickest and easiest method to accomplish this is to heat the end of the wire until it is red hot and then plunge the red-hot end into an alcohol bath. This method is superior to using fine sandpaper as there is practically no risk of breaking the wires and they are all cleaned and ready for the solder.

— *R. F. Wright, jr., W2YZT*

INCREASED VOLTAGE RATING FOR VARIABLE CAPACITORS

While trying out a low-power antenna tuner for the first time, it was discovered that the tuning capacitor did not have adequate spacing between plates. This problem was quickly remedied by applying a few drops of regular lubricating oil along the edges of the plates. The rotor shaft of the capacitor was then rotated until a thin film of oil had been spread across the entire surface of all the plates. Since the oil has a higher dielectric constant than that of air, the treatment raised the working voltage of the capacitor and thus allowed it to remain in use until a suitable replacement had been obtained.

— *John J. Schultz, W2EEY*

FINDING INTERMITTENT CAPACITORS

We all dread the task of locating an intermittent capacitor which makes a set change volume or go entirely dead. Regardless of which capacitor is first by-passed with a spare, invariably the surge imposed on the circuit will restore the set to normal operation, perhaps for days. One way to eliminate erratic operation is to replace all of the capacitors, but it must be admitted that this is a highly uneconomical system. A more practical method of locating the trouble-maker is outlined below.

The capacitor of doubtful quality is shunted by a series-connected *RC* combination consisting of approximately 25,000 ohms (not a critical value) and the proper value of by-pass capacitance. The purpose of the connection is to allow the intermittent capacitor to remain charged at the usual circuit voltage and to prevent the new unit from acting as a by-pass. Then, when the set finally acts up, the series resistor is shorted out with a screwdriver or other tool having an insulated handle. In this way, the unit that has lost its by-pass capabilities will be found immediately. Naturally, more than one section of a set can be treated at the same time.

— *Robert B. Witschen, WØSV*

MOUNTING SHAFTS AND DIALS

In many cases of surplus conversion or modification of other gear it becomes necessary to mount a knob or extension shaft in a location where the use of a setscrew is not feasible. Most cements or glues will not serve satisfactorily because they contract upon hardening, which results in a loose, wobbly shaft or knob. The solution lies in the use of "Smooth-On No. 1," available in any hardware store, which *expands* during hardening.

— *R. L. Baldwin, W1IKE*

VISE SUBSTITUTE

One good substitute for a small portable vise when the latter is not available is an ordinary adjustable wrench. Soldering lugs or other miniature components can be clamped in the jaws of the tool and then worked on with two hands after the wrench has been laid flat on a box, table, bench or other handy surface.

— *Steve Graham, W9REV*

TIPS ON USING SHIELDED WIRE

Shown in Fig. 1-8 is a method of preparing the ends of shielded wires which produces a neat and simple termination. It is in general use in commercial practice, but apparently has been overlooked by hams.

The sketches tell the story. First, bend the wire, as at A. Next, slide the shield over the bend (B) using either a blunt instrument or your fingernail to separate the strands. Pull the short end out of the shield, as in C, and then pull the shield taut as in D. The end of the shield may then be cut to desired length and tinned for soldering. The result is neat and strong, with no frayed ends to short-circuit the high voltage.

This method can also be used to tie into the middle of a shielded run, as is necessary when wiring the heaters of several tubes in parallel. The type of connection is shown in sketch E.

— *Paul A. Quinn, W1QXU*

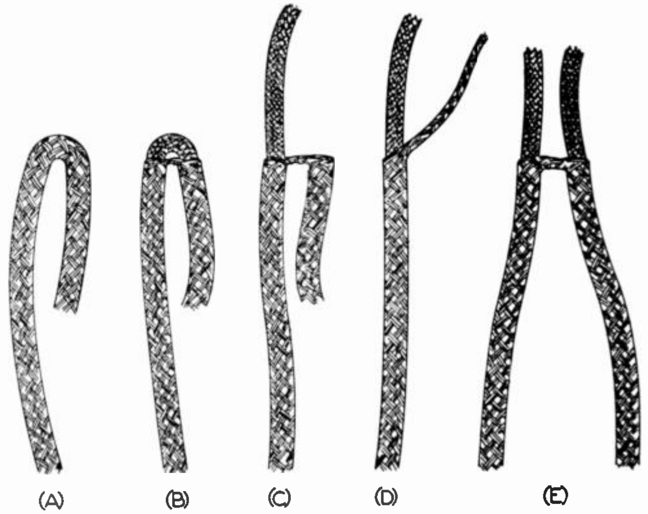


Fig. 1-8 — Here's a simple way to make neat connections with shielded wire. Widely used in commercial practice, it should find equal favor among hams.

QUICK-AND-EASY CHASSIS

Today's small and lightweight radio components do not require the ponderous, hard-to-work chassis to which we have become accustomed. Hardware stores sell a material almost ideal for making small chassis and sub-chassis. This material is called "hardware cloth." It is a heavy wire screen of quarter-inch mesh, costing about ten cents per square foot. With a square yard or two on hand, you can have a chassis of the size and shape you want, just a few minutes after you decide you want it.

Cutting requires only tin shears or a diagonal cutter; bending is easily and neatly done along the edge of a board or in a small vise. Spot-soldering holds the bent-down edges in place. No small holes need be drilled; wires can be brought through anywhere. Larger holes, any size or shape, are easily cut with a diagonal cutter.

Soldering directly to the chassis is easy even with small pencil-type irons, because the screen is well tinned, and there is not much material in it to conduct heat away. No grounding lugs are needed and items like tie-points and sockets (with metal shells) mount more quickly with solder than with bolts.

Rigidity of the finished chassis is surprisingly good. Even small filament or power transformers are well supported when mounted at a corner. If necessary, bracing cross members of hardware cloth can be soldered in place. Larger chassis can be assembled from several "strip" chassis soldered in place side by side. I have a receiver made up of four such strips: front end, i.f., audio output, and power (including a filament transformer and a selenium rectifier).

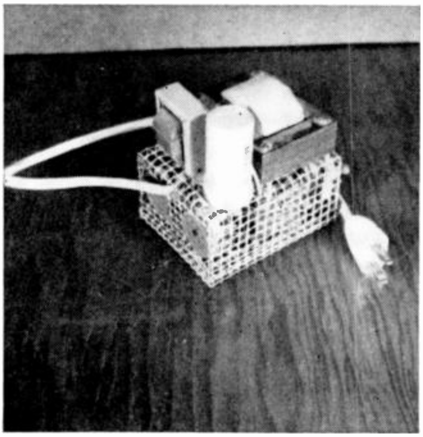


Fig. 1-9 — Example of experimental lash-up using hardware-cloth chassis.

Unsuited for this construction are items with heavy components, or precision r.f. items. Particularly suited are all those small gadgets for which suitable chassis are hard to find, gadgets such as multirange meters, audio amplifiers, power supplies, test oscillators, and various test circuits. An example of one of these chassis is shown in Fig. 1-9.

Because this material is so easy to work, new techniques are possible. For example, instead of planning in detail before beginning to assemble, you can plan as you go along. Parts can be mounted on a flat sheet before the sheet is cut to size, and the wiring can be done before the sides are bent down.

There are two things to watch when you buy hardware cloth for this purpose: (1) It should be bright and shiny; too long a stay in the dealer's back yard makes it dull and hard to solder. (2) The cross wires should be reasonably straight and perpendicular, so the resulting chassis will be rectangular.

— *S. Milton Thomsen, W2CGN*

CHECKING CONDENSERS FOR DRIFT

If you have the usual junk box filled with condensers of unknown characteristics, the following scheme may be of interest to you. If you are looking for a condenser to use in a frequency-determining circuit, you want one with a low temperature coefficient. A pretty good check on those unknown micas can be made as follows:

Make up an inductance of 10 turns of No. 20 wire on a ⅞-inch form. Space the winding to occupy ⅝ inch, and attach short clip leads to the ends of the coil. The condenser to be checked is then clipped across the coil, and the resulting *LC* circuit is checked with a grid-dip oscillator to determine its approximate resonant frequency. Now bring a hot soldering iron close to the condenser, and hold it there until the condenser becomes warm to the touch. Recheck the resonant frequency with the grid-dip meter. The difference between the two resonance points will give you a good idea of the advisability of using the condenser in the VFO circuit. Usually you can find which of several condensers will be least apt to cause drift with no trouble at all.

— *Clare B. Reynolds, W9MBI*

CRYSTAL-GRINDING POINTERS

Previous attempts to change the frequency of a crystal frequently resulted in diminished activity or complete failure to oscillate. The probable cause was that the grinding surface was not perfectly flat. Much of the so-called plate glass does not have a truly flat surface. As an excellent substitute the good old-fashioned razor hone was pressed into service, and since then results have been far better.

When rapid cutting is desired, grinding compound may be used with water in the usual manner. Putting the grinding compound in an old salt shaker and using a medicine dropper to add water when needed cuts down on the messiness of the operation. For finishing, the hone is used alone with plain water for slower cutting.

The hone used here is of the hard-surfaced type, and measures 3 by 5½ inches. Figure eight strokes utilizing as much of the surface as possible were used. Approximately 500 such strokes moved an 80-meter crystal about 125 kc., depending on the pressure exerted. It is wise, of course, to check results frequently so that you don't overshoot your goal.

— *Harry H. Heinrich, W9KPG*

OUR civil defense net in Princeton recently solved the problem of regrinding crystals to get all stations on the same frequency. We worked out a fairly simple and economical method using surplus crystals and emery paper.

The actual grinding equipment consisted simply of a piece of plate glass plus sheets of ½, 0, 00 and 000 emery paper. To check frequency during grinding we used the same oscillator circuit shown in the Measurements chapter of the *Handbook*. A standard communications receiver was tuned to the oscillator and the various crystals were checked to zero-beat with the master crystal.

Most of our crystals came in FT-243 holders. To check frequency during grinding, we would merely reinsert the crystal in the holder and, rather than screw the plate back on, hold the spring in with our fingers. Final checking was done after complete assembly.

It's surprising how sloppy one can be and still get workable results. Place the emery paper on the glass and then simply rub the crystal by holding it with one or two fingers. Rotate the crystal 90 degrees every 10 or 20 strokes. We raised forty- and eighty-meter crystals as much as 65 kilocycles and noticed no reduction in activity. As a matter of fact, there was a definite improvement in several cases. As a rough gauge of how much rubbing is needed, 100 strokes on 000 paper will raise the frequency anywhere from 20 to 500 cycles, depending mostly on the pressure you use. The coarser papers will raise the frequency proportionately faster. The ½ grade should be used with care and only when you have a long way to go. Some simon-pures may be horrified but we didn't even clean the crystals during or after grinding; just wiped them off on our shirts.

— *George R. Webster, W2CPT*

COPPER BRITE, a polishing agent for copper kitchen utensils, works very well as a crystal-grinding compound. It cuts fast enough — but not too fast — is generally available and sells for only eighty-nine cents per 8-ounce bottle. Be sure to keep the stuff out of open cuts because it's got a powerful bite.

— *LeRoy G. Riesland, W7LVB*

CHECKING CRYSTALS FOR OVERTONE ACTIVITY

IN the course of doing some work with overtone crystal oscillators, still another use for the grid-dip oscillator came to light. Merely connect a few turns of wire to the pins of the crystal holder, and then couple them closely to the coil of the grid-dip meter. If the crystal being checked has possibilities of use in an overtone circuit, the meter will dip as the oscillator is tuned through the odd-harmonic frequencies of the fundamental.

Some surprising things will result. For instance, one 3497.5-kc. crystal showed activity on the *twenty-third* overtone, and 13th and 15th overtone activity with ordinary crystals seems to be quite common.

Harry T. Simms, W4HBD

TUNING DEVICE FOR SURPLUS GEAR

IF you own some surplus gear containing tuning elements that can be adjusted only by poking a small screwdriver through a hole in the panel, you'll be interested in this simple method of attaching a regular tuning knob and calibrated dial.

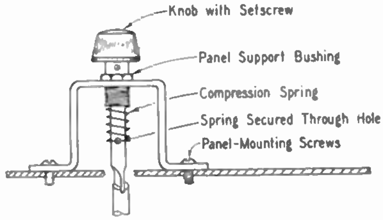


Fig. 1-10 — Novel tuning device for those screwdriver-adjusted condensers encountered in surplus gear.

A 1-inch strip of metal is formed into a bracket as shown in Fig. 1-10. It is drilled for mounting screws and for a standard panel bushing. A length of ¼-inch insulated shafting is then drilled through its diameter to take the ends of a small compression spring (available at most auto supply stores). Slip the ¼-inch shafting through the panel bushing, adjust the tension, and tighten the setscrew in the knob. The other end of the shaft is cut to proper length and filed to fit the slotted shaft of the condenser after the shaft is aligned properly on the panel.

To make a calibrated dial, slip a sheet of cardboard under the bushing and draw in whatever calibration you want.

— *F. H. Maley, W1GZH*

CUTTING POLYSTYRENE ROD

WHEN cutting polystyrene rod or tubing into short lengths, as for feeder spreaders, the usual method of hack-sawing leaves a rough edge. Further, the sawing must proceed at snail's pace or the polystyrene will melt, gumming up the saw blade.

Next time, try an ordinary tubing cutter, the kind with a circular knife that rolls around the tubing. It will cut either rod or tubing in a fraction of the time required for sawing, and will leave a much neater cut end. If an extra-smooth end is desired the raw-cut end may be "fire polished" in the manner of glass tubing, by pressing it briefly against the barrel of a hot soldering iron.

— *Basil C. Barbee, W5FPJ*

SOCKETS FOR TYPE 15E TUBES

ANYONE who has acquired some of the Type 15E tubes that have been available in surplus will be interested to learn that the problem of finding a socket for them can be solved quite simply. The filament pins, which extend out of the base of the tube, are just the right size and spacing to fit snugly in a crystal socket designed for the new small crystal holders (½-inch spacing, 0.125-inch diameter pins). For grid and plate "caps" the pins can be removed from an Amphenol type 54 miniature socket and slipped over the pins of the tube.

— *Tom McMullen, W1QVF*

115-VOLT A.C. TEST LAMP

One of the most simple and inexpensive test units for 115-volt a.c. sources is shown in Fig. 1-11. To construct the gadget, solder two insulated wires to a 6-watt lamp bulb and then

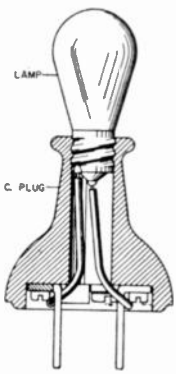


Fig. 1-11 — An inexpensive 115-volt a.c. test unit.

force the bulb down into the grip of a rubber a.c. cap. Naturally, the wire leaders are fed through the assembly and then connected to the regular terminals of the cap. The unit will be more convenient to handle if the a.c. plug is one having a long, grip-type neck.

— *Walter C. Downes, W3UVD*

NEON-BULB SUBSTITUTE

When your only neon bulb succumbs in a fatal skirmish with gravity, W1UXS suggests a VR-tube as an emergency r.f. indicator. It may be necessary to peer carefully to observe the glow, however.

SIMPLIFICATION OF PILOT-LAMP REPLACEMENT

It is often next to impossible to remove the bulb from a panel-mounted pilot light assembly because the end of the bulb is recessed just far enough to elude the tips of your fingers. At W1AW, where numerous pilot lamps are used, much time is saved by the simple replacement "tool" described below.

The center conductor, dielectric, and shield braid are pulled out of a 3-inch length of ½-inch diameter coaxial cable, leaving only the black vinyl covering. This fits snugly over the end of the bulb and makes replacement easy.

— *Charles Wood, W2VMX/W1AW*

WELDING ALUMINUM WITH A BLOWTORCH

Beam construction at W3MTE has always involved loading a quantity of aluminum tubing into the W3MTE Crosley, driving to the nearest welding shop, and then trying to find a way to get the finished beam home. Some method of home welding was obviously in order.

In the construction of a two-meter plumber's delight gamma match, I wanted to use half-inch tubing for the boom, with quarter-inch tubing for elements. The boom was to be pushed through a half-inch hole in the end of a 1¼-inch mast section. I wanted to tack-weld the elements in place, with no mechanical claptrap.

Co-worker Les Graffis mentioned that he had used die-cast welding rod and an oxyacetylene torch in mending cracked aluminum heads on Fords, and that the weld couldn't be knocked off with a hammer. Santa Claus had brought me a nice new gasoline blowtorch, and some experimenting was done. Results were excellent.

Here is the process:

1) Wire brush thoroughly the two pieces to be joined.

2) Heat with the blowtorch the larger of the two pieces; the heat will flow into the smaller piece.

3) Rub the die-cast welding rod on the joint until both pieces are tinned. Leave a small blob on the joint. Use no flux.

4) With a piece of iron wire, push the blob around until a smooth joint is obtained.

5) Allow to cool without movement.

A few notes are in order. Heating a heat-treated metal like 24ST draws the temper, but for light work it's satisfactory. Soon after the rod melts, the aluminum will blister, then collapse; *moral:* work fast and remove the torch as soon as possible. Support the work so that it is not under strain during the heating, or it will bend where you don't want a bend. Open the blowtorch fairly wide and keep the pressure up. The minimum setting may not melt the rod. Experiment with some scrap to get the hang of it before working on the middle of your new boom. *Wear gloves* — aluminum doesn't look hot, but it can burn you. The rod costs about $3.25 a pound, which comes to about 15 cents a stick.

As usual, a good coat of aluminum paint will protect the beam and retard corrosion caused by junctures of dissimilar metals. No experimenting has been done on iron or brass parts. It may work.

This process will never put the welding shops out of business, but it has its place in my ham shack and home workshop.

— *H. H. Washburn, W3MTE*

TIPS ON SOLDERING

When soldering small parts, especially replacements, in crowded quarters, a useful gadget can be made from an alligator clip. Solder short lengths of heavy wire or brazing rod to the clip, and form them into a handle. The clip can then be used to hold the parts securely in places too small for ordinary tools while the solder is applied.

— *Robert A. Vogt*

Did you ever get ready to start an outdoor soldering job and then find that everything is on hand except the solder? This won't happen again if you make a practice of keeping a few turns of solder wrapped around the handle of the iron.

Incidentally, if the iron is a short-barrel job (gun or low-wattage type) the end of the wrap can be pigtailed out to the tip. If this is done, it is frequently possible to complete a soldering operation that normally calls for a third hand.

— *L. Bennett, KL7LV*

Research has revealed that the brief overheating resulting from soldering operations can permanently change the value of small carbon resistors by as much as 20 per cent. To avoid this, attach some heat-dissipating medium to the lead while it is being soldered. Holding the resistor lead in long-nosed steel pliers while it is being soldered and for 10 or 15 seconds after the heat is removed will serve the purpose, but for those who like to be fancy, a "thermal shunt" made by adding heavy copper jaws to a crocodile-type clip can be used in the same manner.

— *U. S. Dept. of Commerce*

When the tip of your soldering iron becomes pitted, instead of filing it smooth, thus wasting copper, draw the copper tip by squeezing it in a vise or with a ball-peen hammer. The elongation of the tip not only restores the length, but the cold working will make the tip last longer. Any small irregularities remaining can be smoothed with a few light strokes with a fine file.

— *Warren S. Lincoln, W6EYP, ex-W1JFA*

In many soldering irons, especially the cheaper ones, the tip does not fit snugly in its socket after a few weeks of use. A layer of oxide forms on the base of the tip inside the socket, and heat conduction is greatly impaired. Scrape the tip until the oxide is removed and the bare, bright copper shows. Also scrape the inside of the socket to remove the oxide scale. Then wrap the base of the tip with aluminum foil (available in hardware stores for food-storage purposes). Use only enough foil to shim the tip to a snug fit within the socket.

This little kink will usually restore the iron to its original efficiency.

— *Charles Erwin Cohn*

BLUEPRINTING DIAGRAMS

Amateurs so situated as to have blueprint facilities available may find it a convenience to have enlarged copies of small circuit diagrams run off for workbench use. Tacking tracing paper over the enlargements will then permit checking off wiring and connections easily as construction progresses.

— *John J. Towey*

PROTECTION FOR SCHEMATIC DIAGRAMS

When I make a schematic diagram which I want to save as a permanent record, I paint it with colorless nail polish. Two coats will usually be enough if you draw the diagram on an index card or other similar material. "Varnishing" diagrams in this way saves them from wear and tear. The same treatment is useful to keep hand-calibrated dial scales looking clean and neat.

— *Carolyn J. Hull, W2YCX*

PERMANENT IDENTIFICATION FOR COMPONENTS

Some manufacturers of chokes, transformers, etc., are continually changing part numbers and, after several years, it is possible to end up with a stock of usable parts that can no longer be identified. However, if the ratings of a component are etched on the metal case with a scribe at the time of purchase, the fact that the manufacturer changes numbers or discontinues production of that part is of no consequence.

— *C. Deane Kent, W2JFA*

PROTECTING POLYSTYRENE FORMS DURING SOLDERING

To eliminate the need for gripping the pins of a polystyrene coil form with pliers when connections are being soldered, use of the gadget shown in Fig. 1-12 is highly recommended. It is a short length of brass with a hole the size of the terminal drilled in it, plus a slot to permit a nice sliding fit to be obtained.

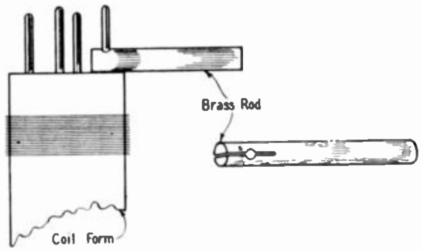


Fig. 1-12 — Handy "third hand" for preventing polystyrene coil forms from melting during soldering operations.

Just slip the brass over the terminal, and apply solder as you would with a bakelite form without fear of melting the pin out of the form. Furthermore, when it becomes necessary to remove the winding for change or for use in another rig, you can remove the winding with ease and safety so long as the brass rod is in place.

— *J. E. Dussault, VE2EV*

To prevent damage while soldering, VE3AOZ wraps watersoaked pipe cleaners around the pins of polystyrene coil forms or the leads of crystal rectifiers.

Anyone who has disformed a polystyrene coil form during the soldering process will appreciate any suggestion that helps solve this problem.

One method of protecting the form and the pin alignment is to immerse the form in a shallow pan that has been filled with cold water and ice cubes. If the water extends up approximately ⅛ inch above the base of the form, it will dissipate excessive heat as the soldering operation is performed.

— Carlton T. Ross, W9ABA

POLYSTYRENE MOUNTING BOARDS

A commercial appearance can be lent to that new piece of gear by mounting capacitors and resistors in bank form. One quick-and-easy way of making these assemblies is to lay the components flat on a narrow strip of polystyrene and then curl the wire leads over the edges of the sheet.

If the leads are then heated with a soldering iron — no solder, please — they may be forced down into the polystyrene as the latter melts. After the material has reset, it will maintain a permanent grip on leads of the components. Mounting holes for the finished assembly may be drilled at each end of the strip.

— Roy R. Campbell, W4DFR

PROTECTION FOR RESISTORS DURING SOLDERING OPERATIONS

Small composition resistors frequently undergo a change in resistance during soldering, and even though the resistor is not completely damaged, it may become unusable for the application on hand. The ordinary method of protection or heat dissipation that uses pliers clamped onto the resistor lead is inconvenient because it makes a one-handed soldering job necessary.

A simple tool or heat-dissipating gadget that can be made up in a moment's time is shown in Fig. 1-13. The clip is bent from a small strip of copper and its size will determine the rate of heat dissipation. To be most effective, it should be

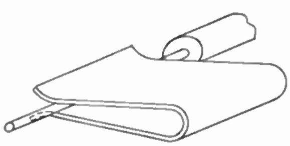


Fig. 1-13 — A copper-strip heat-dissipating clip as described in the text.

as large as space and component size permit, and should be clamped onto the lead close to the body of the component. It can be clamped in place by an alligator clip, which will tend further to increase the heat-dissipating ability of the device. The easy-to-make gadget will afford protection for crystal diodes, small capacitors, etc. during soldering.

— George Grammer, W1DF

LETTERING ON ALUMINUM

Although many amateurs are unaware of it, labeling of a permanent nature may be done with a fountain pen on unpainted aluminum panels and chassis. First wipe the surface clean with alcohol, thinner, or cleaning fluid. When dry, moisten the surface slightly with a detergent solution (saliva will do). In most cases the surface will now take the lettering, but some experimentation may be needed to determine if you are on the right track.

Allow the ink to dry thoroughly, and then apply a thin coat of clear nail polish to complete the job.

— Neil Johnson, W2OLU

GANGING TOGGLE SWITCHES

Ordinary toggle switches may be ganged by the method shown in Fig. 1-14. Mount the switches side by side on the panel, and then join the switch levers with a slotted length of ⅜-inch

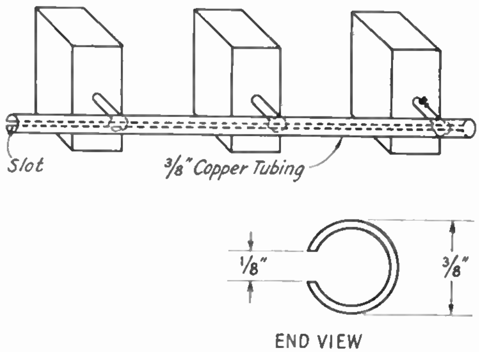


Fig. 1-14 — A simple method of ganging two or more toggle switches for operating convenience.

o.d. copper tubing. To do this, machine a ⅛-inch slot the full length of the tubing as shown in the end view. A hack saw will do the job, although it can be done better with more elaborate equipment. Now slide the copper tubing over all three switch levers. Fasten it by wrapping wire around the tubing on each side of the switch levers and soldering the wire to the tubing.

— Allan H. Poe, W3RGN

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Toggle-switch contact resistance can be minimized by agitating the switch in carbon tetrachloride for a short time.

— W1LOP

UTILIZING BURNT-OUT METAL TUBES AS CABLE PLUGS

Excellent cable connectors can be made from tubes such as the 6H6, 6C5, etc. First, pry the metal shell loose from the base of the tube. Then remove the glass and metal components from the shell and unsolder the leads which connect to the base prongs. Drill a hole for a rubber grommet at the end of the shell and slip the grommet in place. After the cable has been passed through the grommet and the ends soldered to the base prongs, place the shell back on the base and crimp it securely in place with pliers or other suitable tool.

— Peter Baghdararan, WN1YHU

2. Hints and Kinks . . .

for the Receiver

"Q5-ER" MODIFICATION

If you use a surplus BC-453 receiver as a "Q5-er," the quality with headphone reception may be greatly improved when the low-impedance output tap (300 ohms) is terminated in 300 ohms and the ordinary high-impedance 'phones are hung across it. The response loses a broad peak near 1000 cycles and becomes essentially flat over the audio range. The same trick could be applied to the 4000-ohm tap if necessary. If the audio output of the BC-453 is fed to another amplifier, the resistor termination should also be included.

— *James M. Sharp, W6DMY*

CURES FOR ITV

In many instances hams find it impossible to use the 160-, 80-, and 40-meter bands because of "hash" radiated from near-by TV receivers. This hash originates with the horizontal oscillators operating at about 15 kc. and driving a flyback system of power supply operating as a Class B amplifier. Harmonics of the oscillator frequency are generated, and are radiated by the wiring of the receiver, appearing at 15-kc. intervals through the spectrum.

To eliminate the interference it is usually only necessary to by-pass the high-frequency harmonics to ground. For example, in an Admiral model 30A1, a 0.01-μfd. 600-volt by-pass from the B+ side of the plate loading resistor of the horizontal oscillator and a 0.05-μfd. 600-volt by-pass at the output of the low-voltage power supply did the trick.

In other cases it may be necessary to by-pass the a.c. line where it enters the set. A pair of 0.001-μfd. 400-volt mica condensers installed with short leads from each side of the line to chassis should help.

— *John F. Gallagher, W2VAQ*

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An article on interference caused by television receivers published in the September, 1950, issue of *Electronic Engineering* (a British magazine) contains a clue worth passing along.

To reduce the annoying hash radiated by poorly shielded TV receivers, they recommend spraying the inside of the cabinet with a conducting paint. Using shielding of this sort is not a new idea, but the application in reducing ITV is worth knowing about.

— *Charles B. Martin, W4PXS*

IMPROVED TUNING RATE FOR RECEIVERS

If you have sharpened the selectivity of your receiver to keep pace with the increased occupancy of the ham bands, you'll probably feel the need for a slower tuning rate. The sketch in Fig. 2-1 shows one way to attach a vernier dial to the bandspread tuning condenser of your receiver without drilling into the panel. An angle bracket is formed to fit under the front edge of the receiver so that the vernier dial can be applied. Most receivers are heavy enough to hold the bracket in position without additional support, but if necessary, small self-tapping screws can be passed through the horizontal lip into the bottom plate of the receiver.

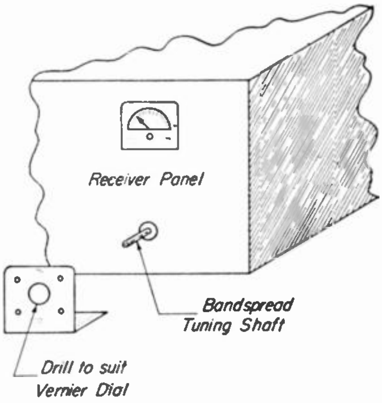

Fig. 2-1 — Here's an easy way to add that vernier dial to the bandspread tuning shaft of your receiver.

— *Robert J. Morrison, VO6VB*

THE ANTENNA COUPLER HELPS THE RECEIVER, TOO!

Many amateurs do not give adequate attention to the most efficient means of coupling the receiver to the antenna. Where an antenna coupler is used, the antenna feeders are usually connected to the receiver by means of a single-pole double-throw relay in each feeder line, if balanced feeders are employed, or by a single-pole double-throw relay if coax is used. Sometimes an untuned pick-up coil is coupled to the tuner tank coil.

After completing a wide-range coupler with B & W type TVL coils, various means of coupling the receiver coax input to it were tried. The pick-up coil was tried because it offered flexibility for all-band operation with the possibility of eliminating costly relays. Because of the low-impedance coax input to the receiver, the pick-up coil, which was loosely coupled to the tank coil, required series tuning by a variable condenser. A 100-$\mu\mu$fd. tuning condenser was incorporated in the coupler, mounting it beneath the main chassis so as to be out of the direct field of the tank inductance and yet be conveniently adjustable from the front panel of the coupler by means of a knob.

A small d.p.s.t. normally-closed relay opens the receiver antenna and B+ during transmitting periods. A small coax relay is preferable for the antenna switching.

The advantages of this means of coupling the receiver to the antenna are obvious. The proper impedance match between antenna and receiver is readily obtained. The coupler tank is, as usual, tuned to the desired frequency. By adjusting the series variable condenser, the receiver input circuit is tuned to the same frequency. The condenser tuning is not critical and need not be varied over any one band.

The relay is mounted outside the coupler housing as indicated in Fig. 2-2. This is desirable as no supply lines enter the coupler housing and thus no r.f. is induced in the relay-solenoid windings and possibly the supply lines.

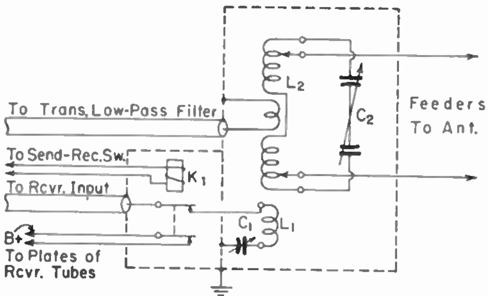

Fig. 2-2 — **A separate link and coax line is provided for receiver input.**

C_1 — 100-$\mu\mu$fd. variable.
L_1 — 3.5 Mc. — 35 turns, 1 3/8 inches long.
— 7 Mc. — 19 turns, 1 inch long.
— 14 Mc. — 8 turns, 1/2 inch long.
— 28 Mc. — 4 turns 3/8 inch long.
All coils wound with No. 26 enameled wire, 1 1/2 inches diam. (National XR-6 forms).
L_2C_2 — Usual transmitter antenna-coupler coil and condenser.
K_1 — D.p.s.t. normally-closed (coax type preferable).

The appropriate receiver pick-up coil is plugged in place with the tank coil for the desired band. A combination arrangement can be constructed in which the pick-up coil and tank inductance are integral so that both may be plugged in as a unit.

With C_1 tuned to resonance, a gain of six S units has been observed over the nonresonant condition, or with the condenser shorted.

— *John J. Glauber, W3GQD*

INEXPENSIVE HIGH-CAPACITANCE VARIABLE

When looking for a truly inexpensive high-capacitance variable condenser, don't overlook the b.c. receiver field. Some of the dual-superhet tuning units offer a capacitance of approximately 400 $\mu\mu$fd. per section for a cash outlay of only a dollar or so. Sometimes, you even find these variables on the bargain counter — marked down to 29 cents!

— *John J. Schultz, W2EEY*

BC-459A CALIBRATION CRYSTAL FOR CONVERTER USE

Anyone who has the 8000-kc. calibration crystal from a BC-459A transmitter kicking around may be interested to know that it can be put to good use in a crystal-controlled 10/11-meter converter. When the crystal is operated at the third harmonic in the oscillator section of a converter, the resultant i.f. permits use of the calibration of the main receiver with as simple a correction factor as possible. Complete coverage of the 28-Mc. band is had by tuning the receiver between 4 and 5.7 Mc. and the 11-meter band will be tuned by the receiver range of 2960 to 3230 kilocycles.

— *John W. Watson, W7GHB*

IMPROVING PERFORMANCE OF SURPLUS RECEIVERS

The performance of some surplus receivers, notably the BC-348 and BC-342, can be improved by the following simple operations: First, replace all of the 0.01-μfd. by-pass condensers with new mica or ceramic units. The condensers in the original equipment *look* like mica condensers because they are enclosed in a black bakelite case, but actually they are paper, and as they grow older they develop leakage sufficient to reduce the over-all performance of the receiver. Next, apply a liberal coating of "Lubriplate," which is available in most hardware stores, to the bearings of the main tuning condenser, and — in the case of the BC-348 — to the gear train in the bandswitch. This will eliminate the tendency to instability that sometimes develops in these receivers because of corrosion of the moving parts in the h.f. oscillator tuning mechanism.

— *Paul E. Griffith, W2SOY*

BROADCAST-BAND COVERAGE WITH THE BC-348-Q

Fig. 2-3 shows the circuit of a simple one-tube converter that is useful in adding coverage of the standard broadcast band to the BC-348 or any other receiver that tunes to approximately

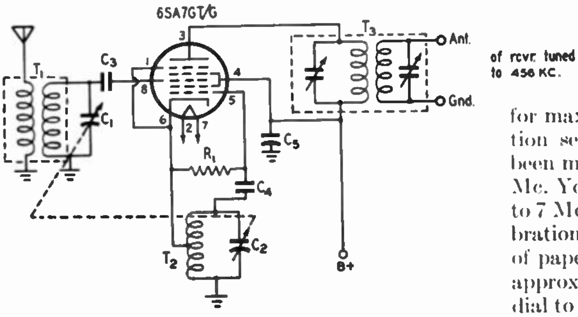

Fig. 2-3 — Diagram of a simple converter used to provide broadcast-band coverage with the BC-348 and similar receivers.

C_1, C_2 — Ganged tuning condenser, 365 μμfd. with cut-plate section.
C_3, C_4 — 100-μμfd mica.
C_5 — 0.1-μfd. 200-volt paper.
R_1 — 20,000 ohms, ½ watt.
T_1 — B.c. antenna coil (Meissner 14-2436).
T_2 — Tapped oscillator coil (Meissner 14-1033).
T_3 — 456-kc. i.f. transformer (Meissner 16-5712).

450 to 500 kc. Standard parts are used throughout, and construction layout is not critical. The power-supply requirements are small. Almost any source of 150 to 200 volts d.c. at a few milliamperes and 6.3 volts a.c. at 0.3 amp. will suffice.

— *Victor Alfonsi, W2VSU*

FURTHER IMPROVEMENTS IN THE BC-342

Greatly improved i.f. selectivity in this popular surplus receiver results if the last two i.f. transformers are replaced with Millen type 62456 units. It is necessary to cut the shield cans down if the receiver is to be replaced in its case after this modification, but it is a simple job. New spade lugs are bolted or riveted to the cut-down cans.

In addition, it is necessary to remove 7 turns from each of the windings in the transformer, because their tuning range must be moved a little higher to correspond to the 470-kc. crystal filter frequency. Litz wire is used in these coils, so care is required to assure a good joint when the leads are resoldered.

After replacement, the transformers can be aligned by ear to the crystal frequency. Alignment with a signal generator will be better, but it is not a requisite. The improvement will be quite obvious to anyone who has tried to combat QRM with the receiver in its original form.

Another great aid in knifing through QRM can be obtained by *tripling* the apparent bandspread in the 7-Mc. range. This can be done with no tools except a small screwdriver. Set the bandswitch to the 8- to 11-Mc. range. This range is not used to cover any ham bands, but by turning the oscillator padder condenser on the rear of the set, 7 Mc. can be made to come in at the low end of the dial, where the rate of capacitance change is much slower than at the high (numerically speaking) end. This, too, can be done without the aid of a signal generator. First tune in a strong signal near 8 Mc. Turn the oscillator padder a little bit at a time until the signal shows up at 8.2 Mc. Now peak the r.f. and mixer trimmers for maximum signal strength. Repeat this operation several times until the original signal has been moved up to where the dial reads about 8.7 Mc. You will now find that the receiver will tune to 7 Mc. when the dial is set near zero. A new calibration can be drawn on a crescent-shaped piece of paper and glued to the dial scale. It will take approximately *eleven* full rotations of the vernier dial to cover the 7-Mc. ham band, a big improvement. Most of the "expansion" will be found to have taken place at the low-frequency end of the range, where it is most needed. With the added selectivity gained by changing the i.f. transformers, this slower tuning rate will be a big help in spotting the weak ones.

A minor change will be of help to those who like to use the b.f.o. to tune in single-sideband 'phone signals. The tuning rate of the pitch control is reduced by bending the rear rotor plate on the pitch-adjusting condenser away from the remaining plates. Only slight adjustment is needed here to restrict the range of control to just cover the full audio range instead of considerably more. This will also be of help when the b.f.o. is used in conjunction with the crystal filter to get single-signal performance.

— *Richard M. Smith, W1FTX*

ELIMINATING BACK-LASH IN THE BC-342 AND BC-348

It is a simple matter to cure back-lash in the BC-342. This is done by tightening the screw which pushes against the end of the rotor shaft of the main tuning condenser. To get at this screw it is necessary to remove the shield cover which houses the oscillator circuit at the left end of the receiver. Remove the numerous machine screws which fasten the cover to the main chassis, tighten the screw, and the job is done.

— *K. G. Bucklin, W2CDP*

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The following method has been found to be a permanent cure for back-lash in the tuning mechanism of a BC-348 receiver. No major dismantling of the receiver is required, and the results permit approaching the desired signal from either side of zero beat without missing the mark.

Slip the chassis out of the case and stand it on end with the bottom of the chassis facing you and with the panel to the left. You will notice that the ganged tuning condenser is held in place with six screws, two at the bottom and four at the top. Loosen the two bottom screws slightly and one or two of the top screws. Using a screwdriver as a "pry," place it between the condenser frame and the panel, and with slight pressure bring the gear on the end of the condenser shaft and the worm on the dial-drive assembly closer together. The change in position will be slight, but will be enough to take up the play. While still holding the "pry," tighten up on the holding screws.

This operation will disturb the original calibration somewhat, but it can be corrected easily by readjustment of the oscillator trimmers.

— *Norman E. Blackie, W6WNZ, ex-W1BNB*

MODIFYING TUNING RANGE OF THE BC-348

It is a fairly simple task to modify the tuning range of the BC-348 to add the 10-meter band, and to obtain full bandspread of the 20- and 40-meter bands. Bandswitch Positions 6, 5, and 4, respectively, are used.

Only in Band 6 is it necessary to change the coils in any way. On all other bands the changes involved are in the size of the padding and trimming condensers shown in Fig. 2-4, which represents the basic circuit used. Two and one-half turns are removed from each coil in Band 6, and the remaining turns are spaced evenly along the length of the coil form. The job can be done without removing the form, by unsoldering the bottom lead of the coil and taking off the required number of turns. In addition, 4 turns are removed from the coupling coil between the oscillator grid and the converter cathode circuit. Without this change, the oscillator is loaded too heavily and will not function properly. Again, the coil form need not be removed.

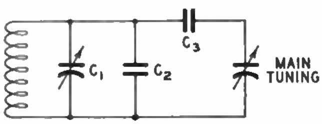


Fig. 2-4 — Basic tuning circuit used in the BC-348. By modifications described in the text, full bandspread of the 20- and 40-meter bands is obtained, and by also changing the coils of Band 6, 10-meter coverage is gained.

Changes in the values of capacity needed are shown in the accompanying tabulation. The resulting tuning ranges obtained are as follows: Band 6 — 27,987 to 30,052 kc.; Band 5 — 13,395 kc. to 14,405 kc.; Band 4 — 6963 kc. to 7347 kc. These frequencies were checked with a BC-221 frequency meter. Greater tuning range can be obtained by increasing the value of C_3. A signal generator and an output meter were used while values were adjusted until the ones were found that gave uniform sensitivity over the entire range.

— *Jack G. Hines, W5GAB*

	C	C_2	C_3
10 M., Band 6, Osc.	25 μμfd.*	None	30 μμfd.
10 M., Band 6, Other Stages	25 μμfd.*	None	20 μμfd.
20 M., Band 5, Osc.	No Change	No Change	20 μμfd.
20 M., Band 5, Other Stages	No Change	No Change	20 μμfd.
40 M., Band 4, Osc.	50 μμfd.*	395 μμfd.	140 μμfd.
40 M., Band 4, Other Stages	50 μμfd.*	200 μμfd.	65 μμfd.

* Exchange the 25-μμfd. Band 4 padder with the 50-μμfd. Band 6 padder.

REMEDY FOR HEATING-PAD QRM

For some time I had a bad case of QRM from a heating pad used in the house next door. After considerable investigation, it was found that the disconcerting racket could be eliminated only by by-passing each of the thermostats in the heating pad with small condensers.

To do this it is necessary to open the pad and solder 0.005-μfd. condensers right at the thermostat terminals. The new ceramic disk-type condensers are ideal for the job because of their small physical size. They are wafer-thin, so their use does not introduce annoying lumps in the pad.

Care must be taken to see that proper insulation is made of each joint so that the user will not be hurt by exposed wires. By careful placement of the condensers, the thermostats themselves can be used as mechanical guards for the rather frail condensers.

Each manufacturer seems to have his own pet circuit for heat control in these pads, and as many as four thermostats will be found in some makes. By-passing each one has done the job to complete satisfaction here, and it is hoped that others plagued with this annoyance will have similar success.

— *O. S. Keay, W0SJK*

CRYSTAL-CONTROLLED CONVERTER FOR 21 MC.

The circuit diagram of the popular crystal-controlled converter [1] that appears on page 377 of the 1951 *Handbook* can be easily modified for 21-Mc. coverage by those who cannot tune the band with an existing receiver. When converted for 21-Mc. work, the unit employs a 7.09-Mc. crystal operated at the fifth overtone, 35.45 Mc., thus enabling the full 21-Mc. band to be covered by a receiver that tunes 14.0 to 14.45 Mc. Alterations that must be made to the original parts list of the converter are as follows:

C_1 — 25-μμfd. variable.
C_1, C_9 — 25-μμfd. trimmer.
C_{11} — 50-μμfd. trimmer.
L_1 — 4 turns over cold end of L_2.
L_2 — 12 turns B & W 3007.
L_4 — 28 turns No. 22 on ⅜-inch slug-tuned form.
L_5, L_6 — 13 turns B & W 3004; 3/16-inch space between windings.
L_7 — 8 turns B & W 3004, tapped 2⅔ turns from crystal end.
L_8 — 26 turns No. 22 on ⅜-inch slug-tuned form padded with 3-30-μμfd. trimmer.

In the i.f. amplifier circuit of the converter (page 379, 1951 *Handbook*), L_2 was changed to 27 turns of B & W 3004 and was padded with a 75-μμfd. trimmer. L_3 of the same circuit was

[1] The circuit for the converter referred to above also appears on page 371 of the 1952 *Handbook* and in *QST*, September, 1950.

changed to 5 turns wrapped around the cold end of L_2.

Although the converter took only a few hours to build, it has proven itself worthy of recommendation for 21-Mc. operation. In fact, the over-all performance of the converter-receiver combination is probably superior to that of any standard 21-Mc. receiver that already covers the new band.

— *Russel E. Martin, W3MFW*

SAVING BATTERY POWER IN PORTABLE RECEIVERS

A USEFUL kink that will help save precious power in portable receivers is the use of germanium diodes, such as the 1N34, to replace a 6H6 or other dual-diode tube that requires filament power. The 1N34 diodes can be placed in the circuit without disturbing the wiring of the set by the following simple method:

Take an old tube base or an octal plug, and connect the anode lead of one of the diodes to Pin 3, the negative lead to Pin 4. The other diode is connected between Pins 5 (anode) and 6. The 6H6 may then be removed from its socket and the new diode gadget substituted in its place.

This arrangement cannot be used in sets having series-parallel filament connections where the heater of the 6H6 is required to complete the circuit, but will be satisfactory in other sets. If the 6H6 is used with its two diode units in parallel, only one 1N34 will be required.

— *Charles Erwin Cohn*

MODIFIED B.F.O. CIRCUIT FOR THE SX-42

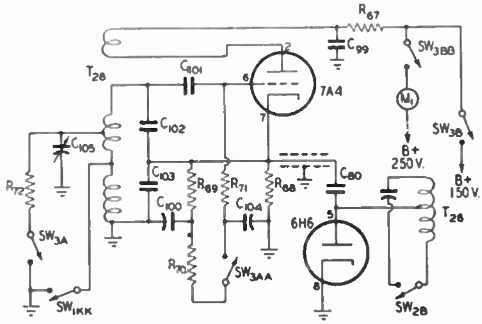
THE c.w. performance of the SX-42 receiver can be improved materially by the changes illustrated in Figs. 2-5 and 2-6. Before the modification was made, c.w. signals sounded meek and chirpy, and there was considerable "pulling" of the b.f.o. frequency when strong signals were being received. Revised methods of b.f.o. injection were tried, but none proved as effective as the change described below.

In the original circuit, a 7A4 triode serves the dual purpose of b.f.o. and f.m. tuning amplifier. The change consists of substituting a 7G7/1232 pentode for the 7A4, thereby gaining the advantages of using an electron-coupled oscillator. This resulted in less pulling, good stability, and the ability to tune through zero beat without any roughness appearing on the signal.

The physical construction of the 7G7/1232 makes rewiring the b.f.o. circuit a simple operation. The only parts needed are the tube and a 2.5-mh. r.f. choke. No test equipment is needed, and the only readjustment necessary is that of the b.f.o. transformer. The change in no way impairs the functioning of the tuning-indicator circuit.

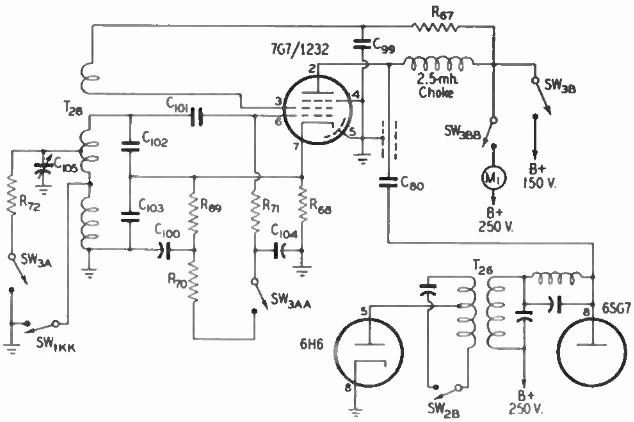
A step-by-step procedure for making the change is as follows: (1) Remove the two wires from Tie Pin 3 of the 7A4 socket. Do not disconnect the wires from each other. (2) Disconnect one end of the b.f.o. coupling capacitor, C_{80}, from Pin 5 of the 6H6 a.m. detector. (3) Connect the loose end of the b.f.o. coupling capacitor, C_{80}, to Pin 8 of the 6SG7 second i.f. amplifier with a short piece of wire. (4) Remove wire from Pin 2 and solder it to Pin 3 of the 7A4 socket. (5) Remove the C_{80} shielded lead from Pin 7 of the 7A4 socket and solder it to Pin 2. (6) Connect Pins 4 and 5 of the 7A4 socket to ground. (7) Connect the 2.5-mh. choke between Pin 2 of the 7A4 socket and the B-plus side of resistor R_{67}. (8) Insert the 7G7/1232 in place of the 7A4, set the "Reception" control to a.m., and tune the receiver to a carrier. (9) Set the c.w. "Pitch" control to zero, set the "Reception" control to c.w., and set a.v.c. switch to "Off." (10) Retune the b.f.o. transformer for proper zero beat by adjusting the tuning slug on top of T_{28}, b.f.o. transformer.

— *Lt. Wilfred N. Caron, USAF*



ORIGINAL CIRCUIT

Fig. 2-5 — The original circuit of the combined b.f.o. f.m. tuning indicator circuit in the SX-42.



IMPROVED CIRCUIT

Fig. 2-6 — Revised b.f.o.-f.m. tuning circuit in the SX-42. An electron-coupled oscillator circuit is substituted for the original triode oscillator. Wiring changes are much simpler than the diagram makes them look. The only added part is the 2.5-mh. r.f. choke. Symbol designations shown are taken from the original diagram.

ADDING AUDIO SELECTIVITY BY MECHANICAL MEANS

The gadgets shown in Fig. 2-7 attack the selectivity problem from an unusual angle, in the sound reproducer itself.

The arrangement shown in sketch A might be termed "A Soft Speaker," for it utilizes a hearing-aid type receiver found in some varieties of war-surplus headphones. A closed-tube resonator is coupled to the receiver, forming a tiny folded horn. Suitable steps should already be incorporated in the receiver audio circuits to maximize the beat note that is most pleasing to the operator. The length of the tube should then be cut to form a resonant air column at this frequency. The resultant build-up in signal at resonance is sufficient to make copying c.w. possible in a reasonably quiet room. Other signals are attenuated, aiding materially when severe QRM is present.

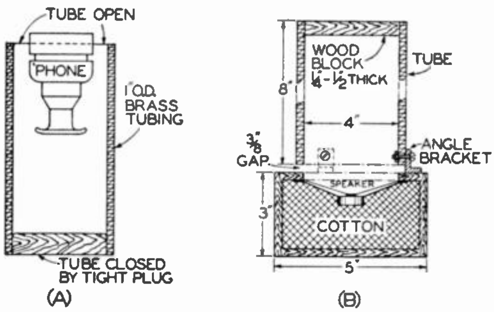


Fig. 2-7 — Two methods of adding further audio selectivity are shown here. Both are extensions of the same principles involved in adding selectivity by means of the Q5-er and other sharp i.f. systems, but attack the problem from the mechanical side.

If you are mathematically inclined, you can compute your own dimensions from simple physical formulae, but a resonator constructed of 1-inch o.d. brass tubing 1¾ inches deep has been found generally satisfactory. A simple refinement would be to install a variable plug in the bottom of the tube so that tuning could be varied at will. If a rather low beat note is chosen it is possible to zero-beat out some adjacent channel signals while still retaining the air-amplification of the desired signal.

— *William Bruce Cameron*

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Shown in sketch B of Fig. 2-7 is a simple resonant 'speaker system which forms an effective tone filter for the reception of c.w. signals under conditions of severe QRM. It consists of a loudspeaker closely coupled to a sealed resonant tube which acts as an attenuator for all except the frequency at which it is resonant. As a result, the bandwidth of the audio system is greatly reduced.

The construction and method of assembly are shown in the drawing. A 3-inch diameter speaker is mounted as shown in a wooden box in which the only aperture is closed off by the cone of the 'speaker itself. The interior of the box is packed with cotton to avoid unwanted box resonances. Care should be taken to avoid overpacking or the cone will not vibrate.

A tube, 8 inches long and 4 inches in diameter, is sealed at one end and mounted over the 'speaker by means of three equally-spaced angle brackets. The open end of the tube should be raised ⅜ inch from the face of the box. The tube itself can be made of stiff cardboard or any other material that will not produce unwanted resonance due to its composition. In operation, the "filter" produces a marked reduction in background noise, and has the property of making most signals sound "pure" in tone. The absence of any ringing effect is useful when weak signals are being copied, since their mark-space characteristics are not altered.

— *R. Young, G3BTP*
(R.S.G.B. Bulletin, Feb., 1952)

AUDIO-FILTER CONNECTION

An audio filter is a very useful addition to most receivers, but many of us hesitate to install one because it usually means that we have to dig into the wiring. If your receiver is equipped with a phonograph input jack, an audio filter may be connected without need for revamping the wiring of the receiver, and without impairing the original function of the phono input jack.

To connect the audio filter, substitute a three-circuit jack for the two-circuit unit usually used. The connections are made as shown in Fig. 2-8.

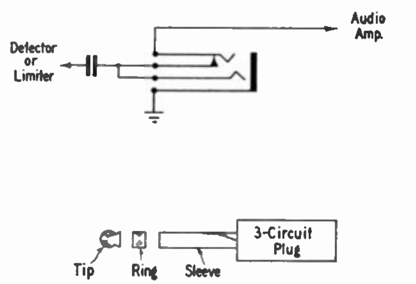


Fig. 2-8 — Simple method of connecting an audio filter to a receiver with a minimum of effort. In the arrangement shown, the tip connection on the plug goes to the input to the audio amplifier, the ring to the input of the audio filter, and the sleeve to ground.

This slight modification is so easy to make that none need hesitate to attempt it. Both the FL8A and "Selectoject" types of filters can be used with this connection.

— *C. Ray Wagner, W2FEN*

HUM REDUCTION IN THE HQ-129-X

A rather high hum level in my HQ-129-X receiver was cured by the simple expedient of rotating the output transformer 90 degrees so that its core was no longer parallel to that of the power transformer.

Only two small holes for mounting the transformer need be drilled. The leads will still pass through the original set of holes.

— *William E. Buehrle, jr., WØGUN*

SIMPLE AUDIO LIMITER

An effective noise limiter that can be installed in almost any receiver in a few minutes' time consists of a pair of 1N34A germanium crystals connected across the secondary of the last i.f. transformer. The crystals should be connected in parallel with opposing polarity. Clipping depth for the system is adjusted by the r.f. gain control of the receiver.

I use the system principally as an "ear-saver" on break-in c.w., but it also performs effectively on 'phone signals. One of the nicest features is that it can usually be installed without necessitating the removal of i.f. cans or other components.

— *Ralph W. Stewart, W6KIR*

A LOW-COST AUDIO FILTER

This unit is not intended for the amateur who is already using selective audio for c.w. reception, but rather for one who has considered building an audio filter but has put it off because he thinks a satisfactory audio filter is (a) too complicated, (b) too expensive, or (c) too time-consuming a project.

The most convenient filter is one that requires connections only to the audio output of the receiver; this means no power connections and therefore no tubes. In addition, for the most usable selectivity in c.w. work, the response curve of the filter should be reasonably broad at maximum, with steep skirts, as opposed to one that is sharply peaked. These requirements naturally sound like a bandpass filter, and a good bandpass filter suggests expensive high-Q toroidal inductors. I decided to see what could be done, junk-box style, with ordinary power-supply chokes.

Considerable experimenting with two such chokes and a handful of assorted capacitors led to the arrangement shown in Fig. 2-9. The circuit was designed to operate from the 4000-ohm output of a BC-348 receiver into a pair of headphones of 15,000 ohms impedance. Other impedance levels may require coupling transformers or a different design. The s.p.d.t. toggle switch by-passes the filter for normal reception. Fig. 2-10 is a graph of the measured transmission loss, plotted in db. *versus* frequency. With the filter connected in the output of a BC-348 receiver, it is difficult to determine whether the crystal is in or not; although the crystal selectivity of the BC-348 is not extremely sharp, this test gives some idea of the effective audio selectivity of the filter.

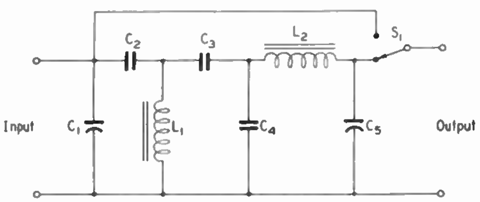


Fig. 2-9 — Circuit diagram of the audio filter.

C_1 — 0.1-μfd. paper.
C_2 — 0.01-μfd. mica.
C_3 — 0.0015-μfd. mica.
C_4 — 0.015-μfd. mica.
C_5 — 0.05-μfd. paper.
L_1, L_2 — 6.5-henry choke (Thordarson T-20C52).
S_1 — S.p.d.t. toggle.

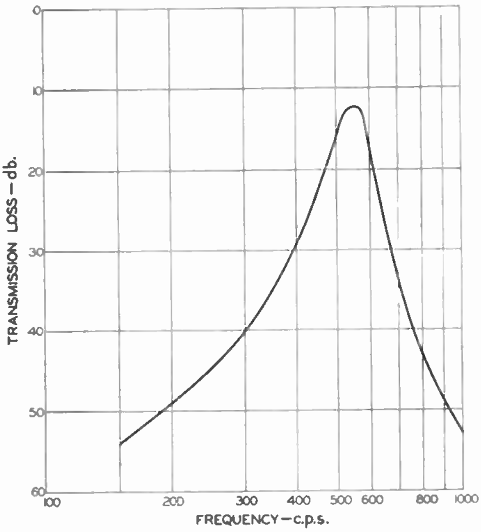


Fig. 2-10 — Selectivity curve of the audio filter.

The peak of the filter response occurs at 550 cycles. This frequency was chosen after operating for an hour one evening with a surplus FL8A filter. I may be alone in this, but a filter with a peak frequency as high as 1000 cycles conditions my ears to the point of hearing signals with the receiver turned off.

One precaution should be observed in building the filter. Even nominally identical chokes differ in inductance because of manufacturing variations, and to obtain the best selectivity the two capacitively-coupled sections should be tuned to the same frequency by adjusting C_2 or C_4. A suitable procedure is to connect the filter in the receiver output, tune in an unmodulated carrier with the receiver c.w. oscillator turned on, and rock the receiver tuning back and forth while trying slightly different values of either C_2 or C_4. A size will be found that will give the sharpest selectivity and the strongest tone at maximum. If either C_2 or C_4 is far from the correct value, it will be possible to detect two definite peaks. In addition, C_2 and C_4 may be increased or decreased slightly to shift the peak frequency to individual taste.

There is nothing special about the particular chokes listed here; measured on an impedance bridge, they had an inductance of about 6.5 henrys and a Q of about 12 at 1000 cycles, but half a dozen other filter chokes tested were found to have similar characteristics. Above all, the audio filter can be built and adjusted in an evening, without recourse to anything but the junk box.

— *G. Franklin Montgomery, W3FQB*

DIRECT-READING DIAL FOR THE HRO

Many hams find it inconvenient to have to refer to the calibration charts supplied with the coils of the HRO receiver. Shown in the sketch of Fig. 2-11 is a method of applying a direct-reading calibrated scale to the flange of the HRO dial.

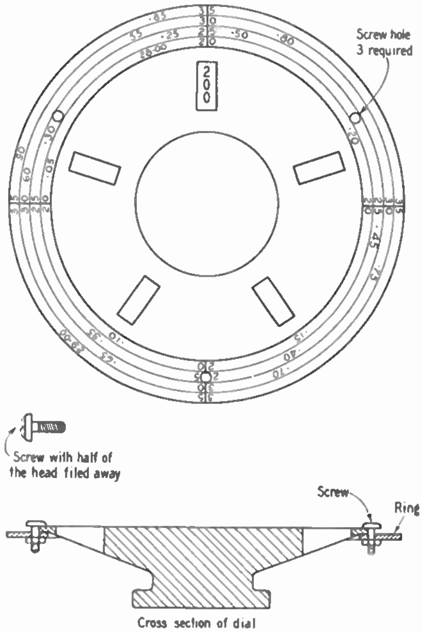


Fig. 2-11 — Novel direct-reading calibrated scale for attachment to the HRO dial.

A cardboard or lucite circle, slightly larger than the dial, is pierced with a hole that is just slightly less in diameter than the dial. Four concentric circles are then scribed as shown in the drawing. It usually takes about four complete revolutions of the dial to cover a given amateur band with this receiver, thus one circle is available to carry the calibration for each revolution.

Key figures to indicate which of the various circles applies for a given dial setting are lettered on the ring in contrasting color. Any arbitrary system may be chosen. In the one illustrated, the numbers 20, 25, 30, and 35, lettered at 90-degree intervals around each of the four circles, are used. These correspond to dial readings of 200, 250, 300, and 350 respectively.

Thus, in tuning over the range from 28 Mc. to 29.6 Mc., the calibration data are lettered in the first circle until the dial has been turned through 360 degrees. For the second dial revolution, the calibration is lettered in the *second* circle, and the key figure, obtained from the numerical dial reading at the start of the second revolution, is made to correspond. The same process is extended through the entire range.

Separate scales may be made for each amateur band. They are attached to the dial by three screws as shown in the drawings.

— *Kenneth M. Sen, LU3EJ*

BROADCAST COILS FOR THE HRO-50

Broadcast-band coils from earlier model HRO receivers can be used in the new HRO-50, but only after a slight mechanical modification has been performed. Trying to use the old coils without the modification described below is to be avoided, because they cannot be inserted in the HRO-50 without using force which may crack the ceramic brush board in the receiver.

Fortunately, the modification is simple to perform, as follows: (1) Remove the shield cans from the old coil set. These come off when the screws holding them are loosened. It is not necessary to remove the screws entirely. (2) Remove the three screws holding each of the coil assemblies in the shield. (3) Place one external (star) lock washer, such as General Cement No. 7350-E, between the coil assembly and the shield, under each of the three screws. These will act as spacers and will lower the contact points on the coil assembly enough to permit its safe use in the HRO-50. (4) Reassemble the coil units, first tightening the three screws holding the coil assemblies inside the shield, and then replace the shield. (5) Place the coils in the receiver and realign according to the instructions in the operating manual.

— *Lieut. John H. Parrott, jr., W5QOQ*

SUBBAND MARKINGS FOR HRO COILS

Markings which indicate the limits of the various amateur subbands can be easily added to coil assemblies such as those used with my HRO-7 receiver. Along the bottoms of the face plates for these coils there is a space, ½ inch wide by the length of the plate, occupied by the words "Band Spread." Take a piece of ½-inch white adhesive tape having a surface texture that will take ink or pencil and apply it to this area. Now, mark off the edges of the subbands to line up with the slide-rule calibration just above. In addition to the markings which indicate the frequency limits of the c.w., 'phone and Novice sections of a band, there is ample room on the tape for listing the type of service permitted, A1, A3, n.f.m., etc.

— *Harry Engwicht, W6HC*

SELENIUM-RECTIFIER AUDIO LIMITER

Change-over relay clicks, extra-loud heterodyne howls, etc., are deadened at the output of the HRO here at W1BDF by an extremely simple limiter consisting of nothing more than a pair of 115-volt 60-ma. selenium rectifiers. The rectifiers are connected in parallel with opposing polarity and this combination is in turn tied across the 500-ohm output terminals of the receiver. The 'speaker is connected to the 8-ohm terminals of the output strip.

— *Edgar Seeler, W1BDF*

CRYSTAL-FILTER CIRCUIT

The circuit shown in Fig. 2-12 has been in use here to provide a flat response between two crystal frequencies. It is an adaptation of the

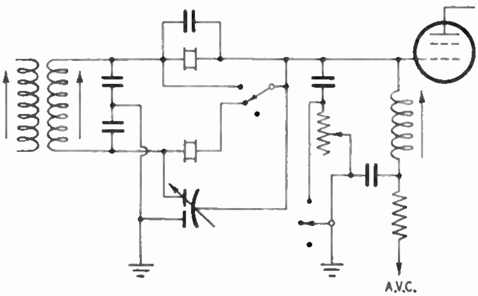


Fig. 2-12 — Crystal-filter circuit used at W3IUF. A modification of the Hammarlund filter, it permits a wide range of adjustment with two crystals.

Hammarlund SP type filter. A variable resistor in the tuned output circuit is used to adjust the shape of the "nose" of the response curve. It can be made to show double-peaked response by increasing the resistance in the circuit. With the resistor in the zero position, the resulting curve has a rounded top, provided the circuit is tuned to the center frequency. Otherwise, double peaks of unequal amplitude are obtained.

The original selectivity switch was modified to permit switching one or both crystals out of the circuit. Use of a.v.c. does not appear to change the response characteristics through Miller-effect detuning.

It should be pointed out that conventional i.f. crystals are not suited for this application unless they are damped in some way. An exception is where the circuit is to be used for c.w. alone, when the resonant frequencies of the crystals are separated by only a few hundred cycles.

— *Harold M. Nickel, W3IUF*

SIMPLE CRYSTAL MARKER OSCILLATOR

Many present-day communications receivers use two tuning dials, one to set the range and the other for bandspread tuning. Before the calibration on the bandspread dial is usable, the main tuning dial must be set accurately. A crystal-controlled marker oscillator is about the best way to do this. The circuit shown in Fig. 2-13 is ideal for this purpose, because it can be built right into most receivers and turned on or off at will by a toggle switch mounted on the front panel.

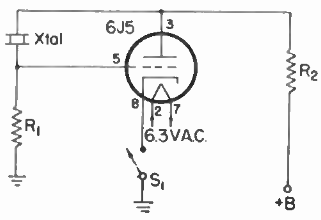


Fig. 2-13 — A marker oscillator that can be added to any receiver to provide a convenient way to set the main tuning dial to the right spot so that the calibration of the bandspread dial will be accurate. The value of R_1 is 27,000 ohms, R_2 is 0.1 megohm, and S_1 is a s.p.s.t. toggle switch.

The 3.5-Mc. crystal found in some of the SCR-274N transmitters makes a good crystal for use in the circuit, although any 3.5-Mc. unit is usable. The fundamental and harmonics of the oscillator make it usable as a band-edge marker for all bands through 28 Mc.

— *Myron C. Pogue, W7FKO*

IMPROVED TUNING RATE FOR THE SX-43

When both a Q5-er and a sharp audio filter such as the FL8A are used with an SX-43 receiver, tuning becomes quite difficult because the tuning rate is too fast, especially in reception in the 40-meter band. There is a simple way to ease this situation. First set up a marker oscillator of some kind on 7 Mc. (your transmitter VFO should be satisfactory). Then set the bandswitch to position "3A" instead of "3." Now set the bandspread dial to 7 Mc., as indicated by the dial marking. Tune in the marker signal with the main tuning dial, and then leave this dial alone, doing all further tuning with the bandspread dial. When set for 40-meter reception in this fashion, full rotation of the bandspread dial will cover only about 60 kc., giving a change of only 1200 cycles per dial division as compared to 10 kc. per division when the bandswitch is set to position "3." With this slow tuning rate the full benefits of the added selectivity gained through the Q5-er and the audio filter can really be appreciated.

— *R. S. Palmer, W4MFI*

INEXPENSIVE 455-KC. I.F. FOR SURPLUS RECEIVERS

I have a suggestion for owners of surplus receivers who would like to obtain better selectivity at low cost. I would like to point out, though, that the increased selectivity is not anywhere near that obtained using a BC-453 receiver as a Q5-er.

With the advent of TV, many homeowners have large b.c. receivers that they no longer use and would be glad to part with for little or no cost. Quite a few of these receivers, like the one in use here, are large general-coverage sets with an r.f. stage, several i.f. stages and pretty good selectivity.

If the i.f. from the communications receiver is fed into the b.c. set either at the antenna terminals or at the mixer grid, the conversion to the lower i.f., usually 455 kc., gives quite an improvement in selectivity. This is, of course, assuming that the b.c. set will tune to the i.f. of the surplus receiver.

The hook-up used here consists of taking the signal from the third i.f. of a BC-348 and feeding it, through shielded wire, into the mixer grid of a Sparton model 1068 receiver. The only modifications to the Sparton were the addition of a 0.1-megohm resistor from the mixer grid to ground (this was necessary because the r.f. stage is not used), the installation of a closed circuit jack between the first audio and output for headphones, and the addition of a b.f.o. stage.

I realize that this is not a new or novel idea. It was suggested to me by W3PID who uses a similar set-up.

— *Gordon R. Rugg, W3TXY*

IMPROVED CIRCUIT FOR HOMEMADE S-METERS

S-METER circuits that work on the plate or screen current of one or more variable-μ tubes have the disadvantage that the meter readings are not linear in terms of decibels. This is because of the shape of the plate- or screen-current curve as the grid bias is varied. At small grid biases the slope is large and the meter is "sensitive," but at some

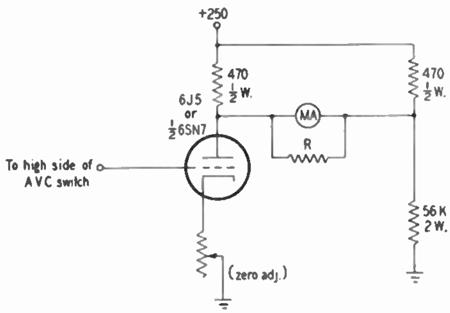


Fig. 2-14 — Circuit for an improved homemade S-meter.

fairly critical value of grid voltage, depending on the tube type, the slope becomes low and further increases in grid bias make very little change in plate current. The needle "hits a stone wall" at the signal level that represents about S9 in the average receiver.

The bias voltage developed by the a.v.c. circuit is approximately a logarithmic function of the input signal voltage, and if it is applied to a tube whose plate current is directly proportional to the grid voltage a meter in the plate circuit will read according to a linear decibel scale. This system is used in at least one manufactured receiver but for clockwise indications requires a d.c. meter with a reversed movement.

The circuit of Fig. 2-14 gives substantially the same results with the conventional meter movement. It uses the familiar bridge arrangement with a triode meter tube. The tube operates as a degenerative d.c. amplifier with the a.v.c. voltage applied to its grid. The reference current flows through the 56,000-ohm resistor and is slightly under 5 ma. with a 250-volt plate supply. A meter range of 0–1 or 0–2 ma. is satisfactory.

To adjust the system, pull the meter tube out of its socket or otherwise break the plate-cathode circuit so no plate current flows, and adjust the value of the resistor *R* across the meter until the scale reading is maximum. The value of resistance required will depend on the internal resistance of the meter, and must be determined by trial and error (the current is approximately 2.5 ma.). Then replace the meter tube, allow it to warm up, turn the a.v.c. switch to "off" so the grid is shorted to ground, and adjust the variable resistor (3000 ohms) for zero meter current. When the a.v.c. is "on," the meter will follow the signal variations up to the point where the voltage is high enough to cut off the meter tube's plate current. This will occur in the neighborhood of 15 volts with a 6J5 or 6SN7GT, and represents a rather high-amplitude signal.

The bridge circuit, while not exactly linear, is quite satisfactory from a practical standpoint. It will handle a signal range of well over 80 db. The meter cannot be "pinned," because the maximum reading occurs when the tube plate current is driven to zero, at which point further increases in a.v.c. bias cause no change.

— *George Grammer, W1DF*

S-METER CIRCUIT FOR BOTH A.M. AND S.S.B. SIGNALS

FEW amateur-type receivers provide for use of the S-meter when the set is tuned to an s.s.b. signal. Fortunately, this deficiency can usually be easily overcome by switching the indicator over to the audio circuit during s.s.b. reception. Fig. 2-15 shows how the arrangement has been applied to a National type NC-183D receiver.

In the modified circuit, the S-meter terminals are connected to the center arms of a d.p.d.t. toggle switch, S_1. When this new control is set at the "r.f." position, it ties the meter back into the original indicator circuit. When the switch is flipped to the "a.f." position, it connects the meter to the output terminals of an instrument-type full-wave copper-oxide rectifier. The input side of the rectifier is connected in series with a calibration potentiometer, R_2, and the secondary of the output transformer, T_1. Naturally, the 'speaker-transformer connections do not have to be disturbed when the modification is being made.

If the receiver on hand does not employ a shunt across the S-meter, it will be necessary to

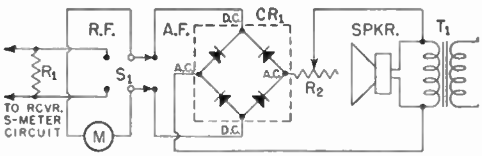


Fig. 2-15 — Circuit diagram for the a.m.-s.s.b. S-meter.
R_1 — 1000 to 2000 ohms; see text.
R_2 — 2500-ohm potentiometer.
CR_1 — Instrument rectifier.
M — Original S-meter.
S_1 — D.p.d.t. toggle switch.
T_1 — Receiver transformer.

add R_1 of Fig. 2-15 to the original indicator circuit. This resistor prevents the a.m.-indicator circuit from opening up whenever the meter is switched over to the s.s.b. position.

A calibration for the s.s.b. S-meter can be made most easily by comparing its readings with those obtained on a general-purpose test meter. Most of the latter have scales that are directly calibrated in terms of decibels.

— *Wayne W. Cooper, YN1WC/W6EWC*

3. Hints and Kinks . . .

for the Transmitter

HOMEMADE TURNS COUNTER

A simple and inexpensive turns counter that may be used with roller-type inductors is shown in Fig. 3-1. The assembly counts tenths of turns as well as full revolutions and can be put together for less than two dollars.

The heart of the unit is a mileage reel salvaged from an automobile speedometer. The reel is bolted to the control panel just to the rear of a rectangular viewing slot. A panel-bearing assembly, mounted below the reel, is used as a direct drive for the roller inductor and as the drive shaft for the counter. The drive shaft is coupled to the reel pulley by means of a dial belt (the type used in b.c. receivers). Tape is wound around the drive shaft to build it up to the diameter of the reel pulley. Naturally, this "build-up" is essential if the counter is to register an exact number of turns. However, the unit will give an arbitrary scale for logging regardless of the drive ratio.

—*Raymond C. Cotton, W1BTY*

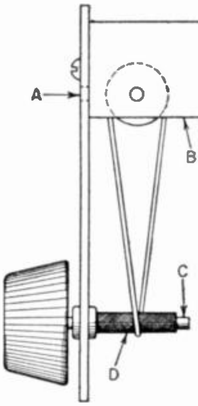


Fig. 3-1 — Drawing of the homemade turns counter. *A*, *B*, *C* and *D* are the viewing slot, mileage reel, panel-bearing assembly and tape "build-up," respectively.

BANDSPREAD FOR THE VFX-680

Owners of the Sonar VFX-680 exciter and n.f.m. modulator may add much-needed bandspread simply and inexpensively by attaching the grid-tuner vernier drive from one of the tuning units for the BC-375 aircraft transmitter, available in surplus. No modification of the exciter is required.

Make up a "U"-shaped bracket 1 7/8 inches long and fasten one end under the cap screw at the lower right end of the exciter panel; the other end matches an existing tapped hole on the vernier and the shafts are then joined by a standard 5/8-inch-long coupler for 1/4-inch shafts. Attachment or removal requires only a few minutes. A chart may then be prepared showing the frequencies at various dial settings across several hundred easily-read dial divisions (200 for the 14-Mc. band) with excellent reset accuracy and minimum back-lash.

— *Fred W. Kinsey, W9DOQ*

TWO-BAND PI NETWORK

A simple method of switching a pi network for two-band operation is shown in Fig. 3-2. Constants shown are for operation on 7 and 14 Mc., but the same principle can be applied to any two adjacent bands. In this particular circuit, the effective inductance is 4 μh. and the capacitance is 600 μμfd. with the control switch, S_1, set at the 7-Mc. position. At 14 Mc., the inductance and capacitance are reduced to 2 μh. and 300 μμfd., respectively.

— *Capt. R. R. Hay, USN, W4LW*

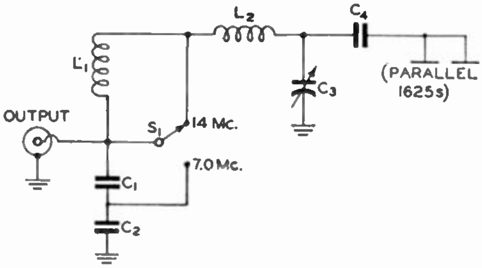


Fig. 3-2 — Circuit diagram of the two-band pi network.
C_1, C_2 — 600-μμfd. mica.
C_3 — Plate tuning capacitor.
C_4 — 200-μμfd. mica.
L_1, L_2 — 2 μh.
S_1 — S.p.d.t. low-loss switch.

PROTECTIVE SWITCHING SYSTEM

The circuit shown in Fig. 3-3 eliminates the possibility of applying plate voltage to a transmitter before the filaments are lighted, a common hazard in most transmitter control systems.

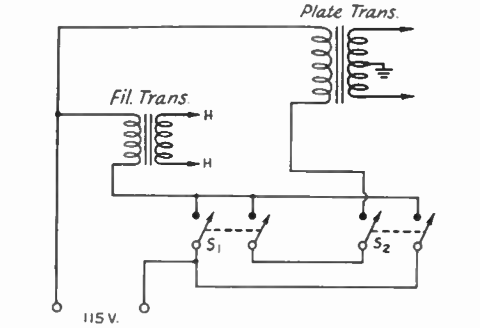


Fig. 3-3 — A novel switching system for the low-power rig. No matter which switch is thrown first, the filaments come on, and the second switch will then turn on the plate supply. S_1 and S_2 are double-pole single-throw toggle switches.

With the connections shown the filament transformer is energized, no matter which switch is thrown first. Whichever switch is thrown second will apply plate voltage. In the reverse operation, the first switch thrown OFF will turn off plate voltage, the second will turn off filament voltage.

— *R. L. Baldwin, W1IKE*

NEUTRALIZING KINK FOR 813s

Class C amplifiers are usually rather easy to neutralize, but in some cases, such as the use of 813s in push-pull, the situation sometimes becomes more complicated. Attempting to use these tubes in a Class B linear stage, I found it very difficult to neutralize them by ordinary means.

After reviewing various neutralizing methods, I hit upon the scheme shown in Fig. 3-4. It has worked out to perfection in my case, and may be useful to others.

My grid coil was coupled to the buffer stage by means of a coaxial line, and the output tank was coupled to a balanced 300-ohm line. I connected the output link to the stator plates of a differential-type butterfly condenser of 100 μμfd. per section as shown. The rotor was then connected to the inner conductor of the coaxial line in the grid circuit. Adjusting this condenser completely neutralized the stage for me, and it is now as stable as a rock. To be used as a Class B linear stage it has to be!

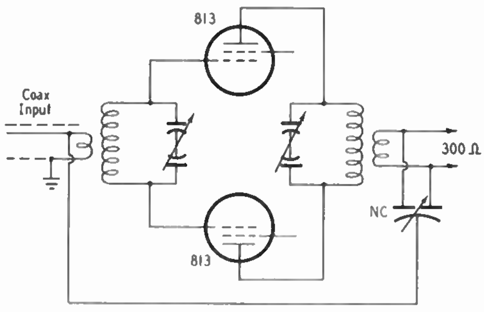


Fig. 3-4 — Neutralizing system for push-pull linear 813s. A butterfly condenser is connected across the output link, and some of the voltage is then fed back to the grid. The position of the condenser determines the phase relationship and amplitude of the voltage fed back.

— *Ward Jensen, WØTLE*

ALL-BAND NEUTRALIZATION FOR BEAM TETRODES

The purpose served by the circuit arrangement shown in Fig. 3-5 is to provide complete and noncritical neutralization of a single-ended beam-tube final amplifier on all bands (1.8 through 30 Mc. in my case).

A standard 5-prong plug-in coil is modified slightly so that the tank circuit itself includes two-thirds of the original winding (you usually have to *remove* turns) and the remaining third is used to obtain a little out-of-phase r.f. for the grid circuit. A small 3- to 30-μμfd. compression-type trimmer is mounted on the plug-in coil, connected as shown, to provide the adjustment needed. Thus, just the right neutralizing adjustment for each band is automatically established when the coil is plugged in. Perfect stability is obtained on each band, a real bonus when one wants to preserve a soft keying characteristic developed in a preceding stage.

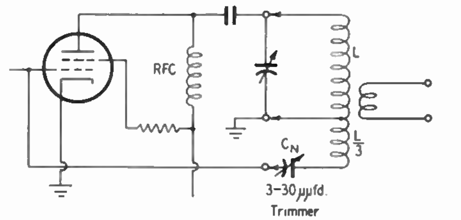


Fig. 3-5 — Simple plug-in neutralizing condenser arrangement for beam-tube amplifiers.

Triode stages, being less power-sensitive, probably do not need this treatment, as one setting of a single neutralizing condenser is usually adequate over the entire frequency range of the transmitter, but as anyone who has built a beam-tube amplifier will agree, it is mighty tricky to come out with maximum stability on all bands with only one neutralizing adjustment. The system shown here sidesteps the problem neatly, and has been used on a parallel-6L6 final stage with very gratifying results.

— *Rod H. Newkirk, W1VMW*

COMBINATION PLATE BY-PASS AND NEUTRALIZING CAPACITOR

A tubular plate by-pass capacitor used in an r.f. amplifier to provide a shorter return path for r.f. to cathode or ground has proved its worth. In most amplifiers a neutralizing capacitor is also required. Why not combine the two?

Fig. 3-6 shows how this type of capacitor can be made of thin-wall copper tubing. The outer section is an 8-inch length of 1¼-inch tubing fastened at one end directly to the chassis. The inner tube is a 7½-inch length of ⅝-inch tubing held concentric within the outer tube by an insulating spacer at the top end and by a beehive insulator at the lower end. The inner conductor is a length of No. 10 hard-drawn copper wire which slides

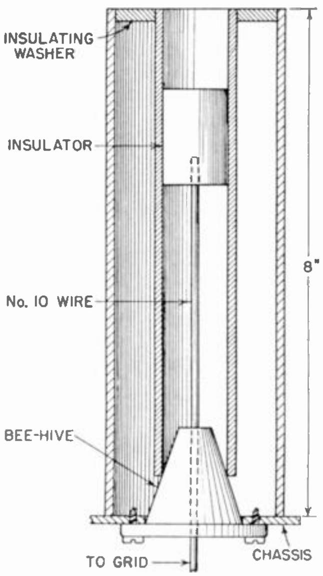


Fig. 3-6 — Combination plate by-pass and neutralizing capacitor used by W1CRU.

through the hole in the beehive insulator and is held centered in the ⅝-inch tubing by a porcelain pillar insulator cemented to the wire's top end.

The beehive insulator projects up through a hole punched in the chassis and is fastened to the chassis by self-tapping sheet-metal screws from the bottom.

Under the chassis the inner wire is held by a small copper alligator clip which is fastened to the grid wire coming from the opposite tube socket. Neutralizing adjustments are made by sliding the wire in or out of the plate or inner tube. After the amplifier is neutralized the extra length of the inner wire showing beyond the clip at the bottom can be clipped off, leaving an inch or so for future adjustments.

— *George D. Littlefield, W1CRU*

CURE FOR "TALK-BACK" IN THE BC-610

In most instances where serious "chatter" or "talk-back" is experienced when the BC-610 is used on 'phone, the trouble is caused by the overload relay, *RY-5*, and not by the modulation transformer, as is commonly supposed. The cure is effected by connecting a large capacity, 30 to 50 μfd., across the relay. This may be done simply by connecting the condenser, which should be rated at 150 volts or more, from the center tap of *T-6* to ground.

— *J. K. Hall, jr., W4KCT*

QUIET OPERATION OF RELAYS

The clank and clatter of relays is both annoying and unnecessary. Most of the noise can be eliminated by the simple, effective method of mounting described below.

The relay is mounted on a strip of discarded carpeting about 5/16 inch thick and somewhat larger than the bakelite base of the relay. Mount the relay equidistant from all edges of the carpeting by passing machine screws, with flat washers next to the heads, through the carpeting and the relay base so that the nuts and the lock washers will be against the base. Now take a second piece of carpeting the same size as the first and place it against the back of the assembly, sandwiching the heads of the machine screws between the two pieces.

To fasten the unit to a chassis, cut two strips of aluminum about ½ inch wide and long enough to cover the full width of the carpeting, and use them as hold-down plates, one at each end of the carpeting. Pass machine screws through the aluminum strip, the two layers of carpeting, and the chassis.

As an example of the effectiveness of this system of mounting the writer uses two keying relays mounted in a metal box. They cannot be heard when wearing earphones, even though they are only a couple of feet away.

— *Rev. Joseph A. Terstegge, W9LQE*

MORE ABOUT THE GRID-PLATE OSCILLATOR

Since the Petersen Radio Co. presented the circuit of the grid-plate oscillator in an advertisement that appeared in *QST* for June, 1951, the oscillator has become extremely popular. However, some of the fellows have experienced difficulty in making the performance of the circuit live up to their expectations. Perhaps the following detailed report of my own experiences with the oscillator will be of assistance to many amateurs.

In the circuit referred to above, C_1 and C_2 are the grid-to-cathode and the cathode-to-ground capacitors, respectively. It has been found that the ratio of C_1 to C_2, and also the total capacitance of the two in series, are fairly critical. If C_1 is too large, the crystal current will be high and the harmonic output will be low. If C_2 is too large the output will drop off, and if it is too small the crystal current will be excessive and the circuit will continue to oscillate when the crystal is removed.

The circuit, as shown in *QST*, is designed around a Type 6AG7 tube. Substitution of a different type of tube will require a different value of total capacitance or a different ratio of C_1 to C_2. In some cases both the total capacitance and the ratio must be changed. To obtain both maximum harmonic output and minimum crystal current for a particular crystal-tube combination, it is advisable to use variable capacitors for the feed-back divider. A 3–30-μμfd. trimmer may be used for C_1, and C_2 should have a capacitance of

100 $\mu\mu$fd. or more. Ceramic trimmers may be used but their power factor is rather high.

When adjusting the circuit, start with both capacitors at minimum capacitance and the crystal removed from the oscillator. The circuit will oscillate under these conditions and the capacitance of C_2 should be increased until oscillation stops. Now, with the crystal inserted and the plate circuit (C_4L_1) tuned to the third or fourth harmonic, adjust C_1 for a setting that gives maximum output along with minimum crystal current. A slight readjustment of both C_2 and C_1, in that order, will probably increase the output and decrease the crystal current.

The use of an r.f. choke in series with the grid-leak will reduce the loading on the crystal and may improve the activity of sluggish crystals. The grid choke should have a different inductance value than that of the plate choke (RFC_2) to avoid low-frequency parasitics.

A second look at the grid-plate circuit will show that it is nothing but a Colpitts with the crystal replacing the usual tank coil. If the crystal is replaced with a coil, preferably slug-tuned, and a blocking capacitor is inserted to prevent shorting out the grid-leak, this circuit will operate as a Colpitts with frequency stability determined by the *LC* ratio of the new inductor and the effective capacitance of the series-connected feed-back capacitors. This provides a handy way of hitting a frequency for which a crystal is not available.

— *Richard B. Jeffrey, W8GDC*

[Editor's Note: Additional data pertaining to the keying of the grid-plate circuit are presented in "Crystal-Controlled Oscillators," *QST*, March, 1950.]

HOMEBUILT SHIELDED LINK

It is a simple task to build your own shielded link from the shield braid removed from a short length of coaxial cable, as shown in Fig. 3-7. First cut a length of braid to correspond to

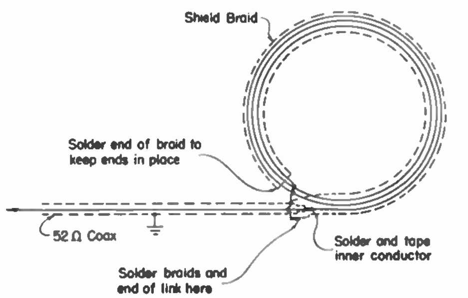


Fig. 3-7 — W9MUR's method of making shielded links. Note that one end of the shield braid is left "floating," while the other is soldered to the coaxial cable.

the circumference of the desired link. Remove the inner conductor and the polyethylene dielectric, and then push on the ends of the braid to make it about half as long and twice as large in diameter as it was to begin with. In this form, it is easy to thread the required number of turns of insulated wire through the braid to form the link winding.

One end of the braid can then be opened up for about ½ inch to provide means for joining it to the braid of the coaxial line that runs to the output terminal of the transmitter. One end of the insulated wire is soldered to the inner conductor of the coaxial cable, and the other end to the point where the two shield braids meet. Stretch the braid over the entire link coil and form it to the desired shape. Cover the entire unit with a winding of cellulose tape and mount it on a swinging-arm assembly.

A six-turn link constructed in this manner has been in use for 75-meter operation at W9MUR for quite some time, with excellent results.

— *Richard C. Vail, W9MUR*

COMBINED OUTPUT CONTROL AND SCREEN-PROTECTIVE CIRCUIT

By now the use of a 6Y6G or a 6V6 as a screen-protecting device in tetrode stages is well known. The circuit shown in Fig. 3-8 makes use

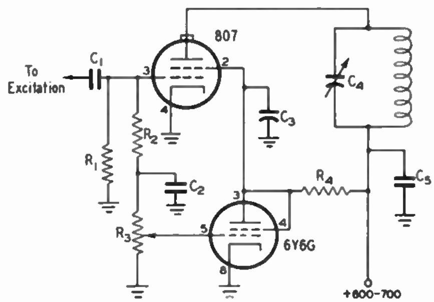


Fig. 3-8 — A combined screen-protective and output control circuit.

C_1 — Normal coupling condenser (100 $\mu\mu$fd.).
C_2 — 100-$\mu\mu$fd. mica.
C_3 — Screen by-pass (0.01 μfd.).
C_4 — Plate tank condenser.
C_5 — 0.001-μfd. mica.
R_1 — Normal grid-leak (22,000 ohms, 1 watt).
R_2 — 0.1 megohm, ½ watt.
R_3 — ½-megohm potentiometer.
R_4 — Screen resistor (50,000 ohms, 25 watts).

of this device plus the added feature of output control. It will be found most useful in cases where a tetrode, such as an 807, is used in the driver stage for a final amplifier that requires carefully-adjusted grid drive.

In operation, the 6Y6G draws maximum plate current when excitation is removed, as when the oscillator, or any earlier stage, is keyed. This reduces the screen voltage on the 807, and limits its plate dissipation. When excitation is applied, screen voltage is controlled by the potentiometer, and it can be set at whatever value is required for the amount of output needed. The potentiometer is part of a voltage divider across the bias voltage applied to the grid of the 6Y6, thus controlling the flow of plate current in the tube. If desired, the potentiometer can be set so that the 6Y6 remains cut off during periods of excitation, resulting in full output from the 807. It can also be set to permit some plate current to flow in the 6Y6 at all times, so that screen voltage is reduced slightly during key-down periods, but not to the extent that it is lowered when the key is up. The result is a really flexible control system that fits many needs for controlled output without circuit complications.

— *Ed Roller, W1ORP*

LOW-DRIFT CONDENSERS FROM BC-375-E

The low-frequency BC-375 tuning unit, TU-26B, 200–500 kc. range, contains many high-quality high-voltage mica condensers, among which are two special types having a very low temperature coefficient, especially made for use in frequency-determining tank circuits. The capacitance and temperature coefficient have been individually measured and stamped on each one. The nominal capacitance is 400 μμfd., a useful value for VFO tank circuits. In my case, it was the exact value needed, which led to inquiry about its characteristics. The answer was a pleasant surprise, since the list price is about $12 each. This is the Cornell-Dubilier type 641–15AH, the only one for which I have any information, although apparently similar ones are made by Sprague and Sangamo. Substitution of one of these tuning-unit condensers for an equal-capacitance silvered mica unit in my VFO reduced total warm-up drift from about 400 cycles to 100 cycles.

— *R. V. McGraw, W2LYH*

CAPACITANCE OF BC-375-E TUNING CONDENSERS

The following tabulation, gleaned from an obsolete U. S. Army manual, lists the capacitance ranges of various condensers found in the tuning units of the BC-375-E. The part number can be found stamped on the end plate of the condenser. The condensers are listed according to the number of the tuning unit in which they are found. Capacitances are in μμfd.

In addition, each tuning unit contains two identical neutralizing condensers. The range of these is from 26 to 19 μμfd.

— *W. E. McCormick, W5KMA*

T.U.	*Part No.*	*Max.*	*Min.*
5A	P-7761569P2	35	20
	T-7660443P6	156	20
6A	P-7761569P3	77	15
	T-7660443P1	116	19
7A	P-7761569P4	111	23
	T-7660443P2	116	19
8A	P-7761569P5	66	14
	T-7660443P7	81	15
9A	P-7761569P6	77	15
	T-7660443P3	116	19
10A	P-7761569P7	62	14
	T-7660443P4	116	19

SAFETY INTERLOCK FOR CABINET RACKS

The sketch shown in Fig. 3-9 is a simple, inexpensive method of making it impossible (or at least difficult) to open a cabinet rack without

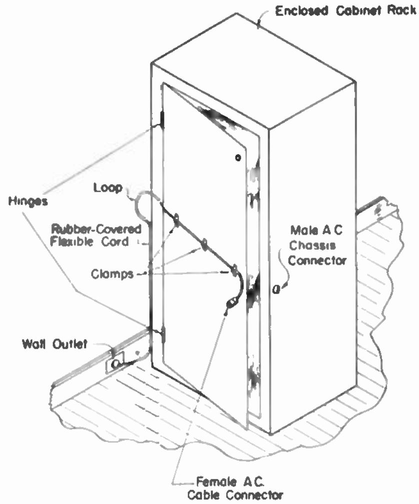


Fig. 3-9 — Here's an inexpensive interlock system devised by W2PFJ.

killing the power first. Terminate all transmitter a.c. supply leads at a male chassis connector in the side of the rack near the back, as shown. Feed this connector with a convenient length of heavy rubber-covered cord clamped across the door, with a female connector on the end of the cord. Leave only enough excess cord here to make the connection when the door is closed. The rest of the cord should be clamped down the hinged corner of the cabinet, leaving a small loop at the turn so that the door can be operated without undue flexing of the cable. It will then be impossible to open the door without first unplugging the power cord.

— *R. M. Girdler, W2PFJ*

21-MC. OUTPUT FROM THE 813 RIG

It is a very simple matter to obtain 21-Mc. output from the single-813 transmitter described in July, 1951, *QST* and in the 1952 edition of *The Radio Amateur's Handbook* (page 179). All that is needed is a new coil for the 6V6 driver plate circuit. We used 11¼ turns of No. 14 enameled wire spaced to occupy 1 inch of a 1½-inch diameter coil form (National XR-5). This coil resonates at the low end of the band with about 20 per cent of the capacity of C_8 in use, and permits the stage to be operated as a tripler from the 7-Mc. output of the 6AG7 oscillator stage.

The 813 stage uses the same coil as that specified for use at 14 Mc. It resonates at 21 Mc. with the main tuning condenser set close to the low-capacity point of its range.

— *Richard M. Smith, W1FTX*

CLAMPER-TUBE TROUBLES

Several instances of improper transmitter operation have been reported by stations using the convenient clamper-tube arrangement shown in Fig. 3-10 to eliminate the need for fixed bias in a tetrode amplifier. The operation of this circuit has been described previously.

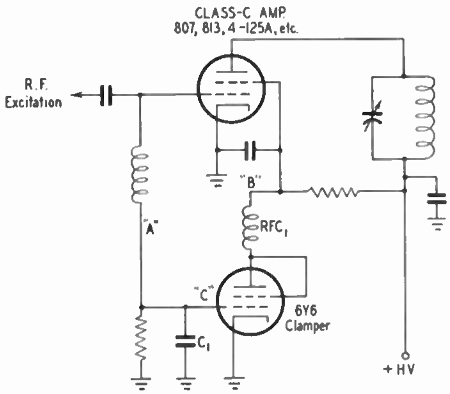


Fig. 3-10 — **Method of insuring proper operation of a "clamper" tube. A good r.f. by-pass is added at the grid of the 6Y6, and a parasitic choke is inserted in its plate lead. Leads designated "A," "B," and "C" should be kept as short as possible. The by-pass condenser C_1 should be about 470 μμfd., and the r.f. choke RFC_1 suitable for the frequency of whatever parasitic is encountered in the 6Y6 stage.**

In most cases, difficulty is encountered only when the transmitter is operated in the 28-Mc. band. The symptoms vary, but in general all may be traced directly to the presence of r.f. at the grid of the 6Y6 clamper tube. A good mica by-pass installed right at the grid of the tube as shown in Fig. 3-10 usually solves the trouble.

Less common troubles include parasitic oscillation in the 6Y6 circuit itself. The frequency is apt to be anywhere in the v.h.f. range, but in at least one case it was right in the middle of TV Channel 6, resulting in a weird case of TVI where interference was present only when the key was *open!* These parasitics yield to the usual treatment of inserting an r.f. choke such as the Ohmite Z-144 or Z-50 (depending on the frequency of the parasitic) right at the plate connection of the 6Y6. It may be significant that in cases where parasitics were encountered, the clamper tube was installed in the power-supply chassis instead of close to the amplifier tube. Thus, short leads seem to pay off again.

— *Richard M. Smith, W1FTX*

TETRODE CIRCUIT FOR CLAMPER TUBES

A space-saving and very practical idea was recently suggested by W2SGJ, using a miniature tube (6AK6, 6AQ5, etc.) connected as a tetrode in the protective circuit for a screen-grid amplifier. After trial, we can safely say that for a given tube the arrangement provides more effective clamper action than does the more commonly used low-μ triode circuit. Referring to the characteristics of a pentode or a tetrode tube, it will be seen that the plate current is more dependent on screen voltage than it is on plate voltage. Therefore, if the screen voltage of a multigrid tube is maintained as some suitable value, the normal plate current of the tube will not be too greatly affected by reduced plate voltage. Naturally, this feature is ideal for clamper-circuit operation because it means that the protective circuit will continue to draw heavily through the screen-dropping resistor even after the plate voltage (screen voltage for the r.f. amplifier) has been reduced to a very low value.

Fig. 3-11 is the schematic diagram of a clamper circuit which uses a Type 6AQ5 tube. The circuit differs from the standard low-μ triode layout in that the screen of the tube is fed from a fixed voltage source. R_1, R_2 and RFC_1 are all normal r.f. amplifier components. The voltage applied to the screen grid of the 6AQ5 may be obtained from the screen circuit of one of the exciter stages or it may be taken from the low-voltage supply through a dropping resistor. In any event, the applied voltage must be less than the value which will cause the screen-grid dissipation rating to be exceeded. A potential of approximately 130 volts appears to be maximum for the 6AQ5.

It is logical to assume that the screen-grid voltage for the tetrode clamper could be obtained from the amplifier high-voltage supply if the latter is one of the low-power jobs. If this system is employed, it may be necessary to tap the screen onto a voltage divider connected between the h.v. supply and ground. A simple series-dropping resistor may be used between the supply and the screen if the voltage does not rise too high when the clamper tube is cut off.

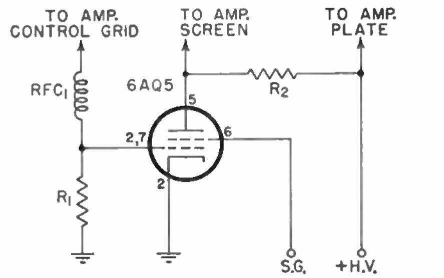


Fig. 3-11 — **Circuit diagram of the tetrode clamper using a miniature tube.**

The above circuit will be of special interest to anyone who wants to clamp a 6146 — a tough tube to hold down. The writer has used both the 6AK6 and the 6AQ5 to clamp a 6146 to 15 ma. when the amplifier was operating with 360 volts on the plate. Under the same conditions, a conventional triode clamper held the current to no less than 100 ma.

— *R. B. Hauer, W2FBA*

[Editor's Note: Here in the ARRL lab we found that the 6AQ5, operated as a tetrode clamper, will draw approximately 30 ma. plate current under the following conditions: E_p — 500 volts; plate-dropping resistor — 15,000 ohms; E_{sg} — 130 volts; I_{sg} — 13 ma.; E_{cg} — 0 volts.]

SIMPLIFIED BIAS CIRCUIT FOR CLASS-C AMPLIFIERS

The circuit shown in Fig. 3-12 is a simple means of obtaining operating bias for tubes such as the 304-TL which require relatively large bias voltage at more grid current than it is convenient to furnish through the usual small bias pack.

A tetrode, such as the 6L6 or 807, connected as a high-μ triode (both grids tied together) is used as a cathode follower. Bias voltage for the Class C stage is then obtained from the voltage drop through the cathode follower. In key-up conditions (when no grid current is being drawn by the Class C stage) the bias furnished by the small power pack keeps the final amplifier cut off, and the bias on the cathode follower is then adjusted to cut-off by means of potentiometer R_1. When the key is closed, the Class C stage draws grid

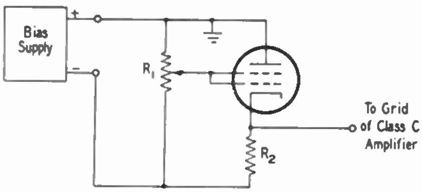


Fig. 3-12 — A simplified biasing arrangement for tubes such as the 304-TL. A cathode follower, biased to cut-off under key-up conditions, takes the place of a heavy-duty bias supply. R_1 should be a 0.5-megohm potentiometer, and R_2 about 0.25 megohm.

current through the cathode follower, which must be rated to handle the power consumed in the grid circuit (grid current × bias voltage). In my own application, the 304-TL runs at a kw. input, with 90 ma. grid current and −280 volts bias. Two 6L6s in parallel handle this situation nicely.

The supply voltage must be greater than the bias required by an amount sufficient to bias the cathode follower to near cut-off under key-up conditions. When the key is closed the output voltage will change by the amount of change in the cathode-follower bias necessary to pass the load current, but the drain on the supply is very small, being about 1 ma. in the set-up described above. Thus, the need for an expensive well-regulated bias source is eliminated.

— *George H. Nibbe, W6BES*

ANOTHER CLAMPER-TUBE KINK

Heavy-duty bleeders on the high-voltage supply are not necessary when a clamper tube is used on the final amplifier tube. The rig here, which has an 813 final with a 6L6 clamper tube, draws 50 ma. residual plate current. This key-up drain exceeds the requirements for good voltage regulation, so the big bleeders were removed from the power supply and replaced with a series of 1-watt carbon units adding up to about 200,000 ohms. This serves as a protective bleeder, decreases the load on the power supply, raises the supply voltage a bit, and saves a few pennies on the electric bill.

— *Phil Grover, KL7ABF*

TIPS ON USING THE 6BQ6-GT

This tube, which is being used frequently in ham shacks because of its low cost-*vs.*-power ratio, has a ½-amp. heater, the top of which is only about ¼ inch below the plate cap. Good ventilation is required, therefore, to avoid loosening of the plate cap. Ceramic plate connectors should be avoided, and instead the solid metal type should be used.

The basing arrangement of the tube leaves Pin 3 blank. This makes it possible to wire transmitters with the plate lead connected to Pin 3 as well as to the plate cap. Thus, in emergencies, other tubes, such as the 6V6, 6F6, and 6L6 may be plugged in and used.

— *Nelson Bigelow, jr., W1RVV*

CONVERTING 28-VOLT D.C. RELAYS FOR 6-VOLT OPERATION

To convert the small 28-volt relays used in most ARC-5 and 274-N receivers and transmitters for 6-volt d.c. operation, remove all of the wire from the spool or spools and rewind them with No. 32 enameled wire.

By improvising a stand on which a spool of No. 32 wire can rotate with the pull, and by placing the spool to be rewound in the chuck of a drill press, the whole job can be done in less than five minutes. A long No. 6 machine screw in the base of the replay spool facilitates its placement in the chuck.

— *Arthur Worsnop, W2WBH*

TV RECEIVER FRONT ENDS AS HARMONIC CHECKERS

An inexpensive method of checking transmitter harmonic radiation is available now that mail order houses are offering TV receiver front ends for less than $10.00. The TV tuner is used in broadband-converter fashion, its output feeding the regular station communications receiver which is tuned over the i.f. range 21 to 25 Mc. The effect of adjusting harmonic traps or suppressors may be readily observed by watching the communications receiver S-meter. A length of shielded wire, with four to six inches exposed at the far end, makes a good probe.

— *W8LMV*

MODIFIED SWITCHING CIRCUIT FOR THE ELMAC TRANSMITTER

As delivered, the 3-band Elmac transmitter does not include a switch for cutting off the audio tube filaments during c.w. operation of the rig. However, the manufacturer does wire the filament circuit so that a control for this purpose may be added. Recently, when this addition to the rig was being considered, it was decided that the new switch could be mounted on the panel just to the right of the power-amplifier on-off switch. Furthermore, it became apparent that a little more input to the amplifier could be obtained by rerouting the high-voltage wiring around the secondary of the modulation transformer whenever the transmitter was switched to the c.w. position.

Section A of Fig. 3-13 shows part of the original Elmac schematic, and B shows the revamped circuit that uses a d.p.d.t. toggle switch to handle the filament and the high-voltage switching. Notice that S_1 disconnects the secondary of the modulation transformer when the switch is snapped to the c.w. position, and that it turns on the audio filaments only when set at the 'phone position. Of course, the original filament on-off switch remains in the circuit.

The compactness of the transmitter makes it difficult to do any soldering at the switch terminals after the latter has been mounted on the panel. Therefore, it is advisable to equip the switch terminals with 2-foot wire leaders before the unit is mounted in place.

— *William G. Grella, W1DKR*

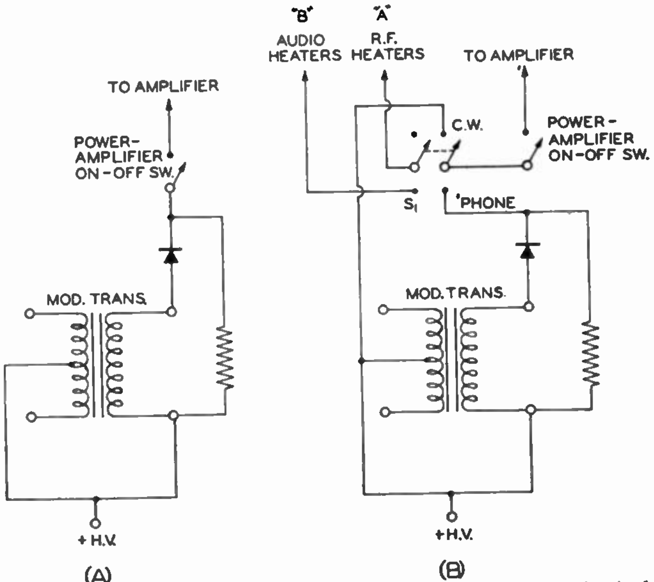


Fig. 3-13 — A before-and-after wiring diagram of the filament circuit for the Elmac transmitter. S_1 is a d.p.d.t. toggle switch.

A VFO COUPLING AMPLIFIER

Shown in Fig. 3-14 is the circuit for a foolproof VFO coupling amplifier which utilizes the existing crystal oscillator, part of its circuits, and requires no extra coils nor tuned circuits, and no switching. It is about as simple a system as you could want, and it won't go into self-oscillation. About the only extra part required to install it in your transmitter is a ceramic octal socket.

While it isn't evident from the schematic diagram, the system uses a 6L6 connected as a high-μ triode in a grounded-grid amplifier circuit with the VFO input fed into the cathode. The connections shown in the diagram will result in this circuit. Note that a direct connection is made between the grid of the crystal-oscillator tube and Pin 6 of the added VFO coupling-tube socket. This pin is a blank for the 6L6 tube, and thus

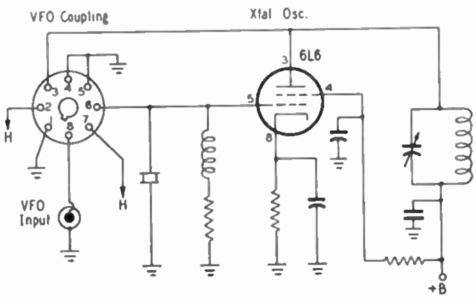


Fig. 3-14 — A VFO coupling stage that can be added to almost any crystal oscillator. A second octal socket, wired as shown, is used to convert the crystal-oscillator stage to a grounded-grid amplifier.

Pin 6 of the socket is used along with Pin 4 for the crystal socket. When crystal-controlled operation is desired, plug the crystal into Pins 4 and 6 of the VFO coupling-tube socket and tune in the normal fashion. For VFO operation, remove the 6L6 crystal oscillator tube from its socket, and the crystal from the VFO coupling-tube socket. Put the *6L6* in the VFO coupling-tube socket, fire up the VFO, and tune the plate circuit to resonance. It's as simple as that, and you need have no fear of the 6L6 oscillating, whether you work it straight through or as a doubler.

Note that the d.c. return for the cathode circuit of the VFO coupling tube must be completed through the coaxial link line used between the VFO and the rig. In other words, a low-impedance link with one side grounded is called for in the VFO unit.

— *R. L. Tester, W6YVO, ex-W8WMP-W9FAI*

AN AUTOMATIC TRANSMITTER TURNER-ONNER

As many operators know, the need for sleep during the latter parts of SS and DX contests cuts down on a fellow's efficiency. My decreased effectiveness shows up in a particularly serious way — sometimes after finishing a call I find that I have forgotten to turn on the power switch. Too much of that can really cut down one's score, since I am not an accomplished telepathist. Down through the years the condition has been getting worse instead of better, but I now have a solution and I pass it along for anyone else who might find it useful.

Fundamentally, the circuit was designed for commercial equipment as a power-failure control.[1] In high-power transmitters, filament power

[1] U. S. Patent 2448371.

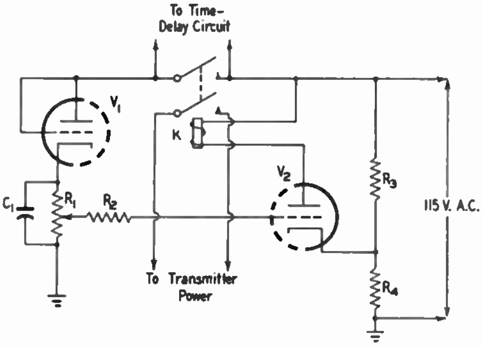


Fig. 3-15 — A commercial circuit for protecting transmitter tubes from line-voltage failures that serves as the basis for the "automatic transmitter turner-onner." The a.c. relay, *K*, will close immediately after a short power failure, jumping the time-delay circuit and turning on plate power, only if C_1 has not discharged below a certain level. If the voltage at the arm of R_1 is too low when the power resumes, it is necessary for the time-delay relay to recycle.

must be applied some little time before the plate power, to provide tube protection. In case of a power failure, it is desirable to return to the air as soon as possible. Provided the power outage does not exceed a certain time, it is permissible

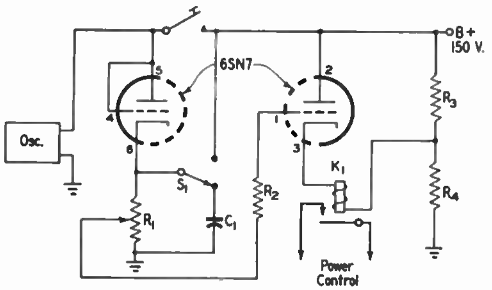


Fig. 3-16 — The a.t.t.o. circuit. The setting of R_1 determines the "hold-in" time of K_1.
C_1 — 1-μfd. paper, 200 volts.
R_1 — 1-megohm potentiometer.
R_2 — 1 megohm, ½ watt.
R_3 — 10,000 ohms, 2 watts.
R_4 — 1000 ohms, ½ watt.
K_1 — Low-current (6 or 7 ma.) relay. See text.
S_1 — S.p.d.t. toggle.

to throw on both plate and filament voltages simultaneously. However, if there is too long a power failure, it is then necessary to recycle and use the standard filament time delay. In its original form, Fig. 3-15, the circuit was used across the power line. In normal operation, C_1 is charged through V_1. This puts a positive voltage on V_2, and V_2 draws plate current, closing the relay. One set of relay contacts shorts out the time-delay relay contacts. If a power failure occurs, the relay opens up and the charge on C_1 starts to leak off through R_1. If power returns before the voltage on C_1 drops too much, the relay will close, shorting out the time relay. If, however, the off time is too long, there will not be enough charge left in C_1, V_2 cannot conduct, and the filament time-delay relay will have taken over. Resistors R_3 and R_4 make up a voltage divider to furnish bias voltage for V_2. R_2 is a high resistance that limits the grid current to V_2 and also lengthens the discharge time. The potentiometer, R_1, actually sets the outage time that the circuit will handle, a maximum of two or three seconds in this case.

The circuit of Fig. 3-15 can be used in any ham rig using filament time delay. However, a very slight modification provides automatic transmitter turn-on. A.t.t.o. works like this: When the rig is first keyed, the transmitter power is turned on and stays on for about two seconds. This is long enough to hold the power on continuously during any transmission. If there is a keying pause of more than two seconds, the power turns off, but it comes right back on with the next dot. Fig. 3-16 shows the modified circuit. The potentiometer, R_1, controls the length of time the power stays on after the key is up. The switch, S_1, was added when it was found that there was some rectifier hash present, and the switch is shifted off C_1 for manual turn-on of the transmitter. Thus the power can be removed immediately after a transmission, using S_1 for the control, and there is then no 2 or 3 seconds of rectifier hash to listen through. The relay, K_1, can be any high-impedance low-current relay that will operate on 6 or 7 ma. A Clare telephone-type relay, with a 34,600-turn 4000-ohm coil, performs very satisfactorily.

The circuit can be modified very easily for use with a keying relay that will work from rectified 60-cycle a.c. The wiring diagram is shown in Fig. 3-17. If K_1 and the keying relay, K_2, are a.c. affairs, the selenium rectifier and filter condenser, C_2, can be omitted. In any event, the impedance of K_2 must be low enough so that the diode-connected tube section will not cause the relay to tend to hold in.

There are no tricks in these circuits, and their operation certainly saves wear and tear on the

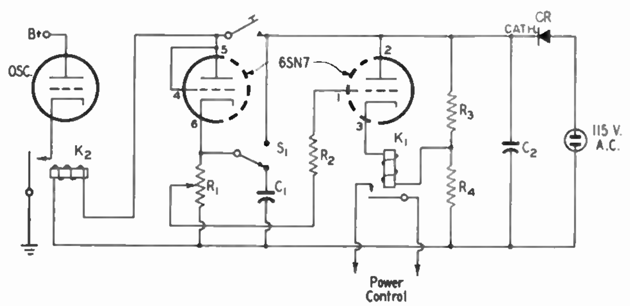


Fig. 3-17 — The circuit modified for relay keying of the oscillator. Constants are the same as Fig. 3-16, except as below.
C_2 — 8 μfd., 250 volts.
K_2 — D.c. keying relay. Use series dropping resistor if necessary.

operator, either during general operating or those rugged hours near the end of a contest. To adjust the circuit, just step once on the key and then release it. If the length of time K_1 stays closed is too long or too short, adjust R_1. Repeat the check until you have what you want. Using this system with good break-in, you can just forget everything except the QSO. Incidentally, a.t.t.o. provides a degree of filament time control, because power cannot be applied to the transmitter until the 6SN7 heater warms up. This usually takes about 20 seconds or so, after which you are ready to enjoy the pleasures of operating with an "automatic transmitter turner-onner."

— *M. E. Hiehle, W2SO*

CRYSTAL ADAPTER FOR ARC-5 TRANSMITTERS

The task of changing crystals in a modified ARC-5 transmitter can be greatly simplified by employing an adapter of the type shown in Fig. 3-18. The device consists of a discarded crystal holder, a crystal socket, and an aluminum bracket. The bolts that were used to hold the name plate on the holder are used to lock the bracket in place, the name plate being discarded. Two wires connect between the socket at the top of the assembly and the contact plates of the crystal holder. It is advisable to shorten the length of the contact plates before the soldering operation is performed. The rest of the construction is evident from the sketch.

This adapter may be plugged into any of the octal sockets at the rear of the transmitter. To remove a crystal, merely brace your hand against the top landing and then pull on the crystal. In

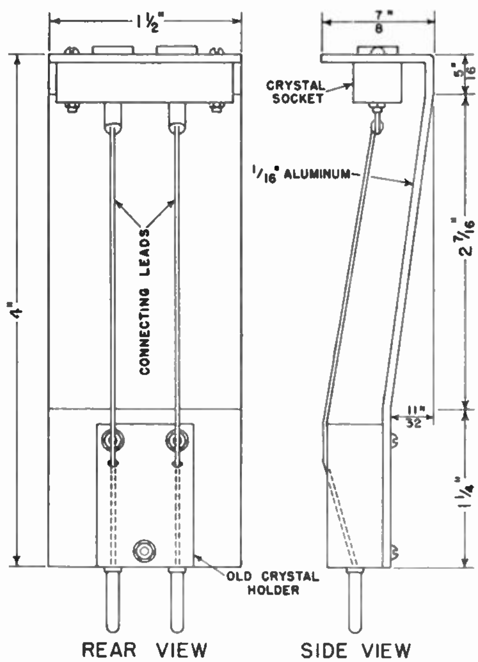


Fig. 3-18 — A crystal adapter of this type will simplify crystal changing in converted ARC-5 transmitters.

this way, the device remains in the rig during crystal changing. For Novices using converted ARC-5s, this adapter will facilitate QSYing.

— *John R. Abbott, W6ZOL*

CURING CHIRP IN COMMAND TRANSMITTERS

My BC-459A chirped, and from what I've heard on the air, most everybody else's does, too. I tried various methods of keying, and extremes of voltage stabilization, but the chirp persisted.

Checking with a good v.t.v.m. showed 12.6 volts on the filaments with the key up, but from 18 to 22 volts when the key was closed! The added voltage was r.f.

To remedy this situation, shielded filament wire was substituted in the rig, with by-passes at each end of the wire. Old microphone cable (with high r.f. losses) seemed best. A heavy copper strip was run across the chassis, and the "cold" ends of the 1625 filaments and the cathodes were connected to it to get a good ground. This change resulted in chirpless keying for me, and has done the same for all others to whom I have passed this hint.

— *Alfred Scott Cline, W6LGU*

BANDSPREADING THE "COMMAND" TRANSMITTERS

If you use one of the "Command" series transmitters as the VFO in your station, you may be interested in having a bit more bandspread than that obtained with the original. In the case of the BC-458, remove the iron slug from the oscillator coil and replace it with a large brass slug. Now adjust the slug so that when the dial is set at 6.7 Mc. the oscillator frequency is actually 7 Mc., and when the dial is set to 7 Mc., the oscillator frequency is 7.3 Mc. This works out to 10 kc. per dial division. To make the dial direct-reading simply add 300 to the dial reading to get the actual frequency.

For the BC-457, glue the iron slug from the BC-458 onto the bottom of the slug in the oscillator coil, and adjust so that when the dial is set to 4 Mc. the oscillator is actually tuned to 3.8 Mc. With this arrangement, tuning the dial from 4 Mc. to 4.2 Mc. results in tuning the oscillator from 3.8 Mc. to 4 Mc., again resulting in a convenient 10-kc.-per division arrangement for use in tuning the 75-meter 'phone band.

— *George Young, W5KQD*

[Editor's Note: While this system may work out well in practice, it should be pointed out that no provision is made for correcting the tracking error in the amplifier stage caused by the change in oscillator tuning rate. Over the limited range involved, however, the error may not be serious enough to cause trouble.]

IMPROVED KEYING FOR THE GF-11 TRANSMITTER

After trying numerous ideas to eliminate the chirps and clicks that resulted from keying the GF-11 transmitter, the following system, which was suggested by W6CX, was installed with very gratifying results. Instead of the original keying system, which keyed the positive high voltage, oscillator keying in the cathode circuit of the 89 oscillator tube and cathode bias for the final amplifier were installed as shown in Fig. 3-19. The modifications are extremely simple, and

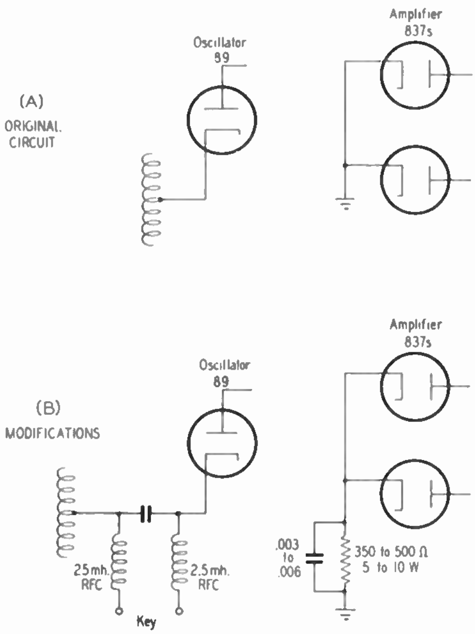


Fig. 3-19 — Suggested modifications of the GF-11 transmitter for improved keying. Oscillator keying is installed, and cathode bias applied to the amplifier tubes.

require a minimum of digging into equipment and time. It is merely necessary to bring a couple of leads for the key out of the rear cable plug.

Chirpless keying has been obtained even without the use of regulated supply voltages. The fact that the 837 amplifier stage draws current when the key is open tends to hold the plate voltage at a nearly constant level. A choke-input filter in the power supply is recommended for best results, but satisfactory keying can still be obtained with condenser input. If greater power output is desired, the amplifier tubes can be replaced with 1625s, which permit the use of considerably higher plate voltage.

— *R. W. Thornally, W6NG*

ADJUSTABLE TUNING RATE FOR VFOs

In most of the VFO units described in recent years the 3.5-Mc. band has been spread out over the full tuning range of the oscillator dial. While this is a satisfactory arrangement for operation on 80 meters, it crowds the 40- and 20-meter bands badly, resulting in a fast tuning rate that is difficult to use. The arrangement shown in Fig. 3-20 has been used with success in a Clapp VFO in which the oscillator was on "160," and where harmonics of the oscillator frequency were to be used in the other bands. The effect is to slow

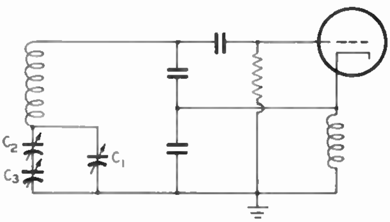


Fig. 3-20 — Handy system of adjusting the tuning rate of a Clapp VFO. Adjustment is described in the text.
C_1 — 25-μμfd. variable padder.
C_2 — 50-μμfd. variable padder.
C_3 — 140-μμfd. variable.

down the tuning rate in the lower-frequency portion of the range (where you want it to be slow for multiplying into the higher-frequency bands) and to speed it up at the high-frequency end of the band where frequency multiplication is not called for.

Tuning is done with C_3, which is connected in series with a 50-μμfd. padder. To set the frequency range, first set C_3 at minimum capacity, and adjust the parallel padder C_1 until the harmonic falls at the high-frequency end of the desired tuning range. Then set C_3 at maximum and adjust series trimmer C_2 to bring the *low*-frequency end of the tuning range to where you want it. These two adjustments interlock to a certain degree, but with care you can get things set so that the desired spread of the low-frequency end of the bands is obtained.

If you find that the tuning rate at the high-frequency end of the dial is now too fast, it can be slowed down by filing away a portion of the rotor plates of C_3 as shown in Fig. 3-21. In this way, the

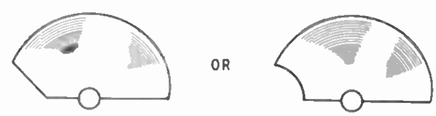


Fig. 3-21 — Notching the condenser plates in this manner will spread the high-frequency end of the tuning range.

75-meter 'phone band can be spread, with some crowding at the middle of the 3.5- to 4-Mc. range, while still retaining the "open" bandspread at the low-frequency end.

— *Clifford E. Fisher, W0MTF*

UNTUNED AMPLIFIER TO TUNED FREQUENCY MULTIPLIER

Multiband transmitters that employ plug-in coils are sometimes tricky to handle when the output frequency demands straight-through operation of all stages. Frequently, one or more of the circuits must be critically tuned to prevent either overdrive or self-oscillation somewhere within the exciter line-up. Although either of these problems may be solved by using a switching system that permits cutting out a stage or two, there remains the possibility of inadequate isolation between the frequency-control and the amplifier stages when the number of active intermediate circuits is reduced.

Fig. 3-22 shows a circuit diagram that provides a suitable solution to the problems outlined

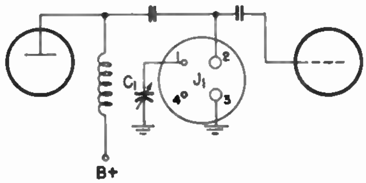


Fig. 3-22 — This simple arrangement converts an exciter stage for use as either a straight-through amplifier or as a frequency multiplier.

above. The stage is converted from an untuned amplifier to a tuned frequency multiplier merely by inserting a coil in J_1. Output at the fundamental and the harmonic frequencies is more nearly balanced and stability at the fundamental is improved by the tuned and untuned modes of operation. Naturally, the improvement in stability and the reduced output at the fundamental usually allow the stage to remain in operation during straight-through operation of the rig.

The coil which allows the circuit to perform as a multiplier must be so arranged as to connect between Prongs 2 and 3 of the four-prong socket, J_1. The base of the inductor must also have a jumper connected between Pins 1 and 2 so that the variable capacitor, C_1, will be automatically connected across the coil when the latter is inserted in place.

— *Jose A. Vivares, LU1EP*

CATHODE-FOLLOWER ISOLATION STAGE

The following information received from VE3DKG should be of interest to many amateurs and is passed along for their benefit.

While working with a transmitter consisting of a 6C4 Clapp oscillator, two 6F6 intermediate stages and a final amplifier, it was discovered

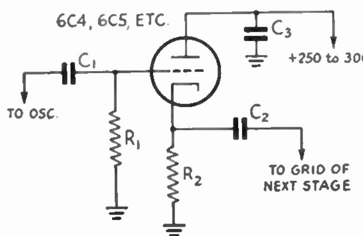


Fig. 3-23 — Circuit diagram of the cathode-follower isolation stage.

C_1, C_2 — 100 μμfd. R_1 — 50,000 ohms.
C_3 — 0.001 μfd. R_2 — 1500 ohms.

that the oscillator keyed well only when disconnected from the rest of the line-up. Furthermore, when the complete line-up was in use, the oscillator frequency was shifted as much as 1 kc. whenever the final was tuned through resonance. Inasmuch as a careful check showed the intermediate stage to be working properly, it looked like a clear case of oscillator loading and inadequate isolation.

Both problems were cured by using a cathode-follower circuit, shown in Fig. 3-23, immediately after the oscillator stage. The oscillator can now be keyed without chirp and amplifier tuning has no detectable effect on oscillator stability. It would seem that the input circuit of the cathode follower presents a load of nearly infinite impedance to the oscillator and that Miller effect has been overcome by use of the arrangement.

— *A. R. Williams, VE3BSH*

OPERATING AMPLIFIER SCREEN GRIDS FROM THE EXCITER SUPPLY

There are times when it is advantageous to employ the exciter plate supply as the voltage source for the screen-grid circuit of a tetrode or pentode final amplifier. However, this system presents the problem of how to remove amplifier screen voltage during periods when the transmitter is operated with the final plate supply turned off.

Fig. 3-24 shows a circuit that does protect the amplifier screens during the tuning or testing of the low-level stages. Ry_1 has the coil connected in series with the bleeder resistor, R_1, for the amplifier plate supply and the contacts connected

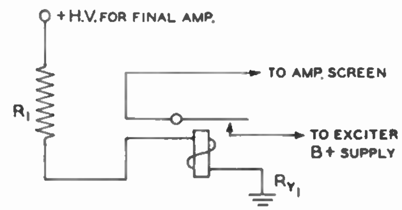


Fig. 3-24 — Relay connections which permit safe operation of the amplifier screen-grid circuit when the latter is powered by the exciter supply.

in series with the lead which runs from the exciter supply to the amplifier screen circuit. Thus, screen voltage is applied to the final only when the high-voltage supply is turned on. Surplus relays having 5000- or 10,000-ohm coils are well suited for the job. Of course, the value of resistance for R_1 must be one which permits adequate bleeder action and, at the same time, must drop the high-voltage output to a value suitable for safe operation of the relay. Caution: The bleeder circuit for the high-voltage supply will fail if the relay winding is opened because of overload or other misuse.

— *D. D. Andrews, W0NCV*

REFRIGERATOR-TYPE TRANSMITTER CABINET

If your transmitter needs a little dressing up, and if there is an old refrigerator within sight, think twice before dashing off to the radio store for a new cabinet. Here's how I housed my 813 rig in an old Kelvinator unit that outlived its intended purpose. The r.f. units were mounted in the food compartment after the door, the ice-cube trays, and a few other items had been removed. There is ample room for the power supplies in the lower section of the box and the original panel for this section is used as the mounting surface for the control switches, the pilot light and the circuit breaker.

— *J. P. Eckhardt, W2CLC*

CONTROL CIRCUIT FOR VIKING I TRANSMITTERS

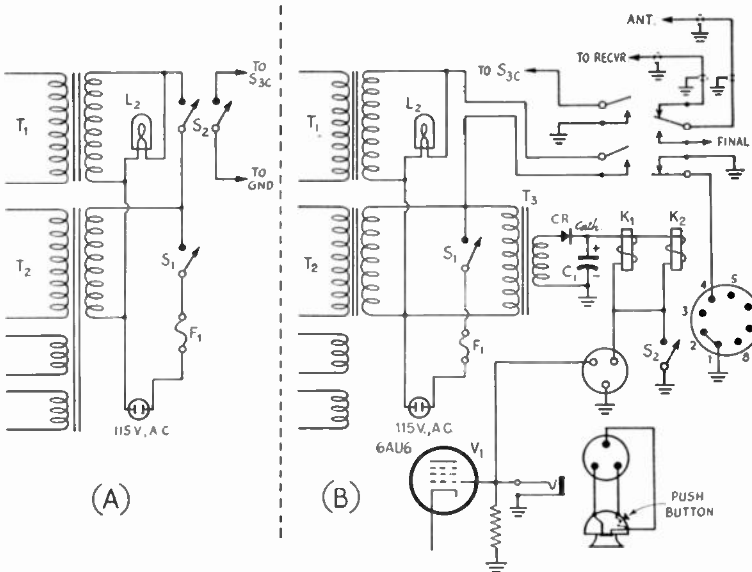
The Viking I transmitter as assembled by the factory, or as wired in accordance with kit instructions, is made to operate by throwing the panel-mounted plate switch. There are no means for microphone-button control of the rig and there is no provision for either antenna change-over or disabling of the receiver during transmitting periods. However, all of these convenient operating aids can easily be added to the transmitter by installing the simple control circuit shown in Fig. 3-25.

Section A of the diagram is the original control circuit for the Viking I and Section B of the drawing shows the modified arrangement. Notice that the revised layout employs K_1 as the main control and that the original control switch, S_2, of the Viking schematic, is used as the relay control switch. Incidentally, only one side of S_2 is used in the new circuit. K_2 is used as the antenna change-over relay and can be used for disabling of the receiver in some installations. Power, 6 volts d.c., for the relays is obtained from a small supply consisting of T_3, *CR* and C_1. Incidentally, 6-volt relays were selected to reduce the hazards of higher voltages on the microphone switch.

Attention should be called to the receiver-disabling contacts of K_2. Notice that one of the contacts is wired to Pin 4 of the 8-prong socket located at the rear of the Viking transmitter. Since Pin 4 is unused in the original circuit, it was used in the modification as part of the receiver-disabling circuit. A Hallicrafters model S-76 receiver is used here at WØNMN and this set has Pin 4 of the power socket, SO_2, connected to the receive/stand-by switch. To complete the circuit between the receiver and the transmitter, two 8-pin male plugs were tied together with Pin 1 to Pin 1 and Pin 4 to Pin 4. Pins 6 and 7 at the receiver end of the cable were shorted with bus wire. Plug PL_2 (normally used in a.c. operation) is removed from the receiver and the new cable is plugged in its place. The other end of the cable fits into the socket at the rear of the Viking. Accidental reversal of this cable will only result in an inoperative receiver since Pins 6 and 7 on the receiver end complete the a.c. heater circuit for the S-76. This error will have no effect on the transmitter since Pin 6 on the transmitter socket is not used. However, to eliminate the possibility of error, the plugs were color-coded to their respective sockets.

— *Lawrence F. Caccomo, WØNMN*

Fig. 3-25 — Control circuit for Viking I transmitters.
C_1 — 2000-μfd. 15-volt electrolytic.
CR — 500-ma. selenium rectifier.
K_1 — D.p.s.t. 6-volt relay.
K_2 — Coaxial antenna relay with s.p.s.t. receiver disabling contacts.
T_3 — 6.3-volt filament transformer.
NOTE: All other components are original parts of Viking transmitter.



A METERING KINK FOR COMPACT EQUIPMENT

The standard closed-circuit 'phone jack, frequently used for metering in equipment where compactness or economy is an important consideration, has a number of shortcomings in this application. The size of the jack itself may be a limiting factor — resulting frequently in inadequate metering provision in a small rig. It is unsatisfactory for plate or screen metering since insulating the shell from the chassis presents a shock hazard. For these reasons it is usually used only in essential tuning positions, leaving a number of handy trouble-shooting test points unmetered. Polarity reversal presents a problem unless the jacks are insulated.

Figs. 3-26, 3-27 and 3-28 illustrate a solution employed at W7MUI to eliminate some of these difficulties. The device in Fig. 3-26 is extremely

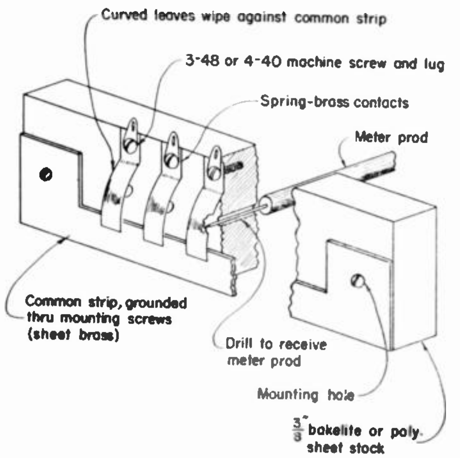


Fig. 3-26 — **A homebuilt metering system for compact gear. Instead of using the usual closed-circuit jacks, W7MUI uses a strip mounted on the equipment in such position that it can be reached with test prods.**

simple and compact, while the somewhat more elaborate version in Fig. 3-27 is handier to use since it holds the test prod, freeing both of the operator's hands. Both of the units shown are intended for grid or cathode metering, one meter prod being clipped to the chassis. To meter above chassis separate contacts are used in place of the common strip and additional clips, similar to those in Fig. 3-27, are provided for the other meter prod. Paint dots or panel-marking transfers are used to indicate polarity. Installation is shown in Fig. 3-28.

Note that in each type of strip the spring brass contacts are arranged to provide a wiping action as they open and close. This effectively eliminates erratic operation due to tarnishing or corrosion. Better contacts may be had by raiding the junk box for old switch or relay leaves.

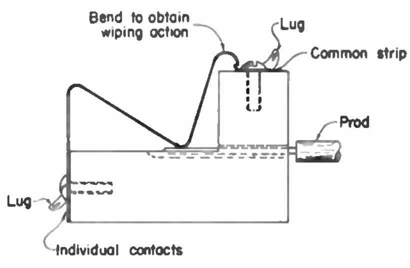


Fig. 3-27 — **A slightly different application of the same idea shown in Fig. 3-26.**

In Fig. 3-26, the plastic should be sufficiently thick to prevent insertion of the prod to the point where it will permanently bend the leaves. If a soft insulating material is used for the base, nuts should be used on the screws holding the

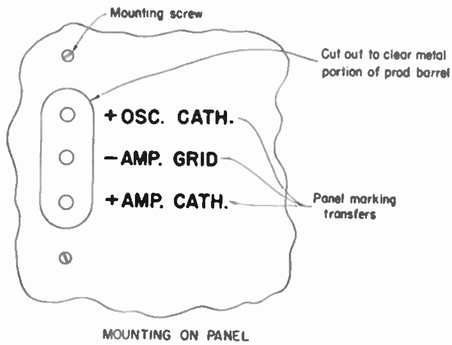


Fig. 3-28 — **To make a professional-looking job, the test points can be labeled with panel-marking transfers.**

leaves, ¼-inch holes being countersunk from the front to take the nuts. Tapped holes may be used on hard plastics.

For safety's sake it is recommended that metering be done at ground returns whenever practicable. A 50-ohm resistor from leaf to ground will prevent high voltage from appearing on the meter terminals while changing ranges.

Using this arrangement, it is possible to meter ten positions in the space normally occupied by 2 or 3 standard jacks. You may not need them all for tuning, but they're mighty handy for front-panel trouble-shooting.

— *Paul A. Doty, W7MUI*

SHOCK MOUNT FOR RELAYS

A SIMPLE and inexpensive method of reducing relay noise is shown in Fig. 3-29. The system shown has been used in the construction of a.c.-d.c. receivers (to mount variable capacitors) for

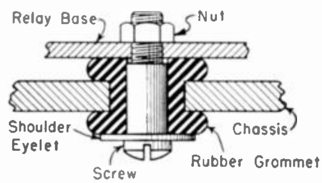


Fig. 3-29 — **Drawing of the rubber-grommet shock mount used by W3WPN.**

years and, when used to support relays, reduces the sounding-board effect normally caused by the chassis or other mounting surface.

Fig. 3-29 is almost completely self-explanatory. However, one precaution should be observed. Make certain the shoulder eyelet is shorter than the grommet thickness so that the grommet will be under compression when the nut is tightened. Otherwise, the cushioning action of the mounting will be impaired. Naturally, this system may be used to shock-mount tube sockets and other components.

— *Sol Davis, W3WPN*

4. Hints and Kinks . . .

for the 'Phone Rig

PREVENTING BREAKDOWN WITH ANTENNA CHANGEOVER RELAYS

In 'phone transmission, antenna relays of the fast-breaking type may cause voltages of destructive proportions to develop in a final amplifier plate circuit and its associated antenna circuit, because the antenna relay opens before the plate-supply condensers have completely discharged, thus allowing the amplifier to continue operating momentarily even though the primary power supply has been cut off. The condition is greatly aggravated if a modulation peak occurs at the instant of break.

Irreparable damage can result to the antenna relay contacts through burning and arcing, especially with coaxial-type relays where the contacts are closely spaced. Also, a large amount of r.f. power may be fed into the receiver, resulting in damage to antenna coils and other components. High-voltage breakdown may also occur in shielded links and low-pass filters when these units are in the antenna coupling circuit between the antenna relay and the final amplifier.

An ideal operating condition is one where the antenna changeover relay has a fast make and a delayed break, allowing the plate power to be completely bled off before the relay switches to the receive position. Experience shows that a time interval of approximately 1/10 of a second is sufficient in average cases.

A practical and economical method of adding the required time delay to existing a.c.-operated changeover relays is indicated in Fig. 4-1. Some experimenting will be required to ascertain the correct values of C_1 and R_1 for a given relay. When the correct value of C_1 has been determined to give more than adequate delay (¼ to ½ second), potentiometer R_1 may be adjusted to set the delay to the desired time. A fixed resistor can replace the potentiometer when the value of resistance that provides the necessary delay action is known. The current rating of CR is dependent on the current drawn by the relay coil and R_1 under sustained operating conditions.

As a guide to those who wish to incorporate this delay unit in existing relay systems, component values that proved satisfactory in one case are given with the diagram.

A small piece of Scotch tape or thin gummed paper glued to the top of the pole piece will prevent the armature from sticking when current is removed from the coil. This is needed only in those cases where the pole piece of an a.c.-type relay has a tendency to become magnetized due to use of direct current. When d.c.-type relays are employed, R_2 and CR are not needed and can be omitted.

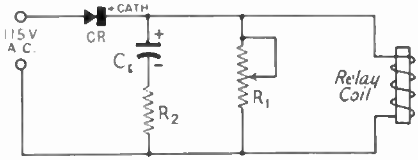


Fig. 4-1 — Protective delay circuit.

C_1 — 60-μfd. electrolytic.
R_1 — 0.1-megohm potentiometer.
R_2 — 25 ohms (current-limiting resistor).
CR — 150-ma. selenium rectifier.

— *T. A. Consalvi, W3EOZ*

PROTECTION FOR MODULATION TRANSFORMERS

In a few minutes' time and with little cost you can eliminate your worries about the possibility of blowing your expensive modulation transformer by operating it with no load on the secondary. The circuit is shown in Fig. 4-2, and it is well worth while when you consider the low value of shorted "audio iron."

The parts required are few, chiefly a single-pole double-throw relay which has one contact normally closed. Almost any relay will do so long as there is one set of contacts in the closed position when the coil is not energized. A 6-, 12- or 24-volt relay is preferable to a 115-volt unit, and an a.c. relay is slightly preferable to a d.c. type. In addition, you'll need a small tubular condenser of at least 8 μfd., rated for at least twice the operating voltage of the relay coil, and a couple of good insulators to mount the relay above chassis ground. These should be able to stand at least twice the highest d.c. voltage encountered in the circuit.

Connect the protective device as shown in Fig. 4-2. The relay coil is in series with the

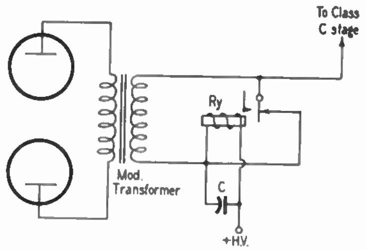


Fig. 4-2 — Protective circuit to eliminate danger of blown modulation transformers due to loss of load. The relay is shown in the unenergized condition.

supply voltage and the low side of the secondary of the modulation transformer. The current drawn by the final amplifier will energize the coil, causing the armature of the relay to open the circuit that normally shorts the secondary. The condenser is used to keep the relay from chattering under modulation.

In selecting the relay, the ideal situation is to have a relay that requires approximately the same amount of current normally drawn by the final amplifier under full load. The desirability of a given relay for this purpose can be checked by connecting it in series with a milliammeter, a variable resistor, and a battery larger than the rated operating voltage of the relay coil. If the relay "falls out" at less than one-fourth of the current you plan to use in the final amplifier, it is too sensitive, and should be shunted by a low-enough resistance to reach the desired value. If the relay fails to operate at the current you plan to use, you'd better try another, or go on c.w., because it just won't do!

— *Cmdr. E. E. Comstock, USCG, W7CNS*

MODULATION INDICATORS

The circuit of Fig. 4-3 is an adaptation of the familiar arrangement using a diode rectifier as an overmodulation indicator. It uses one

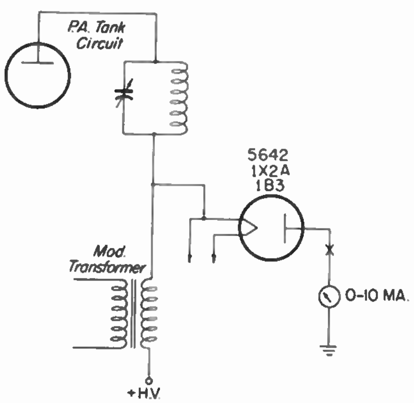


Fig. 4-3 — Simple overmodulation indicator using one of the new TV high-voltage rectifiers.

of the commonly-available TV high-voltage rectifiers, with its filament powered by r.f. from the transmitter.

A one-turn link, placed close to either the driver plate circuit or the amplifier grid coil, serves to pick up enough r.f. to light the filament of the tube. Adjust the coupling of the link to the point where the filament just begins to glow visibly. Less than a quarter of a watt is needed.

The circuit is quite sensitive, and might burn out the meter unless modulation percentage is carefully controlled. As "insurance" it is suggested that a resistor be inserted at point *X* to reduce the sensitivity of the gadget. Anything between 1000 and 10,000 ohms will work, depending on the sensitivity desired.

In operation, the transmitter is adjusted normally and set for 100 per cent modulation. The meter will "kick" each time 100 per cent is exceeded.

— *Jim Barrett, W4KVM*

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The simplicity of the modulation indicator shown in Fig. 4-4 makes it an interesting addition to any 'phone station. The circuit is noncritical, and once set requires no readjustment.

The circuit makes use of the fact that when a signal is modulated 100 per cent or more in a

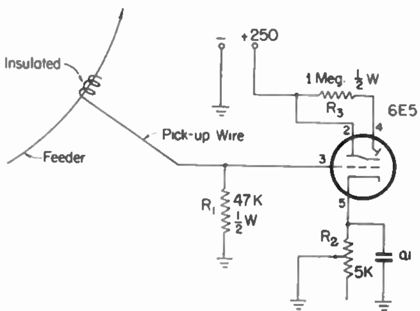

Fig. 4-4 — A simple modulation indicator using a magic-eye tube.

negative direction, periods of no signal result. With the rig turned off, adjust R_2 until the eye just closes. This becomes the reference point of no signal. Turn the rig on and couple the pick-up wire to the feeders, increasing coupling until the eye opens up to about 90 degrees width. The eye will close as the transmitter is modulated. The higher the percentage of modulation, the more closure of the eye. When it just closes, 100 per cent modulation in the negative direction is reached. Operating just below that point insures against getting tagged for infraction of the regulations.

— *Bob S. White, VE7ANR*

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Here is an extremely simple modulation indicator that uses only three resistors and a neon bulb. The circuit makes use of the fact that only one element of a neon bulb will light up on d.c.; if the polarity of the starting voltage is reversed, the other element will light up (the first one goes out). When connected to a transmitter as shown, one element of the bulb is made approximately 60 volts positive with respect to ground by connecting it to a voltage divider, R_2 and R_3. The second element of the bulb is returned to the r.f. amplifier side of the modulation transformer through a series resistor and is normally maintained at a higher voltage than the element which is returned to the divider. However, during the process of modulation, the negative peaks will reverse the d.c. polarity across the bulb, thus causing the dark element to flash.

The values shown in Fig. 4-5 are suitable for low- and high-voltage supplies of 300 and 500

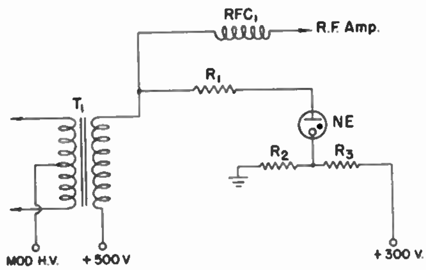


Fig. 4-5 — **Schematic diagram of the negative-peak modulation indicator.**
R_1 — 0.5 megohm, 1 watt; for 500-volt supply.
R_2 — 20,000 ohms, ½ watt; see text.
R_3 — 0.15 megohm, 1 watt; see text.
RFC_1 — Final amplifier r.f. choke.
NE — ¼-watt neon bulb.

volts respectively. Additional resistors (½-megohm, 1-watt) should be connected in series with R_1 if the amplifier plate voltage exceeds 500 volts by any great amount. R_2 and R_3 should have new values if the divider is connected across a source delivering other than 300 volts. If a redesign of the divider is necessary, remember to keep the center point approximately 60 volts above ground. Of course, this point may be set at a slightly higher voltage in order that the bulb can be made to flash just before overmodulation occurs.

Incidentally, the Type NE-51 neon bulb is not particularly well suited for this application because the lighted element makes it difficult to see the dark element flash. In any event, make sure that the bulb is mounted with the dark element exposed to view.

— *William E. Rose, jr., W9KLR*

"HOW'S MY MODULATION?" INDICATOR

Seldom are "on-the-air" reports critical enough, particularly as to quality of modulation, and since it is virtually impossible to tell anything by listening to yourself with a monitor, the following scheme has been adopted at W2PFU for adjusting the 'phone rig for minimum distortion, correct clipping level, general speech quality, hum, etc.

A three- or four-foot length of wire and a 1N34 germanium diode are coupled into the microphone input of a wire recorder placed on a table a few feet from the transmitter, as shown in Fig. 4-6. The wire recorder is turned to "record" position.

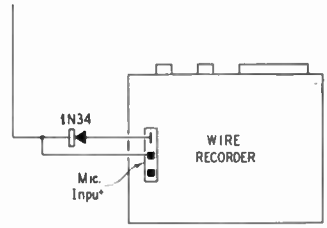


Fig. 4-6 — **Connections used by W2PFU to permit recording of his own signal.**

the transmitter is turned on, and, while the adjustments are being made, the operator describes the adjustments, dial settings, and other pertinent data. At the conclusion of the series of adjustments the transmitter is turned off and the material recorded on the wire is played back. This gives the operator a personal and first-hand description of just what his modulation does sound like. Obviously, during the test the input level to the wire recorder must be adjusted to the proper recording level.

Tests can be made with the transmitter loaded into a dummy antenna or while the operator is in QSO with another amateur. Broadcasting your tests to the world is not recommended.

— *Dallas T. Hurd, W2PFU*

MODULATION MONITOR

Here is a simple modulation-monitor idea for owners of panoramic adapters. A small d.p.d.t. relay operating from the transmit-receive switch in the transmitter is installed at the base of the 'scope tube in the adapter. The leads to the vertical deflection plates of the 'scope tube are disconnected and transferred to the normally closed pair of contacts on the relay. A pick-up loop and a link line with a 0.001-μfd. condenser in series is then connected to the normally open pair of contacts, and is brought out so that it may be coupled to the final tank coil. The vertical deflection plates are then connected to the moving-arm contacts of the relay.

The panoramic adapter operates normally in reception, but when the transmitter is turned on, the modulated r.f. envelope appears on the screen, permitting continuous monitoring of modulation. The position of the link must be adjusted to give the correct pattern height.

— *Earl E. Ferguson, W5PAG*

LOCK-ON FOR THE T-17B HAND MICROPHONE

I have noticed on several occasions when in contact with a station using a T-17B microphone that the audio is frequently interrupted. This is caused by the fact that it takes a lot of pressure to hold the switch button closed, and after a few moments the hand gets cramped. A simple solution to the problem requires only that a ¾-inch piece of No. 18 wire be soldered under the edge of the metal mounting washer that is found beneath the bakelite switch button. After reassembling, it will be possible to lock the switch in the "on" position with a slight twist of the button.

— *R. A. Cohagen, W8NBM*

THE SIMPLEST MODULATOR

Many c.w. operators have been looking for an easy way to modulate their rigs, especially now that 40 meters has been opened up for 'phone. This little modulator may be the answer.

The interesting point about it is that it can be plugged into the cathode circuit of any final amplifier and you are on 'phone. No separate plate supply or matching output transformer is needed. The plate voltage for the unit is derived from the final plate supply.

As shown in Fig. 4-7, the audio output voltage is impressed between the r.f. amplifier cathode and ground, giving principally grid-bias modulation of the amplifier although there is a small amount of accompanying plate and screen modulation. You can modulate triodes, tetrodes or pentodes, single-ended or push-pull. The efficiency is comparable with that of other grid- or screen-modulation systems and so, of course, cannot equal plate modulation, but good quality reports will be obtained. One feature of the system is that, with most finals at least, proper operating conditions for good modulation are attained practically automatically.

The speech amplifier uses a double-triode 6SL7GT with resistance coupling, and gives adequate gain for a crystal microphone. Plate voltage comes from the amplifier cathode, with C_1, C_3, C_6, R_3, R_7, and R_{10} providing additional filtering as well as decoupling. The voltage will vary with the power of the transmitter, but in any event the measured voltages at the 6SL7 plates are quite low. R_{11} is not needed if the modulated amplifier is operating at such low power that the voltage at the screen of the 6Y6G does not exceed the maximum rating of 135 volts.

To use the modulator, first tune up the transmitter for c.w. operation and load it to normal

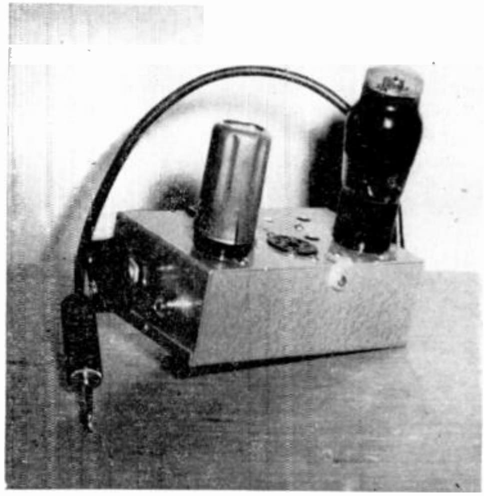


Fig. 4-8 — **Practically any layout you want can be used for the modulator. The unit at W6LNN uses the circuit of Fig. 4-7 and has ample gain for a crystal microphone. A carbon microphone could be coupled to the modulator grid through the usual transformer, without speech amplification.**

input. Then connect the modulator into the amplifier cathode circuit — it can be plugged in in place of the key if there is a key jack in the cathode — and the plate current should drop to about half its c.w. value. Then talk — that's all there is to it! The r.f. amplifier plate current should remain steady except possibly for a slight flicker on voice peaks. In the event that the plate current with the modulator plugged in is considerably above half the c.w. value, it can be brought into the right region by increasing the value of resistor R_9.

One word of caution, especially when using powers over 200 watts or thereabouts: Be sure the modulator filaments are ON before applying plate voltage. This will insure the proper path of the final cathode current and prevent possible burnout of the small audio filter choke in parallel with the 6Y6G circuit. This applies particularly to separate control of filament voltages.

The unit is built into a 6¼ × 3½ × 2-inch

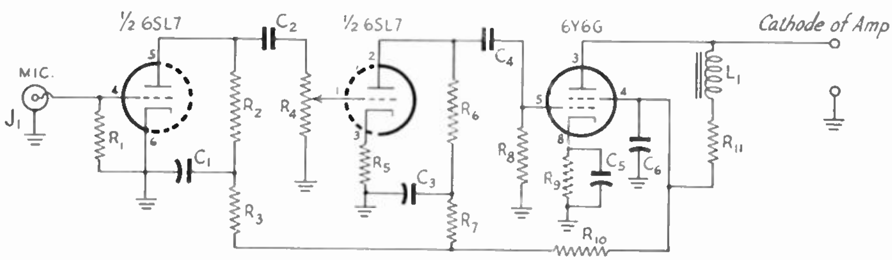


Fig. 4-7 — **Circuit diagram of the speech amplifier and modulator.**

C_1, C_3 — 0.1-μfd. paper, 400 volts.
C_2 — 0.005-μfd. paper, 400 volts.
C_4 — 0.01-μfd. paper, 400 volts.
C_5 — 50-μfd. electrolytic, 50 volts.
C_6 — 8-μfd. electrolytic, 450 volts.
R_1 — 2.2 megohms, ½ watt.
R_2 — 0.22 megohm, ½ watt.
R_3, R_7, R_{10} — 22,000 ohms, ½ watt.
R_4 — 0.5-megohm volume control.
R_5 — 2200 ohms, ½ watt.
R_6, R_8 — 0.1 megohm, ½ watt.
R_9 — 50 ohms, 2 watts (see text).
R_{11} — 2000 ohms, 2 watts (see text).
L_1 — Small filter choke, "a.c.-d.c." type satisfactory.

"channel-lock" box. This size accommodates all the parts except the small audio choke.

In estimating the number of tubes required to modulate a given transmitter, allow one 6Y6G for each 200 ma. of c.w. plate current or 100 ma. when the modulator is plugged in. One tube will modulate up to 200 ma. c.w. current, two tubes up to 400 ma., and so on, it being understood that these values should drop to one-half when the modulator is in circuit. Type 6L6 tubes can be substituted for the 6Y6G but are not as desirable because higher plate and screen voltage are required for the same cathode current. Since the voltage drop across the modulator tube or tubes subtracts from the voltage actually applied between plate and cathode of the modulated amplifier, a larger tube drop means a reduction in power input to the final amplifier stage.

In typical cases, 'scope patterns have shown that with tone input very good waveform is obtained up to about 80 per cent modulation. The positive peaks are somewhat clipped with heavier modulation, but the distortion is not particularly noticeable even at 90 per cent modulation.

The simplicity of the unit makes it readily adaptable to portable rigs. It would also be useful as a spare modulator when the regular high-powered speech system needs attention.

— *Ira F. Gardner, W6LNN*

PREVENTING R.F. FEED-BACK AT 28 MC.

Most 28-Mc. 'phone operators have at one time or another been plagued with feed-back caused by r.f. pick-up in high-impedance microphone circuits. Installations where a microphone cable about six feet long is used are likely to run into this trouble, because that length approximates resonance at 28 Mc. (depending on the velocity factor of the particular cable). Even when well shielded and by-passed, such a cable can be troublesome. Changing the length of the microphone cable may help in some cases, but a more direct approach to the problem is usually called for.

About the best way is to shunt the microphone with a series-tuned circuit installed right at the terminals of the crystal unit inside the microphone case. A 100-μμfd. ceramic condenser in series with ten turns of No. 20 enameled wire close-wound on a ¼-inch form will resonate close to the 28-Mc. band, and will provide a low-impedance short across the line. Slight adjustment of the inductance may be required for different cables. By-pass the inner conductor to ground at the speech amplifier chassis with a 100-μμfd. mica condenser. When soldering the series-tuned circuit inside of the microphone, be careful not to overheat the crystal unit.

Precise tuning of the series-resonant trap can be done with a grid-dip meter, or by connecting the microphone cable (chassis end) across the antenna and ground terminals of a receiver tuned to 28 Mc., and adjusting the inductance until there is a minimum reaction on a steady signal tuned in on the receiver. Resonance of the circuit is indicated when there is no change in the strength of the received signal when the cable is alternately connected and disconnected from the receiver.

— *Fred F. Everett, WØYTY*

TUNING AID FOR SCREEN-MODULATED AMPLIFIERS

The heavy loading required for linear operation of a screen-grid-modulated amplifier usually makes it difficult to observe any "dip" in plate current when the plate tank condenser is tuned to resonance. The simple addition of a resistor and a switch, Fig. 4-9, makes it possible to obtain a good dip, thus permitting easy adjustment.

When tuning up, the switch is opened. This raises the screen voltage applied to the amplifier, which in turn results in more plate current. It is

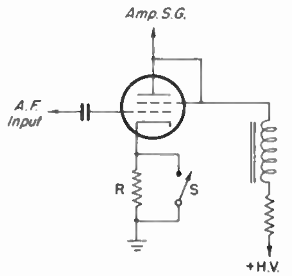


Fig. 4-9 — By adding a 250-ohm cathode bias resistor to the clamper tube, plate current to the final amplifier is increased to make the dip in plate current more pronounced during tune-up.

then easy to observe the dip at resonance. In addition, some means for making the speech amplifier inoperative should be incorporated so that no audio will appear on the clamper-tube grid during tuning procedures. Once the amplifier is tuned properly, the switch is closed, returning the circuit to normal.

— *Jerry Colten, W9CZI/5*

SIMPLIFIED VOICE CONTROL WITH A LOUDSPEAKER

Here is a useful gadget for the single-side-band operator who likes voice-controlled break-in but doesn't care for a headset. The idea is not new, since a similar circuit was described a few years ago.[1] However, this newer circuit is a simplification that eliminates two transformers and a tube from the original design. W6LZE uses the Nowak circuit and has tried this newer modification. He reports that the performances are comparable.

Referring to the circuit diagram in Fig. 4-10, the 6SN7 is a two-channel amplifier. The top channel is connected to the transmitter speech amplifier, ahead of the audio gain control. The lower channel is connected to some point in the

[1] Nowak, "Voice-Controlled Break-In . . . and a Loud-speaker," *QST*, May, 1951.

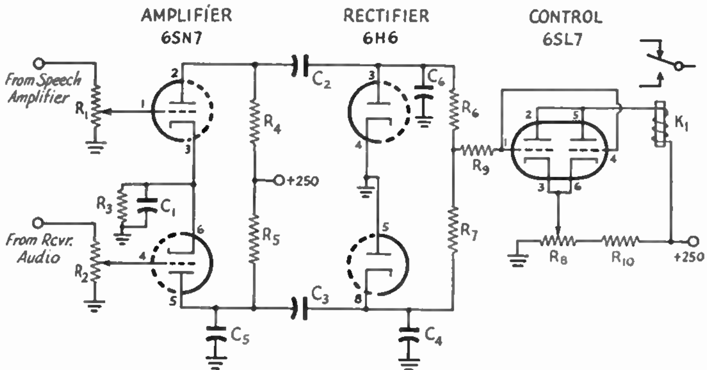


Fig. 4-10 — Circuit diagram of the voice-operated control circuit for use with a loudspeaker.

C_1 — 25-μfd. 25-volt electrolytic.
C_2, C_6 — 0.1-μfd. paper.
C_3, C_4 — 0.05-μfd. paper.
C_5 — 0.01-μfd. paper.
R_1 — 0.5-megohm volume control
R_2 — 50,000-ohm volume control.
R_3 — 470 ohms.
R_4, R_5 — 0.1 megohm.
R_6, R_7 — 0.47 megohm.
R_8 — 500-ohm 4-watt wire-wound potentiometer
R_9 — 1 megohm.
R_{10} — 10,000 ohms, 10 watts.
K_1 — 10,000-ohm sensitive relay.

receiver audio system — a handy point might be the 500-ohm output, if the receiver has one. The 6H6 rectifier rectifies the audio signals in the two channels. When a signal comes only from the speech amplifier, the voltage at the grid of the 6SL7 goes negative, cutting off the tube and causing the relay to "fall out." Signal coming from the receiver tends to bias the 6SL7 grid positive — signals coming through both channels can be made to have little or no net effect by adjustment of R_1 and R_2. A signal from the speech amplifier only, as when the operator speaks into the microphone, will cause the relay to drop out and turn on the transmitter. The "hold-in" time can be modified by changing the value of C_6 — a larger value of capacitance will give a longer hold-in.

It will be noted that the components specified are different for each channel. This is because the writer's speech amplifier has shaped frequency response and capacitors C_3 and C_5 tend to shape the lower-channel response in a like manner.

W6LZE has suggested that the only control needed on the front panel is R_8, which is used to balance for different operators. His experience has been that, once adjusted, R_1 and R_2 will need no further attention, and I have also found this to be the case.

To put the unit in operation, first adjust R_8 to the point where the relay is held closed with a positive action. While speaking into the microphone, R_1 is now adjusted until the relay operates with negligible lag. Now turn on the station receiver (placing the microphone at its normal location) and adjust the receiver audio for a fairly high level. The relay will not probably be tripped by the receiver output. Adjust R_2 to just eliminate this effect.

One word of caution: If your receiver gives a loud "pop" when the relay operates, it will feed through the 6SN7 receiver amplifier and may pull the relay in again. The answer to this is to use a receiver silencing system that will operate without the click. It was done at W6IBR by lifting the output ground connection on the receiver and running it to ground through a set of relay points.

— *Walter N. Hunter, W6IBR*

SIMPLE INVERSE FEED-BACK CIRCUIT

Here's a simple way to add inverse feed-back to a resistance-coupled amplifier. The grid resistor of V_3 in Fig. 4-11 is removed, and replaced by a potentiometer, R_2, of equal value.

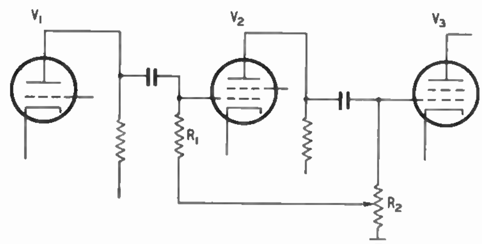


Fig. 4-11 — Adding inverse feed-back to a resistance-coupled amplifier the easy way. In this circuit, only one tube, V_2, is included in the feed-back loop. Variations are discussed in the text.

The grid resistor of V_2 is then returned to the arm of R_2. Thus a portion of the audio voltage at the plate of V_2 is fed back to the grid of V_2 which, naturally, is out-of-phase. The amount of feed-back may be controlled by the setting of R_2.

Although the diagram shows only one tube (V_2) in the feed-back loop, it is possible to have more, so long as there is an odd number of tubes in the loop. An even number of tubes would result in positive feed-back and oscillation. If there are transformers in the loop, make sure that the phase shifts are such that the two ends of the loop are out of phase at all frequencies, otherwise oscillation at one or more frequencies may result.

If there is any reserve gain in your speech amplifier, installation of the simple system described can result in improved speech quality at very small cost.

— *Charles Erwin Cohn*

DUAL CONNECTION FOR 'SCOPE MONITORING

It is often desirable to have a 'scope connected to a transmitter for monitoring, and also have the 'scope available for use with a panoramic adapter or just the audio output of a receiver. Fig. 4-12 is a simple circuit that permits such

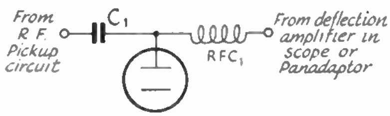


Fig. 4-12 — W2NJR uses this simple circuit to connect (without switching) the vertical deflection plates of his oscilloscope to the transmitter and receiver.
C_1 — 100 μμfd. RFC_1 — 2.5-mh. r.f. choke.

operation. There should not be any receiver or panoramic adapter output when the transmitter is on, of course, or the pattern may become a trifle baffling!

— *Robert W. Ehrlich, W2NJR*

A TRANSISTOR M.C.W. ADAPTER

The development of the transistor has made possible some extremely simple and novel devices, particularly since the transistor requires so little energy for proper operation. It was felt that a simple transistor oscillator that could provide a keyed audio tone to a transmitter modulator would offer an excellent opportunity for expanding civil defense training or any other application where a keyed tone is required.

After some thought and some "monkeyeering," the oscillator shown in Figs. 4-13 and 4-14 was developed. It is a transistor oscillator that may be plugged into a carbon microphone jack and be keyed to produce m.c.w. (modulated c.w.). It derives its operating current (2 to 10 ma.) from the existing microphone current source and, since it requires no warm-up time, is ready for use as soon as it is plugged into the microphone jack. The entire circuit (Fig. 4-14) is assembled on a Yaxley 'phone plug that has been fitted with a $1\frac{7}{16}$-inch aluminum extension. As shown, this extension is secured to the ground terminal of the plug and serves as a miniature chassis for mounting the transistor socket and two stand-off terminals. The dimensions of the extension are given in Fig. 4-15, and the method of mounting it and the rest of the parts can be seen in the photographs. After the circuit is assembled and wired it may be covered with a shield can, potted in casting resin, or just left out in the open. (Our shield can is off more than it is on, for demonstration purposes.) The unit uses a point-contact transistor and was designed specifically for use with the civil defense equip-

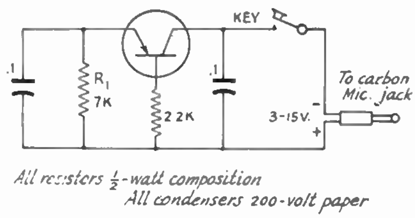


Fig. 4-14 — Circuit of the transistor oscillator.

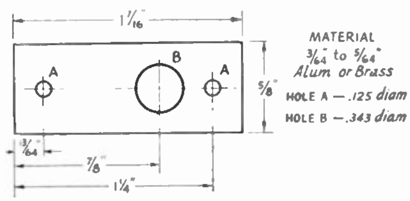


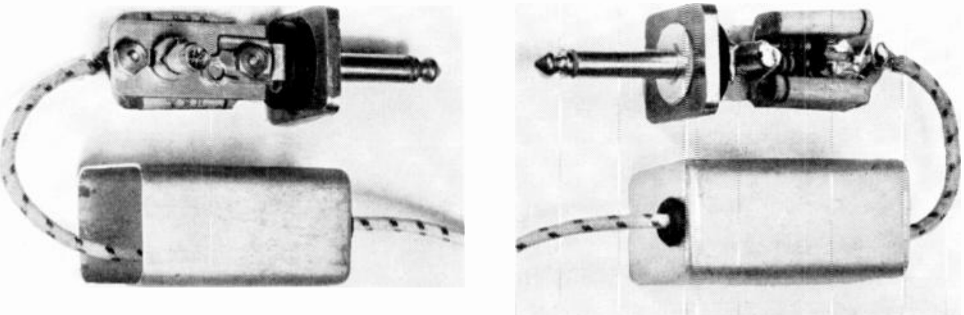
Fig. 4-15 — Details of the oscillator mounting plate.

ment built by the Livingston Amateur Radio Club and described in the April, 1952, *QST*. However, it will work satisfactorily when plugged into any rig that is normally equipped with a carbon microphone. R_1 may be used to control the audio frequency of the device, and some adjustment of this resistor may be necessary when other transistors are used or a different modulation frequency is desired.

Caution: Check the polarity of the supply voltage carefully, since the application of voltage of the wrong polarity will probably ruin the transistor.

— *H. V. Braun, W2RKB*

Fig. 4-13 — Views of the transistor oscillator, mounted on a headphone plug. The cord extending out the back contains the key leads — the oscillator is plugged into the carbon microphone jack when in use. The normal microphone power source also powers the oscillator.



CONTROLLED CARRIER WITH A CATHODE FOLLOWER

The controlled-carrier system to be described has been in use here for over a year, with excellent results. The idea was born after reading several articles [1] that pointed out the advantages of such systems. The ever-prevalent shortage of radio parts here meant dispensing with a crystal rectifier, and the use of a rectifier tube in the more complex Lippert system was not too appealing. I began thinking about using a triode cathode-follower connected in series with the screen supply, with its grid as the rectifying element, and the circuit shown in Fig. 4-16 was developed. It performed well from the first time it was put to work, and has now been tested long enough to merit passing along to anyone else who might like to try it.

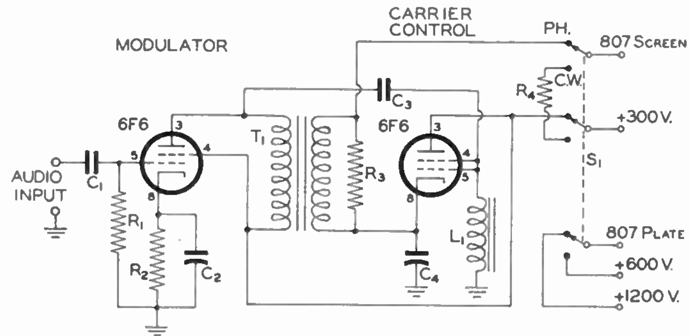


Fig. 4-16 — Circuit diagram of the controlled-carrier system.

C_1, C_3 — 0.01-μfd. 600-volt paper.
C_2 — 10-μfd. 50-volt electrolytic.
C_4 — 1-μfd. 600-volt paper.
R_1 — 0.47 megohm.
R_2 — 430 ohms, 2 watts.
R_3 — 10,000 ohms, 5 watts.
R_4 — 7000 ohms, 5 watts.
L_1 — Midget choke, 5 hy. or higher.
T_1 — 1-to-1 output transformer (such as Stancor A-1752).

With the constants shown in Fig. 4-16, the circuit is used to modulate a single 807 amplifier, but other combinations can undoubtedly be worked out for other tubes and power levels. The 6F6 modulator is conventional and transformer-coupled to the 807 screen. The d.c. voltage across C_4 will determine the carrier level of the 807 amplifier — the higher this voltage is, the higher the carrier level will be. The carrier-control 6F6 is a cathode-follower power source for C_4 — driving the grid of this 6F6 in a positive direction will charge C_4. However, C_4 can discharge only through the screen circuit of the 807 stage being modulated.

When no audio voltage appears across T_1, the grid of the carrier-control 6F6 is at ground potential, and the voltage across C_4 will be low. Thus the screen voltage on the 807 is low, and only a weak carrier is radiated. When an audio voltage appears across T_1, it is coupled through C_3 to the grid of the 6F6 carrier-control tube, and each positive peak results in a surge of current into C_4 and a consequent voltage increase. When the audio voltage is removed, C_4 discharges and the carrier level is again reduced. The magnitude of the voltage across C_4 will be determined by the audio voltage, and thus the circuit gives a "constant-modulation" or controlled-carrier system.

There is a highly-distorted audio component in the current passing through the 6F6 carrier-control tube, but it is filtered out by the large capacity at C_4. This capacity also serves as a low-impedance return path for the modulating voltage that is applied to the 807 screen by the secondary of T_1.

In operation, the idling current of the carrier-control tube is practically zero, and the plate current of the 807 is in the neighborhood of 15 ma. Under full modulation by a steady tone, the 807 plate current rises to about 60 ma. Although the carrier increases about 12 db. between no and full modulation, listeners who have no S-meters never seem to notice any difference between this signal and normal a.m. signals, and the quality is always reported to be very good.

The transmitter is coupled to the antenna with switch S_1 in the "C.W." position (600 volts on the plate) and loaded to 100 ma. plate current. Then S_1 is thrown to "PH" and that's all there is to it. The percentage of modulation can be checked by inspection of the envelope pattern displayed on an oscilloscope when some of the r.f. output is coupled to the vertical deflection plates.

— *Jose A. Virares, LU1EP*

[1] Lippert, "A Constant-Modulation 'Phone System," *QST*, April, 1950; Technical Topics, "Design Limits for High-Output Grid Modulation," *QST*, Feb., 1951; Technical Topics, "Screen Modulation with Limited Carrier Control," *QST*, April, 1951.

GROUNDED-GRID CLASS-B STAGE

The schematic of Fig. 4-17 shows a method of using a triode-connected 807 as a linear amplifier. The grounded-grid stage has a very low input impedance (around 200 ohms), which accounts for the tapping down on the grid coil. Connected this way, the 807 becomes a zero-bias tube.

— *G3BQQ and G3FHL*

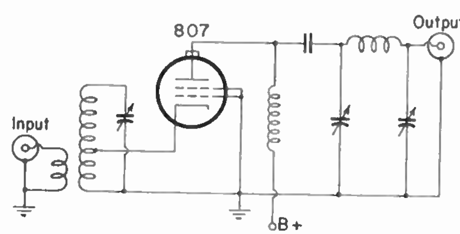


Fig. 4-17 — Triode-connected 807 linear amplifier.

5. Hints and Kinks . . .

for the Power Supply

VERSATILE POWER SUPPLY

The power-supply circuit shown in Fig. 5-1 is an ideal arrangement for any experimenter. As an example of its versatility, assume that a transformer rated to deliver 500 volts each side of center-tap is available. With this supply, by merely throwing a couple of knife switches, the same supply may be used to obtain 500, 1000, or 2000 volts. Thus, as individual requirements change, the supply may be changed to suit without having to rebuild.

The d.c. power available at the output of the filter is as follows:

Condition	Switch Position S_1	Switch Position S_2	Voltage Available	Current Available
(1)	A	B′	½	2
(2)	B	B′	1	1
(3)	B	A′	2	½

The figures in the available voltage and current columns indicate what multiple of the normal rated output may be obtained for the various switch positions. Switch position *A-A′* should be avoided, because with the connections thus set up, the filter condensers virtually short-circuit the transformer secondary.

Examination of the circuit reveals that for Condition 1 as tabulated above, the familiar center-tapped full-wave arrangement is produced by the knife switches. Condition 2 results in a bridge circuit, and Condition 3 results in a voltage-doubler circuit.

There is one precaution to observe in building this type of supply. The reactance of the input filter condensers C_1 and C_2 (storage capacitors under operating Condition 3) should not be so small that the peak plate-current rating of the rectifier tubes V_1 and V_2 is exceeded. This can be calculated simply from the following formula:

$$\text{Reactance } (X_c) = \frac{10^6}{377C}$$

where C is the capacity of C_1 in microfarads. This assumes a 60-cycle supply, and neglects tube drop and transformer resistance. Suffice to say that if the total transformer secondary voltage is 1000 volts, 3 μfd. can be used at C_1 and C_2 with Type 866A rectifiers. At 2000 volts total not over 2 μfd. should be used.

Under operating Conditions 1 and 2, the condensers are in series, but since the ripple frequency is doubled, the input impedance remains the same.

As a variation on the circuit shown, under Condition 3, if *B′* is connected to the cathode-plate junction of V_1-V_2, the rectifiers are connected in parallel, permitting twice the allowable peak plate current to be passed, assuming, of course, that the transformer ratings permit. A word of warning: Turn the power input off before doing any switching with S_1 and S_2!

— *Ray F. Knochel, W9CO, ex-W1CM*

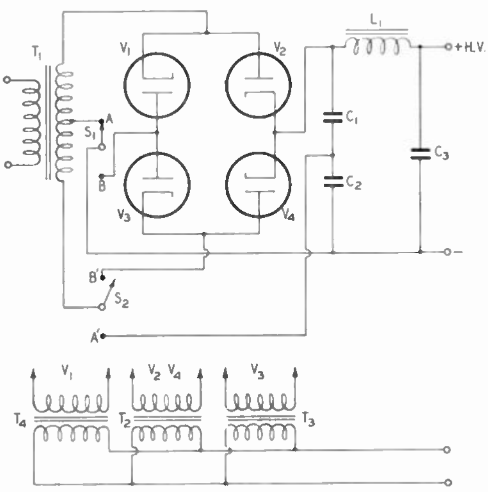


Fig. 5-1 — Schematic diagram of a versatile power supply for the ham shack. Values given below are for a typical supply capable of delivering 550 volts at 300 ma., 1100 volts at 150 ma., and 2000 volts at 100 ma. under various operating conditions.

C_1, C_2 — 3 μfd., 2000 volts.
C_3 — 3 μfd., 3000 volts.
L_1 — 12 hy., 300 ma.
S_1, S_2 — S.p.d.t. knife switches.
T_1 — 1000 volts c.t., 300 ma.
T_2 — 2.5 volts, 10 amp., 10,000-volt insulation.
T_3, T_4 — 2.5 volts, 5 amp., 10,000-volt insulation.
V_1, V_2, V_3, V_4 — 866A.

RECTIFIER PROTECTION

When testing experimental gear for the first time, put a small resistor in series with the high-voltage between the rectifier cathode and the first filter condenser to act as a fuse in case something in the gear is short-circuited.

— *Robert Schuetz, W2BDG*

CIRCUITS FOR SURPLUS DRY-DISK RECTIFIERS

How often, in looking through a surplus store, have you come upon a dry-disk rectifier with a center terminal, a terminal halfway between center and each end, and the ends tied together, and said, "Too bad that's not a half-wave," or "Too bad that's not a center-tap job," or "Too bad it doesn't handle enough voltage for my purpose."

Let's take a look at one of these jobs; a typical stack employing twelve units is shown diagrammatically in Fig. 5-2. If we use this assembly as

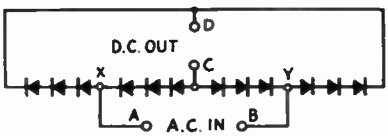


Fig. 5-2.

the manufacturer intended, we connect a.c. to *A* and *B* and take d.c. out at *C* and *D*, and the stack is seen to be a bridge rectifier, with three units in

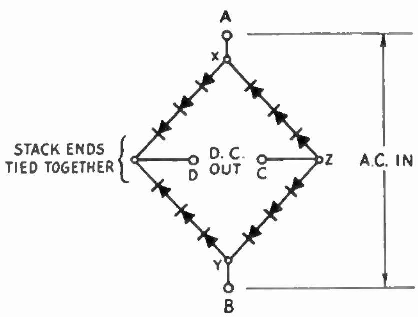


Fig. 5-3.

series in each arm, as shown in Fig. 5-3. However, let's redraw Fig. 5-2 again, and unsolder the leads at *X* and *Y*. Observe from Fig. 5-4 that we now have two half-wave units in parallel,

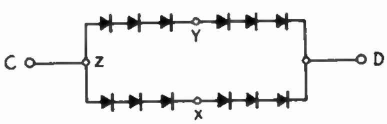


Fig. 5-4.

each half-wave unit being composed of six separate rectifier pairs in series. Observe that we haven't done a thing to disturb the contact pressures on which the rectifier depends for its proper functioning. In fact, we didn't even need to remove the leads at *X* and *Y*, but could have taped them over. We can use single units in any series combination we want, bridge rectification, center-tap, and so on. Four arrangements like that of Fig. 5-4 could be used as the four arms of a bridge rectifier with twice the voltage input capability and twice the current output capability of a single original stack; or two could be used with a center-tapped transformer, in which case each half of the transformer secondary winding could have a voltage equal to that of the original rating on the single stack of Fig. 5-2. A very large number of variations is possible — just use your head.

Now just wait — we're not done yet. Let's clip the lead connecting opposite ends of the

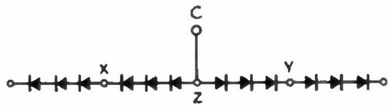


Fig. 5-5.

stack of Fig. 5-2, and unsolder the leads at *X* and *Y* as before. Behold, then, Fig. 5-5. This suggests finding a center-tapped transformer, for full-wave rectification, with the circuit according to Fig. 5-6.

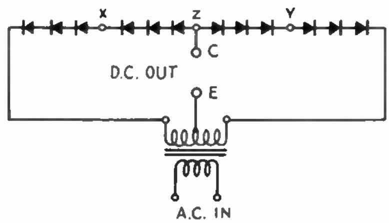


Fig. 5-6.

From all this we can conclude:

1) That any five-terminal rectifier stack, normally used as a bridge-type full-wave rectifier, can be used as a half-wave unit with the same voltage-input and current-output ratings as originally, by using the center as one terminal and the junction of the ends as the other.

2) That such half-wave units can be used in either center-tap or bridge-type full-wave circuits, in series or parallel to withstand the required voltage input or current output.

3) That by breaking the end-to-end junction and using the ends and center terminal as connecting points, the single unit can be used as a full-wave rectifier of the center-tap type, at original input voltage and current ratings.

— *Evert Rodenhouse, W7TQ*

RECTIFIER WIRING FOR RAPID TUBE SUBSTITUTION

It seems to be a natural law that when a rectifier tube goes west, there is not only no spare in the rack, but also the only available tube has a different socket pattern than the deceased.

Perusal of the socket patterns in the *Handbook* discloses that there are only three in use for five-volt octal-base full-wave rectifiers. So far as tube operation goes, two of the three are identical.

A single octal socket can be wired so that it will take any five-volt octal-base full-wave rectifier tube. This is accomplished by wiring Pins 2 and 7 together to form one side of the filament circuit, Pin 8 being the other in all cases. Also, wire Pins 3 and 4 together for connection of plate No. 1, and Pins 5 and 6 together for connection of plate No. 2.

With a socket thus wired, any one of nine rectifier tubes can be plugged in, and will work, provided the load for the tube is not exceeded by any great amount.

It is suggested that all emergency equipment be wired in this manner, to facilitate restoration of service in event of rectifier tube failure.

— *Ronald L. Ives*

JR. OP "INSURANCE"

An automobile ignition switch of the universal type, available at auto supply stores, is just the thing to lock the primary circuit of the transmitter so unauthorized persons cannot turn it on. It helps keep the exploring fingers of the Jr. Op out of harm's way while Dad is at work.

Simply wire the ignition switch in place of the master filament switch. It can be mounted in the same hole by enlarging the hole with a ¾-inch socket punch.

— *Adelbert Kelley, W2CSX*

SOME USES FOR THE SCR-274 DYNAMOTORS

If you have a need for a small high-speed 115-volt a.c. motor, don't overlook the small dynamotors that come with the SCR-274-N receivers. With a minimum of effort they can be converted to do a good job.

Remove the socket and the wires from the base, and take off the end covers. Remove the castings holding the brushes, and replace them just opposite to the way they were removed. The low-voltage brushes and the small condenser that is across the contacts may be discarded.

Connect the wires from the field winding directly to the high-voltage brush holders, and bring out one lead from each brush to serve as the 115-volt a.c. input leads. Make sure that the high-voltage end of the armature is the one contacted by the brushes, otherwise a fuse will be blown! Drill and tap the end of the armature so that a small length of threaded rod can be inserted for a power take-off. A hole with a rubber grommet inserted in the other end of the case will serve to bring out the 115-volt leads. A small toggle switch can also be installed in the end cover. Be sure to remove the small grounding straps from the brushes to the frame.

When reassembled, the motor has its original appearance except for the power take-off rod extending out of one end, and the line cord out of the other. The motor will handle a six-inch fan.

— *Elmo V. Boswell, W0PXW*

D.C. HEATER SUPPLY

There are times when a.c. heater operation results in undesirable hum effects, no matter how much care is taken to prevent it. Examples are the hum introduced in the first stage of a high-gain audio amplifier and the frequency modulation that often occurs in "hot cathode" oscillator circuits. The latter is particularly bothersome at frequencies of the order of 14 Mc. and higher in receiver h.f. oscillators and in VFOs.

A simple way out is to use a d.c. heater supply for the tube in which the hum or modulation arises. The circuit given in Fig. 5-7 will easily handle one 6.3-volt 0.3-amp. heater and has a

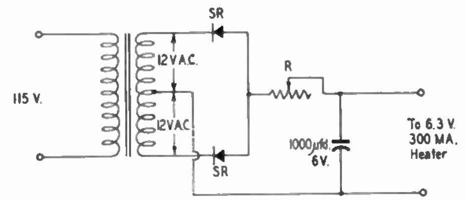


Fig. 5-7 — Circuit diagram of a d.c. heater supply for hum reduction in oscillators, speech amplifiers, etc.

ripple content of only about 3 per cent r.m.s. The rectifier is a rebuilt b.c. type selenium half-wave unit normally rated for 115-volt 100-ma. operation. These rectifiers consist of six plates, and when taken apart may be reassembled into a full-wave rectifier having three plates in parallel on each side. So connected, they can deliver 600 ma. without overload.

The selenium rectifier may be reassembled on the original support if additional soldering lugs similar to those on the unit are made from thin brass or other metal that will take solder.

The resistor, *R*, serves the dual purpose of adjustment of output voltage and of providing filtering in conjunction with the 1000-μfd. condenser. With a center-tapped 24-volt filament transformer, as indicated in the drawing, a resistance in the neighborhood of 15 ohms will drop the voltage to 6.3 across a 300-ma. tube heater. An adjustable resistor should be used and the voltage set to the correct value by means of a d.c. voltmeter. Small 24-volt filament transformers have been on the market, but if not readily available it is not much of a job to rewind the secondary of the smallest size of 6.3-volt transformer. The output voltage is not critical, so long as at least 10 volts each side of the center-tap can be obtained, because any excess voltage drop can be taken up in the resistor.

While it is seldom necessary to handle two heaters (600 ma.), the rectifier is capable of it. To maintain the same filtering, the capacitance should be increased to 2000 μfd. The resistance will be about halved because of the greater current drain.

These supplies should never be operated without the tube heater connected, because with no load the voltage will rise to a value that may break down the filter condenser.

— *George Grammer, W1DF*

ECONOMICAL BIAS SUPPLY

Shown in Fig. 5-8 is a system for obtaining fixed bias from an existing low-voltage plate supply at low cost. The output voltage is adjustable, depending on the size of C_1. Resistor R_2 may be omitted if desired, as it merely serves as a bleeder to discharge C_1. Most constructors will prefer to retain it to avoid shocks, and because its value is high it wastes very little power.

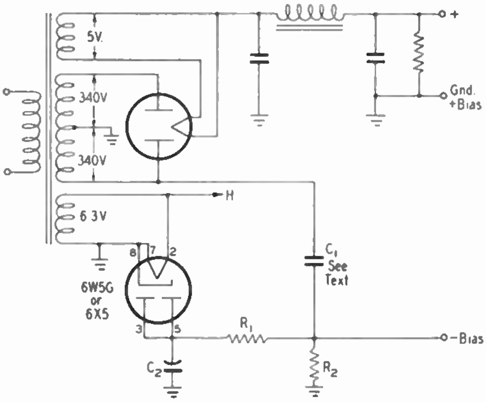


Fig. 5-8 — An economical bias supply that can be added to an existing low-voltage supply with a minimum of effort. Values are given below for the parts in the bias supply only.

C_1 — Value depends on desired output voltage. See text.
C_2 — 8-μfd. 450-volt electrolytic.
R_1 — 30,000 ohms, 1 watt.
R_2 — 0.1 megohm, 1 watt.

The following tabulation shows how the output voltage varies with the size of C_1:

C_1 (μfd.)	D.C. Volts
0.5	−340
0.25	−330
0.1	−240
0.05	−160
0.04	−140
0.01	−37
0.006	−23
0.002	−10.5
0.001	−7.6
0.00025	−3.2

These measurements were made with a vacuum-tube voltmeter and were for a transformer rated at 340 volts each side of center tap. The current rating of such a supply is limited by the size of the components and the ratings of the transformer and rectifiers, but it is adequate to supply bias for small tetrodes such as the 807, and is also usable as blocking bias in grid-blocked keying systems.

As an inexpensive way to get your bias requirements this system is hard to beat. It eliminates the need for large dropping resistors and dry cells, and requires so little space that it can usually be added to an existing power-supply chassis without crowding.

— *Frank A. Reed, jr., W6PWQ*

LOW-IMPEDANCE BIAS SOURCE FOR CLASS-B MODULATORS

Providing a good low-impedance bias source for use with Class B modulators has always been a problem with a high nuisance value, especially in modulators where the grid current requirements are high. Batteries have been about the simplest way out, but batteries are expensive, and they don't last very long when they are tied onto the grids of a pair of tubes like the 810. The circuit shown in Fig. 5-9 solves the problem permanently, and at low initial cost, because the tubes used are readily available from surplus stocks, and the other parts are inexpensive.

The arrangement makes use of Type 2050 and 2051 thyratrons as regulator tubes. When connected as shown in the diagram, with the control- and screen-grids tied to the cathode, these tubes will regulate at 8 volts and 13 volts respectively. At the low anode voltages encountered in normal biasing service, they can be used to regulate up to 100 ma. average current, considerably more on peaks. Thus, they may be used to hold grid voltage constant over the full range encountered in most ham rigs. Because these tubes have indirectly heated cathodes they may be operated from a common filament winding.

By judicious selection of the number of each of

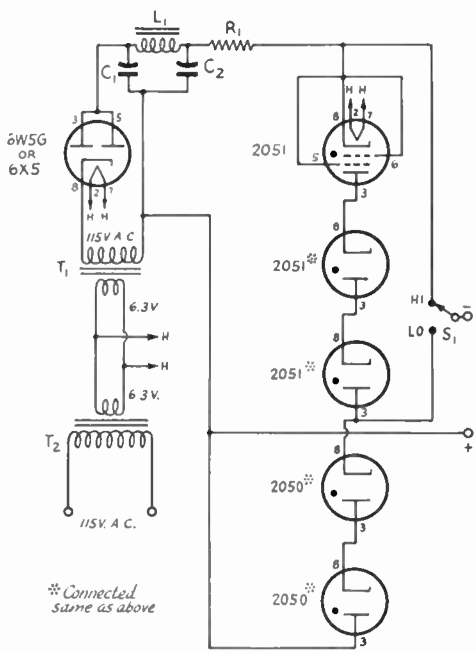


Fig. 5-9 — In this low-impedance bias supply, thyratrons are used as voltage regulators. Two filament transformers are used "back-to-back" in an inexpensive arrangement suitable for biasing Class B 810 modulators or other similar tubes.

C_1 — 40 μfd., 150 volts.
C_2 — 20 μfd., 150 volts.
R_1 — 3000 ohms, 10 watts.
L_1 — 8-hy. 50-ma. filter choke.
T_1 — 6.3 volts, 1 amp.
T_2 — 6.3 volts, 4 amp.

the two types used in the series-connected arrangement, a wide variety of bias voltages may be obtained. For example, in the rig at W4BBL, a "hi-lo" power switch is used to change the plate voltage on the final and the modulators from 2200 volts to 1100 volts. This requires a corresponding change in the bias applied to the modulator tubes. By having three 2051 tubes in series at the high end of the chain and two 2050s at the low end, 55 volts bias is obtained when the switch is in the "hi" position, and 16 volts when it is turned to "lo." Other combinations can be worked out by rearranging the number and type of tubes used.

— *C. S. Harrill, W4BBL*

HAND-DRIVEN GENERATOR HINTS

For emergency use, I recently purchased a BC-1306 rig, complete with hand generator GN-58. Anyone who has ever cranked one of these units will attest to the fact that it is next to impossible to crank with one hand and send with the other, and talking isn't much use either, if you're short-winded! However, by anchoring the tripod that holds the generator, and sitting on a chair, it is possible to pedal the thing like a bike, leaving both hands free. Provided you keep your transmissions short, it's not too tiring.

For the real lazy man, however, it is possible to run the generator from a 6-volt storage battery. Attach the battery leads directly to the brush connections on the low-voltage commutator. The generator will run as a d.c. motor and will generate at the same time, delivering only slightly less voltage than when cranked by hand.

— *Russ Robinson, W4JGS*

BIAS SUPPLY USING VOLTAGE-REGULATOR TUBES IN PARALLEL

Anyone attempting to construct a regulated power supply using VR tubes in parallel usually finds a problem on hand. This is true even though the circuit employs equalizing resistors intended to make parallel tube operation possible. Sometimes, by careful tube matching, it is possible to make a pair of tubes fire, but an attempt to ignite three or more tubes ordinarily spells trouble. The difficulty encountered is that as soon as one tube ignites, the voltage across the other regulators is instantly dropped below the firing point and these latter tubes just cannot fire.

An investigation of this subject came about when the need for a bias supply arose. The supply requirements were −75 volts with key up and −200 volts at approximately 200 ma. (amplifier grid current) with key down. Inasmuch as the supply was to be used with a kilowatt final, it was important that it be foolproof. Naturally, the standard regulator circuits were given a whirl first. Supply voltages up to 400 volts were used, and both gradual and shock excitation of three VR tubes were tried. In all cases, it was impossible to depend on sure-fire operation of the power pack.

The remedy, once arrived at, is simple. Three 0A3s were hooked up as shown in Fig. 5-10, with the circuit broken up into three resistive paths. R_1, R_2 and R_3 are the series resistors for the individual VR tubes and each regulator acts independently of the other two. The normal grid-leak resistor is replaced with three separate units, R_4, R_5 and R_6, of the proper resistance to give the desired voltage drop (125 volts in this case). Naturally, the reliability of the whole circuit is improved because of the divided responsibility among the several components.

Resistors R_1, R_2 and R_3 are selected to maintain 5 ma. current per VR tube, or a 15-ma. total. When keying 100 ma. grid current through these tubes, it is interesting that the 15-ma. supply current remains unchanged. This makes relay interlocking for the bias pack a simple matter. As shown in the diagram, if a relay that operates at 12 ma. is inserted in series with the supply output lead (right after the filter), it can be used to activate the high-voltage supply.

Incidentally, do not attempt to use a 130-volt transformer and a dry rectifier in this type of pack. Use a full-wave vacuum tube such as a Type 80 or 5Y3, and a filter output voltage around 220–250 volts. Otherwise, there will be a current reversal through the dry rectifier, or variation in supply current which interferes with relay action.

— *Donald F. Alexander, W8DMN*

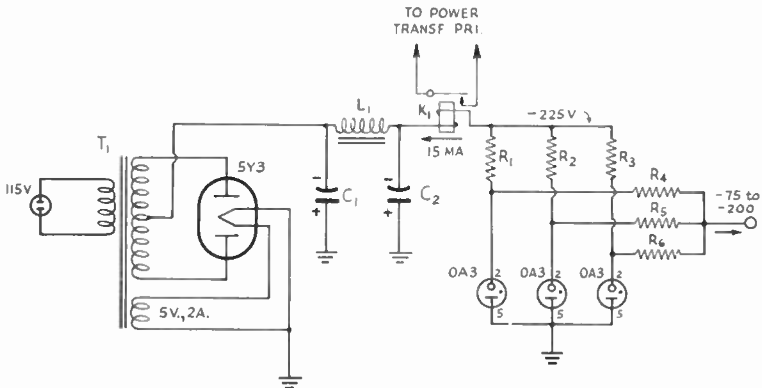


Fig. 5-10 — Circuit diagram of the regulated C-bias supply.

C_1, C_2 — 20-μfd. 450-volt electrolytic.

R_1, R_2, R_3 — 27,000 ohms, 2 watts.

R_4, R_5, R_6 — 4000 ohms, 5 watts.

L_1 — 20-hy. 15-ma. filter choke.

K_1 — Control relay with 50-ohm coil (Sigma model 3A).

T_1 — Power transformer to deliver approximately 225 volts at filter output.

BIAS SYSTEM FOR CLASS-B MODULATORS

Shown in Fig. 5-11 is an arrangement that can be used to provide bias for the Class B modulator set-up encountered in most medium-power

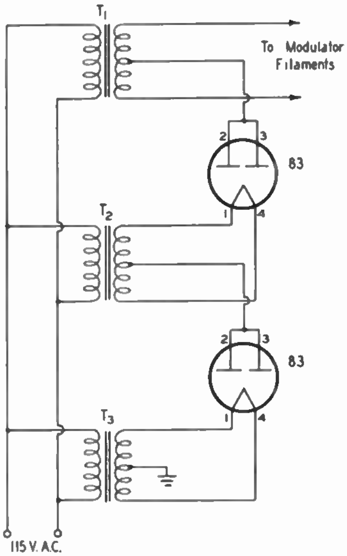


Fig. 5-11 — Simple bias system for use with medium-power Class B modulators. Additional mercury-vapor rectifiers may be added to obtain higher bias voltage, if desired. T_1 is the usual filament transformer in the Class B stage, while T_2 and T_3 should be selected for the particular rectifier tubes used in the system.

ham rigs. The scheme makes use of the constant drop of about 15 volts obtained with mercury-vapor rectifiers. Type 83s are shown in the diagram, and they provide about 30 volts of bias. Adding a third tube and transformer will boost this to 45 volts, and so on. Larger tubes, such as the 866, should be used where higher peak currents are encountered. The filament transformers need not be insulated for high voltage.

— *R. T. McFarland, W2SKT*

BATTERY-SAVING HINT

Much battery-powered gear obtains its "B" voltage from two batteries in series, using, for instance, two 45-volt units in series to get 90

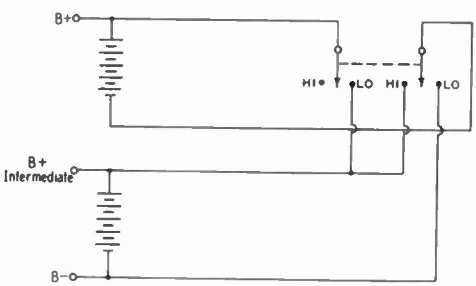


Fig. 5-12 — A novel power-saving system for battery operated gear. Throwing the switch from "HI" to "LO" results in operation at half normal plate voltage.

volts, or, in the case of my own blooper, two 67½-volt units to get 135 volts. In many cases the full B voltage may not be required; for example, when a receiver is tuned to a strong signal which does not require full gain of the receiver, or in the case of a transmitter which is operating over a short distance with a strong signal. In these cases full plate voltage is unnecessary, but we usually adjust things by turning the volume control down. This does not reduce the battery drain in any way, and they go right on draining at the same rate whether conditions are good or bad. Battery power is expensive, and the simple switching circuit shown in Fig. 5-12 goes a long way toward conserving battery life under the conditions outlined above.

A d.p.d.t. switch is used to change the battery connections from series ("HI") to parallel ("LO"). This results in less current drain, and distributes the load over two batteries instead of concentrating it on one. The point in the diagram marked "B + Intermediate" remains at the same voltage regardless of the switch position, and can be used for circuits where constancy of voltage is important, such as for the local oscillator in the receiver or for the VFO in the transmitter.

— *Charles Erwin Cohn*

HOMEMADE HIGH-VOLTAGE TERMINAL

A very satisfactory high-voltage terminal of the quick-disconnect type can be made from a National XS feed-through bushing, a Type SPP plate connector, and the top cap of a burned-out tube. The method is shown in Fig. 5-13.

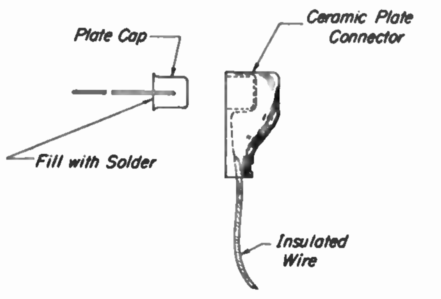


Fig. 5-13 — Improvised high-voltage terminal made from junk-box parts.

Clean out the top cap. Then insert the threaded bolt from the ceramic bushing, and flow solder in around it until a firm joint is made. Reassemble the bushing on the chassis. The ceramic plate connector can then be used to attach the lead from the power supply.

— *Earl F. Hart*

HIGH-VOLTAGE DIVISION FOR POWER-SUPPLY ECONOMY

Considerable saving of space and power can be obtained through the use of the circuit arrangement shown in Fig. 5-14. A single high-voltage supply is used for both driver and amplifier stages by placing the two in series across the

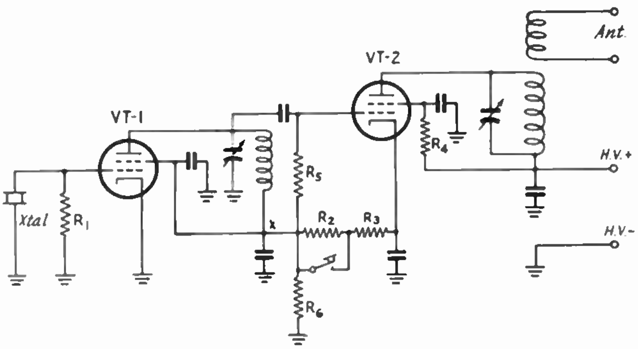


Fig. 5-14 — An unusual arrangement for using a single power supply for both driver and final amplifier. Values of the various components are discussed in the text.

supply. In addition to the savings in power supply, the arrangement has certain other advantages which are discussed below.

The suggested arrangement shown in the diagram may be adapted to nearly any tube complement. The high voltage is applied to the plate and screen circuits of the amplifier, VT_2, in the usual manner. The driver stage, VT_1, is then connected in series with the amplifier, making use of the voltage drop between plate and cathode to reduce voltage to the value needed by the driver tube. This means, of course, that the cathode of the amplifier stage is above ground by the amount of the voltage drop encountered in R_6 plus R_3. The voltage applied to the plate circuit of the driver is thus determined by the cathode current of VT_2.

In the diagram, R_3 is the cathode-biasing resistor for the amplifier, R_2 is a grid-blocking resistor of about 50,000 ohms, and R_5 is the required grid leak for the stage. It is returned to cathode through the blocking resistor, which is shorted out when the key is closed, and through R_3.

Assume that VT_2 is an 807 or 6L6, and the crystal oscillator is a 6C4 or 6C5. The plate supply is rated to furnish 450 volts at 100 ma. In the arrangement shown, 350 volts will be applied to the amplifier plate circuit, and 100 volts to the crystal oscillator. The plate-screen current of the amplifier may be as much as 100 ma., while the oscillator will draw about 20 ma. R_6 should be of sufficient wattage and resistance to pass the total current requirements of both stages and to produce, in conjunction with the voltage drop through VT_2, the necessary plate voltage for the oscillator. In the example cited, the value of R_6 is 1250 ohms.

The voltages and currents mentioned above are those encountered when the amplifier is fully loaded. The novelty of the arrangement becomes apparent when the circuit is tuned. With the oscillator operating normally, and the grid of VT_2 fully excited, the plate-screen voltage of VT_2 will depend upon its loading. Should the antenna be disconnected and the amplifier tank circuit resonated, the plate-screen current will drop appreciably. This, in turn, will reduce the voltage applied to the driver stage VT_1. In consequence, the r.f. drive to VT_2 will be reduced. Thus, grid drive to VT_2 is proportional to its plate loading, and is self-regulating. This prevents high r.f. voltages from appearing in the tank circuit of the amplifier when it is unloaded, which always happens in conventional circuits. It therefore becomes possible to use plate-tuning condensers and band-changing switches of much smaller dimensions and voltage rating than ordinary. As a matter of fact, receiving condensers and small ceramic switches may be used quite successfully in a 50-watt rig.

Another desirable feature of this circuit is the keying arrangement. With the key open the grid is negative with respect to cathode because it is tapped onto the voltage divider made up of VT_2, R_3, R_2, and R_6. Thus, plate current in VT_2 is reduced to a very low value. With VT_2 almost inoperative, the plate voltage applied to the oscillator, VT_1, drops to a very low value, rendering the oscillator inoperative. A hand key is shown in the diagram, but in the interest of safety it is desirable to substitute a relay, especially where high voltages are involved. As a matter of fact, the voltage across the key will not exceed that applied to the plate circuit of the driver tube, as measured from point *X* to ground.

The circuit described has been used by the writer with many tube arrangements. In one case, VT_2 represented a pair of 813s and VT_1 was a series of three 6L6 tubes in multiplier stages. The cathode current of the two 813s was used to provide the voltage drop to the plate-screen circuits of the 6L6s. The number of tubes in the driver circuits is limited only by the cathode current of amplifier, which must equal the sum of the plate and screen currents of all the driver tubes.

While it is true that a sacrifice in amplifier plate voltage must be made to provide plate voltage for the drivers, this reduction is more than offset by the great saving in space and weight of separate supplies, or of the relatively tremendous wattage consumed by dropping resistors.

— *E. F. Lewis, W2CPD*

TRANSFORMERLESS SUPPLY HINT

In circuits using a transformerless power supply it is often suggested, as a safety precaution, that a single lead be run from the "high" side of the equipment to the a.c. plug with the return circuit made by an external ground connection. About half of the time the plug is put in the wrong way, and nothing happens until it is reversed.

This inconvenient condition may be eliminated by marking the polarity of the outlets to be used or, where this is impractical, using the circuit

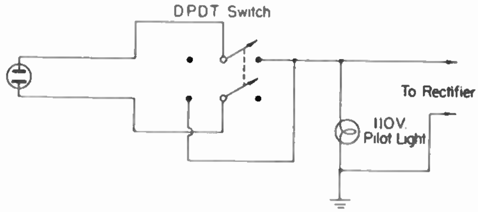


Fig. 5-15 — Handy way to get around the problem of polarization of a.c. input to transformerless power supplies.

shown in Fig. 5-15. Note that the position of the switch that corresponds to "on" is determined by the way the plug is inserted in the outlet.

— *Henry S. Burden, W4MRK*

CONSTRUCTING SAFETY INTERLOCKS FROM STANDARD PARTS

Although interlock switches are recommended on all radio equipment so that when the cabinet door is opened all high-voltage circuits are de-energized, such switches are not readily available, and many of the small commercial models are not in accord with local electrical codes.

A neat and relatively inexpensive interlock switch that is quite safe and which will pass most electrical inspectors can be constructed easily from a Microswitch and a few standard fittings. Constructional details are sketched in Fig. 5-16. Because all electrical parts are standard UL or AN fittings, and all fit together without alterations, appearance is quite workmanlike and neat.

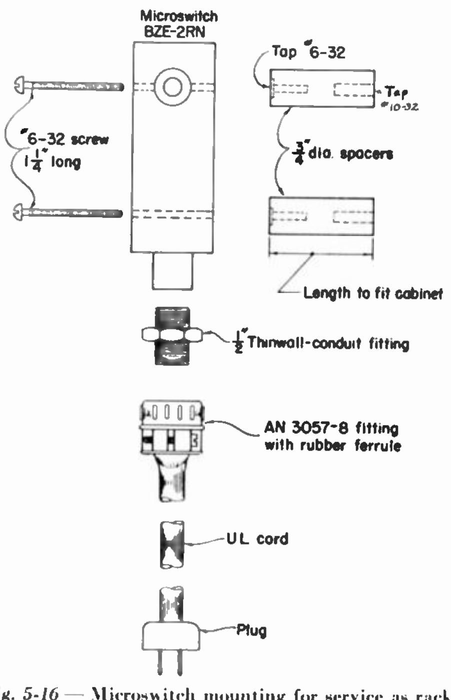
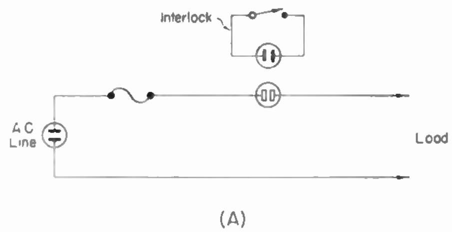


Fig. 5-16 — Microswitch mounting for service as rack-cabinet interlock.

Mountings for most rack cabinets are quite simple, requiring only straightforward machine work, with no highly-critical dimensions.

Length of spacers, for Par-Metal rack cabinets of the ER-223 series, should be about 1¼ inches. The switch is held in place by two 10-32 rack screws through the side of the cabinet. Alternative mountings include a right-angle bracket screwed to the rear frame of the cabinet, and a bracket to support the switch from the rear of a convenient chassis. Best location for the switch is so that the actuating button is operated by the door catch housing when the cabinet door is latched. This eliminates any tendency of the switch to warp the cabinet door.

A satisfactory electrical location for a safety interlock switch is between the main fuse and the main system switch, as in Fig. 5-17A. If extra



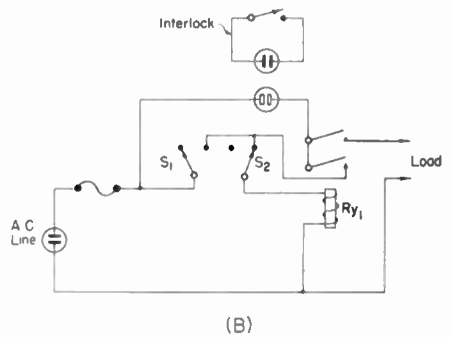


Fig. 5-17 — A — Simple interlock circuit. The switch is simply plugged in series with the a.c. line. B — Circuit using interlock in conjunction with a locking relay. The switches are pushbutton type. S_1 (on) is normally open, while S_2 (off) is normally closed.

safety is desired, the interlock can be used in conjunction with an electrically self-holding relay, as shown in Fig. 5-17B. This prevents accidental or intentional turning on of the power by manual operation of the interlock. Once the circuit is broken by S_2, it is necessary not only to close the interlock, but also to close the "start" or "on" pushbutton switch before the system is electrically live. Since this requires the use of both hands when the cabinet is open, the chance of shocks is at a minimum.

Whatever circuit is used, some sort of safety interlock should be incorporated in every rack cabinet. Safety measures are much cheaper than funerals!

— *Ronald L. Ives*

6. Hints and Kinks . . .

for Keying and Monitoring

"MONITONE" MODIFICATIONS AND APPLICATIONS

After using the "Monitone" described in May, 1951, *QST*, I wanted to do something to reduce the gain of the receiver while the key was closed. The scheme shown in Fig. 6-1 does the trick nicely. The negative bias developed across R_9 in the Monitone is applied to the grid of the first r.f. stage in the receiver. No changes are made in the Monitone circuit.

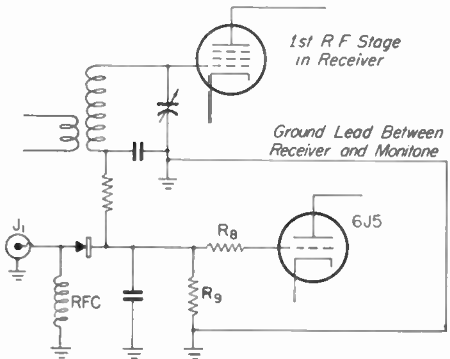


Fig. 6-1 — A simple way to reduce receiver gain during key-down periods. The grid resistor of the first r.f. stage is lifted and connected to a point in the Monitone. No changes need be made in the values of any of the resistors in either the Monitone or the receiver.

In operation, when the key is closed the normal tone is heard in the headphones, but the receiver gain drops sharply, preventing the S-meter from being driven off scale by the transmitted signal. This makes for better break-in, because the receiver takes less time to recover.

— *W. Fraser, GM3BL*

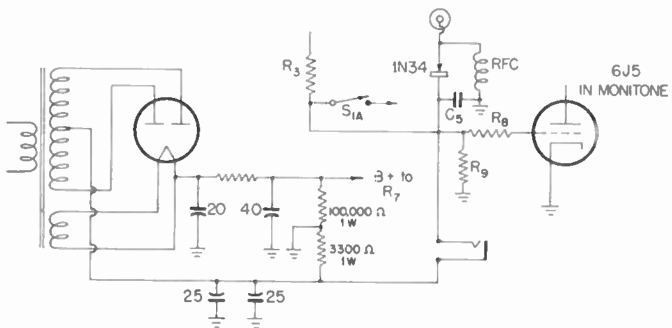
Having a "Monitone," and needing a code-practice oscillator to school my two jr. ops for their Novice ticket, I came up with the idea shown in Fig. 6-2. It is passed along to other amateurs who may find it of interest as a means of adding another piece of equipment to the station without taking up more space on the operating desk.

By lifting the center-tap of the power transformer and inserting about 3300 ohms, a bias voltage is developed when current flows through the resistor. After filtering with the values shown in the diagram, about 6 volts d.c. bias is obtained. This is connected, through an open-circuit jack (insulated from the chassis), to the junction of R_8 and R_9 in the grid of the 6J5 tube in the Monitone.

This arrangement operates the relaxation oscillator very nicely through the full tone range. I have found it extremely useful in adjusting my bug to my liking as well as for sending code practice.

— *Charles E. Tamm, W1MIV*

Fig. 6-2 — Still another modification of the famed "Monitone." This one converts it to a code-practice oscillator at low cost.



QUICK QRS FOR BUG USERS

I HAVE FOUND the following trick quite useful in making rapid changes in speed when using a bug key. I adjust the weights on the bug for the highest speed I normally use, and then slow it down by merely slipping a large nut over the set-screw of one of the weights. Several different nuts can be kept available at the operating position to permit speed changes to be made at an instant's notice without having to disturb the original adjustment.

— *Merritt E. Malvern, W2ORG*

HOMEMADE BUG WEIGHT

USE a 7/8-inch diameter bit to drill a hole 1/2 inch into a block of wood. Then fill the hole to a depth of 3/8 inch with solder. The wood, being a good heat insulator, will help keep the solder molten while you probe for the center (a pit left by the guide screw of the wood drill) with a toothpick. Hold the toothpick in place until the solder

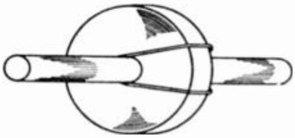


Fig. 6-3 — Homemade bug weight used by W6KIR.

hardens and then use it as a pilot for a 1/8-inch metal drill. Drill straight through the solder and then remove same from the block. After the new weight has been positioned on the bug shaft, it may be secured with an elastic band.

— *Ralph W. Stewart, W6KIR*

ANTI-SKID TREATMENT FOR BUGS

THE tendency for a bug to slide across the smooth top of the operating table can be cured easily without resorting to unsightly rubber pads, screws, etc., and without marring the finish of the finest table. Merely rub a small piece of beeswax on the rubber feet of the bug and it will stay in place as though fastened down. This will work on surfaces as smooth as glass. If beeswax is not available, the wax coating from an old paper condenser will do as well.

— *William J. Wright, W5KYK*

THE following method of keeping bugs from walking has been used on shipboard and has held the key even during a 47-degree roll.

First remove the dust from the feet of the bug and from the desk or table by using a damp rag. After these surfaces have been dried, small pieces of friction tape should be placed under the feet of the bug. Now, hand pressure should be exerted to make the works stick together.

— *W. J. Davenport, W3PFA*

IF you are bothered by having your bug "walk" across the operating table during each transmission, your problem can be solved simply and inexpensively by placing a piece of Life Guard Cushion Rug Holder beneath it. This material, which is designed expressly to prevent small throw rugs from slipping on waxed floors, is obtainable at hardware and rug stores. It won't mar the operating table, and requires no permanent attachment. Just cut a sheet the size of the base of your bug, place the bug on it, and try to budge it. It even works on surfaces as slippery as glass.

— *C. Vernon Chambers, W1JEQ*

HERE's a method of obtaining a solid mounting for your key without having to bolt the thing to your good mahogany desk. Take a piece of 1/4- to 1/2-inch boiler plate about 6 by 4 inches and drill the necessary hole for mounting the key. Counterbore the holes on the bottom surface to "sink" the heads of the mounting screws. Then round off and polish the edges by filing, grinding, and buffing. A piece of billard cloth or felt glued to the bottom will keep it from scratching the desk. Your XYL will be much happier about things, and your key will stay put.

— *James Gray, VE8CR*

THE soft sponge rubber from the inside of an old automobile radio vibrator makes a nifty pad on which to place your key. It won't slip, and it will act as a "silencer" if you are a heavy-fisted brasspounder.

— *Merritt Malvern, W2ORG*

THE "SIAMESE PADDLE"

ALMOST anyone who has built an electronic keyer has gone through the experience of discovering, usually after completing the electronic part, that the control mechanism — the switch, or key — can be much more of a problem. A glance at the circuit of one of these devices fails to show why an old hack-saw blade wouldn't do the trick. But this is far from the truth. Positive and reliable control requires a considerable degree of mechanical refinement, as attested by the fact that a ham will often chop up a twenty-dollar bug to get the few essential parts he needs. Satisfactory homemade substitutes require greater than an ordinary amount of skill with tools.

However, I recently discovered that there is a very simple solution to the problem. A pair of ordinary inexpensive straight keys can be made into a de luxe keyer control in less than an hour, if you don't insist on trimming it up. It not only supplies a good wobble-free mechanism, but it also provides for convenient adjustment of tension and contact spacing, satisfying the most finicky operator.

As Fig. 6-4 shows, it is simply a matter of mounting the two keys back to back in a vertical position. The keys shown in the photograph are Type J-38, selling in surplus for as low as 85 cents each, although almost any other type can be adapted. The J-38s are particularly suitable because they come mounted on bakelite bases, one of which can be put to use since most electronic-keyer circuits require insulation for all three terminals of the control.

First remove the two keys from their bases, strip one of the bases of the remaining hardware and remove the shorting levers from both keys. It may be necessary to lift the key arm out of its bearings to get at the screw holding the lever. Now place the keys on edge, with their bottoms facing, and clamp them together with a 6-32 machine screw through the upper mounting-screw hole. Using another 6-32 screw through the lower mounting hole, fasten a 1-inch hardware-store angle piece on each side with the legs extending outward. (The brass-plated pieces usually found in hardware stores, but less often in dime stores, make a much neater job than the common iron variety.) Make sure that the strap connecting the stationary key contact to its terminal doesn't short-circuit against the angle piece.

The front end of the assembly is supported on 1½-inch hardware-store angle pieces. One leg of each of the two pieces is shortened by cutting it off about midway between the two holes. One of these angle pieces is then fastened to the lower terminal of each key, using the terminal cap screw through the top hole in the longer leg of the angle piece. The short legs should point inward.

One of the J-38 bakelite bases is then marked and drilled to fit the holes in the feet of the mounting angles. The key should be placed with the feet centered on the base. The holes should be well countersunk underneath so that flat-head mounting screws do not protrude.

The paddles are made of pieces of ⅛-inch polystyrene or lucite sheet, 2½ inches long and 1 inch wide. A hole to pass a machine screw that fits the knob hole in the key arm is drilled in each paddle, ½ inch from one end. Most key knobs have a standard 8-32 thread. The exact manner of mounting the paddles depends on factors to be discussed presently.

If you can locate a piece of ½-inch steel or brass, you can add a weighting base with rubber feet like the conventional bug. The base shown is 6 inches long and 3 inches wide. Be sure that the mounting screws on the underside of the bakelite base don't protrude so as to short on the metal base. If the weighting base is omitted, the key can be screwed or cemented to the operating table. Rubber cement sets quickly and yet permits removal without difficulty. Also, it will not mar the finish of an operating table.

The adjustment of the key depends largely on the personal preferences of the operator. I have mine adjusted so that both sets of contacts cannot be closed simultaneously. However, many of those who are using electronic keyers of the self-completing type find possible many short-cuts in the forming of certain characters and increased ease of handling in other ways if it is possible to close both circuits at once when desired. For instance, closing the dot side while dashes are being sent does not interfere with the sending of dashes. Therefore, when both sides are closed, the change-over from dashes to dots can be accomplished merely by opening the dash side.

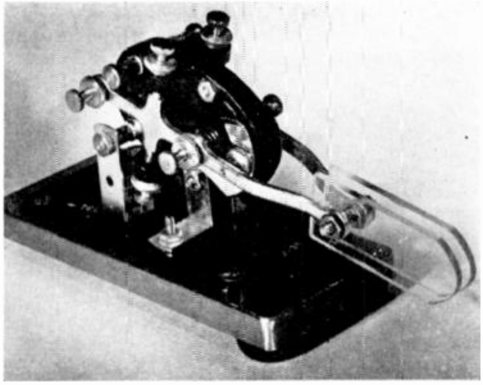


Fig. 6-4 — **By simply mounting two standard keys back to back in this fashion you can have a de luxe control for an electronic keyer in less time than it takes to tell about it.**

Actually, it is necessary to open the dot side only for spaces.

As shown in the photograph, the paddles are mounted on the inward sides of the key levers, with the heads of the 8-32 screws also on the inside. With this arrangement it may be necessary to bend the key levers slightly if it is desired to prevent closing both circuits at the same time. Place a thickness or two of paper between the contacts of each key and press the two paddles together between the thumb and forefinger. Then bend the levers slightly so that when the paper is pinched securely between both sets of contacts, the heads of the screws are in contact.

After the photograph was made, an arrangement making this adjustment more convenient was found. The paddles were placed on the outer side of the key levers and the screws were reversed with the heads on the outside. A locknut was first run onto each screw. Then the screw was passed through the paddle, threaded into the key lever, and then fastened with another locknut on the inside. Now the above adjustment can be made simply by adjusting the screws with a screwdriver and locking with the two nuts. I prefer the wider paddle spacing that results with this arrangement, although others may prefer the closer spacing when the paddles are on the inside. It will usually be possible to use the screwdriver adjustment, even with the paddles on the inside, although it may be necessary to file the nuts down to fit the space between the key levers.

If simultaneous closing of both sides of the circuit is desired, adjustment is merely a matter of setting the contact spacing, bearing play and spring tension to suit the operator, using the adjusting screws already provided on the keys for these purposes. If you have a light touch, it may be necessary to change the springs to lighter ones, or to cut a turn or two off the existing springs and stretch to fit the space.

In the electronic-keyer circuit, the "arm" connection will be made to one of the terminals connected to the frames of the keys, while the two "side"-contact connections will be made to the terminals connected to the straps leading to the stationary contacts. Depending upon how these two "side" contacts are connected, the keyer can be operated either right-handed or left-handed. Simply reversing these connections reverses the operation.

— *Myron Hexter, W9FKC*

BETTER KEYING FOR THE CONVERTED BC-457

I am one of the fellows who has undertaken the job of converting a BC-457 for use on Novice frequencies and, like many others, has encountered considerable difficulty with oscillator instability and poor keying. W7KOG saved the situation for me by suggesting the substitution of a Type 12A6 tube for the 1626 ordinarily used in the oscillator. The only alterations that need be made are the addition of a 20,000-ohm dropping resistor and a 0.001-μfd. by-pass for the screen of the 12A6. With the circuit as modified, there is no difficulty getting any crystal to oscillate and frequency drifting is a thing of the past.

— *Vernon M. Slichter, WN7RKY*

ANOTHER VACUUM-TUBE KEYER

The usual key-click, or "shaping," filter consists of a choke and a condenser and, while effective when you have found the right combination, it does require some large components if any appreciable current is being broken. One alternative is a vacuum-tube keyer,[1] in which a vacuum tube, a few resistors and a condenser can do practically the same job. The vacuum-tube keyer is popular also because it is impossible to get any significant electrical shock at the key terminals of such a unit.

The problem at KL7AQZ was to key the 6AG7 crystal-oscillator stage that was used to drive a pair of 807s. When a conventional triode tube keyer was tried, too much of the available voltage was lost across the keyer tube, and an alternative was looked for. A pentode or tetrode seemed to be the obvious answer, and one was tried (Fig. 6-5). It worked fine. With the values that were tried, the drop across the keyer tube was measured to be less than 10 volts.

Instead of adjusting the keying shape by the selection of R_4 and R_5 and the addition of a condenser from the 6V6 grid to ground, C_3 and C_4 were adjusted until the desired characteristic was obtained. This effect would be present in any event, since C_3 and C_4 are required for r.f. by-passing, and their capacities would contribute to the final result. By making C_4 small compared to C_3, the click on "break" is increased; conversely, by making C_3 small with respect to C_4, the click on "break" is reduced. The sum of both affects the "make" characteristic — the larger the sum, the softer the "make." Since the keying characteristic of a transmitter is a matter of personal preference, one should try different values than those shown, particularly if a different circuit or set of tube combinations is used. In this case it was found that the values of C_3 and C_4 should not differ by a factor of more than about 2 to 1; this might not be true if the circuit were used under different conditions.

The resistor R_3 may or may not be used, depending on the plate voltage in use. A screen bypass condenser may increase the output, but it wasn't necessary in this application. A large screen by-pass will soften the "break" characteristic, and hence it is one other component that can be juggled for optimum keying. If a higher plate voltage is used, it is advisable to feed the oscillator screen grid from the same 150-volt source as the 6V6 screen, since otherwise the value of R_3 would become too large.

As in any tube keyer, the key is quite safe from any danger of electrical shock.

With a tube keyer of this type, the keying characteristic with different crystals remains practically the same with varying tuning and loading conditions, assuming crystals of reasonable activity.

— *Howard F. Bates, KL7AQZ*

[1] E.g., Fig. 8-10, *The Radio Amateur's Handbook*, 30th and 31st editions.

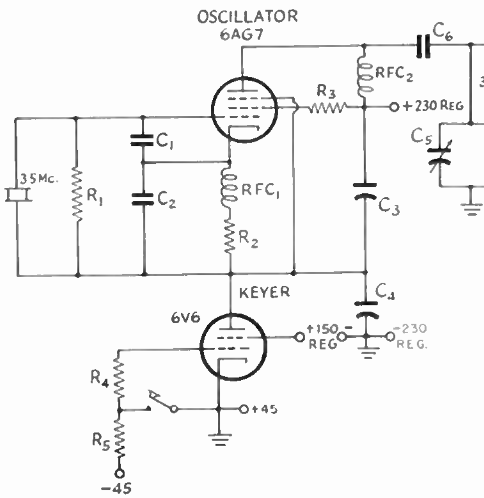


Fig. 6-5 — Circuit diagram of the crystal oscillator and vacuum tube keyer used at KL7AQZ.

C_1 — 10 μμfd.
C_2 — 47 μμfd.
C_3, C_4 — 0.1-μfd. 400-volt paper.
C_5 — 200-μμfd. variable.
C_6 — 0.01-μfd. ceramic or mica.
C_7 — 100-μμfd. variable.
R_1 — 68,000 ohms.
R_2 — 390 ohms.
R_3 — 10,000 ohms.
R_4, R_5 — 1 megohm.
L_1 — 80-meter coil.
RFC_1, RFC_2 — 2.5-mh. choke.

VACUUM-TUBE KEYER USING COMMON BIAS SOURCE

The v.t. keyer shown in Fig. 6-6 is used here at W5DF to key the buffer stage of a push-pull 807 rig. The circuit introduces a new angle in

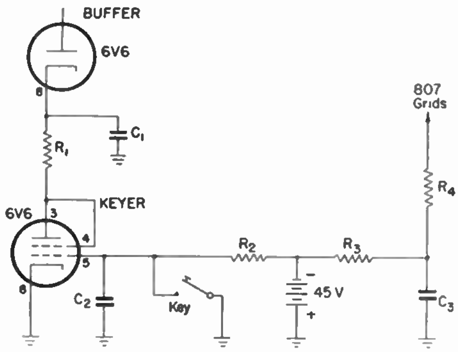


Fig. 6-6 — Circuit diagram of W5DF's vacuum-tube keyer.
C_1 — 0.001 μfd.
C_2 — 50 μμfd.
C_3 — 0.005 μfd.
R_1 — 1000 ohms, 5 watts.
R_2 — 10,000 ohms, ½ watt.
R_3 — 5000 ohms, 1 watt.
R_4 — 100 ohms, ½ watt.

the v.t. keyer arrangement, in using the same bias source for both the keyed stage and the amplifier stage.

A 45-volt battery serves as the bias source for the Type 6V6 keyer tube and for the 807 output amplifier. R_3 and R_4 are the grid-leak and decoupling resistors for the amplifier grid circuit and R_2 prevents a short circuit across the battery when the key is closed. Although R_2 has a resistance of only 10,000 ohms, it does not load the battery appreciably because the current through this branch of the circuit is nearly balanced by the amplifier grid current. Even a half-dead battery with high internal resistance does not show much change of voltage when the circuit is keyed and, as a result, a block of this type may be used as long as it still delivers approximately 45 volts — enough to cut off the 6V6. C_2 is an r.f. by-pass for the grid of the keyer tube.

— *A. D. Mayo, W5DF*

CLAMP-TUBE SCREEN-GRID KEYER CIRCUIT

An arrangement used for both the protection and the keying of an ARC-5 final amplifier is shown in Fig. 6-7. Most of the parts used were taken from surplus equipment, explaining the selection of a Type 12A6 tube for the circuit. The circuit is unlike other clampers in that it provides the amplifier screen grids with a negative potential during key-up periods. Naturally, this condition results in maximum amplifier cut-off, which in turn improves the possibilities of obtaining satisfactory amplifier keying.

In Fig. 6-7, the bias for the amplifier (either fixed or grid-leak) is fed to the 12A6 through resistors R_2 and R_3 and to the amplifier screens through R_1. A fixed positive voltage is fed to the 12A6 grid through R_4 and R_5 and the key is connected between the junction of these two resistors and ground. R_6 is the normal amplifier screen-dropping resistor and C_1 permits adjustment of the keying characteristics. The regulator tube is connected in series with the amplifier screen lead.

In operation, the circuit works as follows: With key up, the grid of the 12A6 is driven positive and the tube draws heavily through R_6 and, as a result, the OD3 will not conduct. Under these conditions, the screens of the amplifier tubes are connected back to the negative bias supply through R_1 and R_2. When the key is closed, it grounds the grid end of R_4 and thereby removes the positive bias from the grid of the 12A6. At this point, the negative bias takes over and cuts off the clamp tube which, in turn, ceases to draw current through R_6. When the 12A6 cuts off, the OD3 conducts and a positive voltage is applied to the amplifier screens.

Most of the circuit constants are not too critical. However, R_3 should be about as shown. If the resistance is too large, it will cause backwave when the final is keyed. If the value is too low,

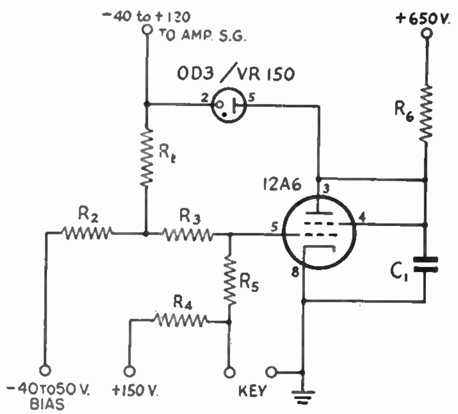


Fig. 6-7 — Circuit of the clamp-tube screen-grid keyer.
C_1 — 0.05 μfd.
R_1 — 0.47 megohm, ½ watt.
R_2 — 27,000 ohms, ½ watt.
R_3, R_4, R_5 — 0.27 megohm, ½ watt.
R_6 — 50,000 ohms, 20 watts.

it will cause the bias to change with keying. The value suggested for R_4 is suitable for use with a 150-volt supply and the resistance should be increased if more than 150 volts is employed. The circuit does not perform satisfactorily with the ARC-5 final when the positive bias voltage is less than 150 volts. C_1, as recommended, may be a little large for another type of amplifier, but 0.05 μfd. is, at least, a good value to start with.

— *Jim Tonne, W5SUC*

TUBE-KEYED GRID-BLOCK KEYING

Tube keyers are usually used in the cathode circuit of a keyed stage, but the principle can be applied to grid-block keying of a low-level

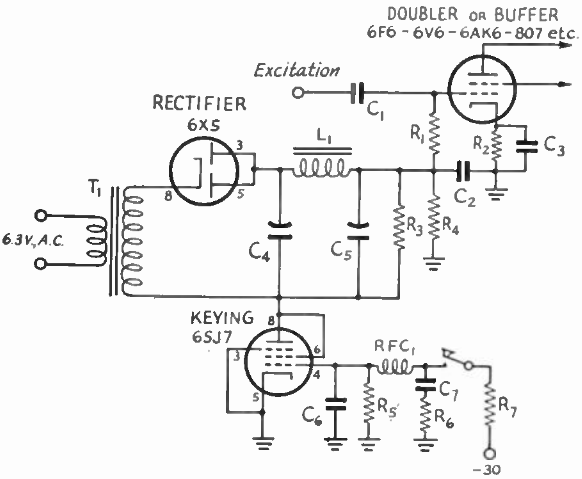


Fig. 6-8 — Circuit diagram of the grid-block tube keyer.

C_1 — 100 μμfd.
C_2 — 0.02 μfd.
C_3 — Normal cathode condenser, if used.
C_4, C_5 — 8-μfd. 350-volt electrolytic.
C_6 — 0.001-μfd. mica.
C_7 — 0.1-μfd. paper
R_1 — 4700 ohms, or 2.5-mh. r.f. choke.
R_2 — Normal cathode resistor, if used.
R_3 — 0.1 megohm.
R_4, R_5 — 47,000 ohms.
R_6 — 470 ohms.
R_7 — 15,000 ohms.
All resistors ½ watt.
L_1 — Small filter choke.
RFC_1 — 2.5-mh. r.f. choke.
T_1 — Small audio output transformer.

stage with little or no difficulty. The keyer to be described has been in use at VE3BSH for over a year, and it has been so satisfactory that it is certain to be included in any future transmitter installations.

As can be seen from the diagram in Fig. 6-8, it consists of a 6SJ7 keyer tube and a low-powered negative-voltage supply. The power supply can be anything that will furnish about 5 ma. at around 250 volts; using material around the shack I found an old audio output transformer, T_1, and a 6X5 half-wave-connected rectifier to be satisfactory. The 6.3 volts for the voice-coil winding can be borrowed from the transmitter heater circuit, of course.

When the key is "up," the 6SJ7 grid is at cathode potential, the 6SJ7 conducts, and the negative voltage from the small supply is connected to the grid of the keyed stage. When the key is closed, −30 volts is applied to the grid of the 6SJ7, cutting it off and disconnecting the small negative supply from the keyed stage. The "make" characteristic is controlled by the value of C_2 and R_4, and to a lesser degree by R_7, C_6 and C_7 in the 6SJ7 grid circuit. Making any of these values larger will "soften" the keying on make — C_2 is probably the best one to operate on to get a desired characteristic. On "break" the keying can be softened by increasing the size of C_7.

C_7, R_6, R_7 and RFC_1 also constitute an r.f. filter for eliminating any local b.c. receiver click caused by minute sparking at the key, but no trouble has been encountered along these lines. The key current is a maximum of ½ ma., and the sparking at the key is imperceptible.

In the transmitter at VE3BSH, two 6F6 isolation stages following a 6AK6 Clapp oscillator are keyed with this arrangement, and the keying is very clean and pleasing to listen to. A resistor is used at R_1 instead of the r.f. choke used there originally, to eliminate a tendency toward a parasitic oscillation, but this had nothing to do with the keying system, of course.

If one has an oscillator that is stable enough to key without chirp, it may be keyed by this circuit by lifting the "cold" end of its grid resistor and connecting it to the junction of C_2, R_3 and R_4. Several stages can be keyed simultaneously by returning their grid resistors or r.f. chokes to this same point. In any event, it should be used with stages running little or no grid current, because any flow of current will develop additional grid bias across R_4.

— *A. R. Williams, VE3BSH*

SIMPLE KEYING MONITOR

Most keying monitors require special power supplies, relays, etc. The interrupters in several surplus equipments, such as telegraph set TG-5, can be converted easily to an excellent keying monitor used in conjunction with the station receiver and transmitter. The interrupter (howler) consists of a double carbon button mounted against the diaphragm of a telephone receiver. When a voltage of 1 to 4 volts d.c. is

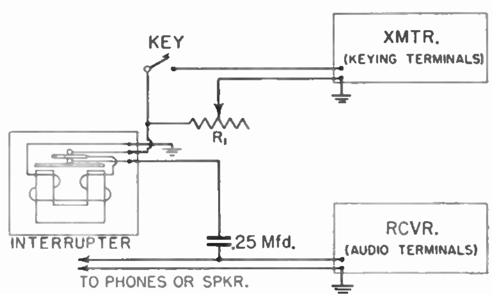


Fig. 6-9 — Circuit diagram of W4KE's simple keying monitor. The voltage control, R_1, for the interrupter should have a resistance of approximately 200 ohms.

applied, the interrupter produces a steady tone of approximately 1000 cycles per second. In the circuit shown, Fig. 6-9, this voltage is obtained by inserting a low-resistance potentiometer in the keying leads of the oscillator. The small voltage drop required will not normally cause any noticeable change in the operating of the transmitter. The variable resistor is used to control the volume of the keying monitor, or shut it off completely when it is not required, such as when operating on 'phone. The audio output of the interrupter is sufficient to drive either headphones or a loudspeaker.

— *Lt. Col. Lloyd D. Colvin, W4KE*

SAFE KEYING OF A.C.-D.C. MONITORS

An a.c.-d.c. monitor can be keyed safely and simultaneously with the transmitter if a Microswitch is used to activate the monitor circuit. The control arm of the Microswitch should be slipped under the regular key knob so that the switch will be actuated when the key is closed.

— *E. M. Brownlee, VE2APO*

MODIFICATION OF W5LVD'S BREAK-IN SYSTEM

The electronic break-in system described in December, 1951, *QST* has been installed here at W5VRP. Because the VRP transmitter line-up is somewhat different than the one for which the system was designed, and because of a desire to avoid the use of a battery in the control circuit, it was necessary to modify the original circuit. The revamped circuit does eliminate the battery and also makes the action of the first diode control tube independent of the number of stages or the type of tubes that are keyed.

Fig. 6-10 shows that a keying relay, K_1, has been introduced to the circuit and that the plate potential for the first diode of the control section is now obtained from a voltage divider, R_1R_2, that

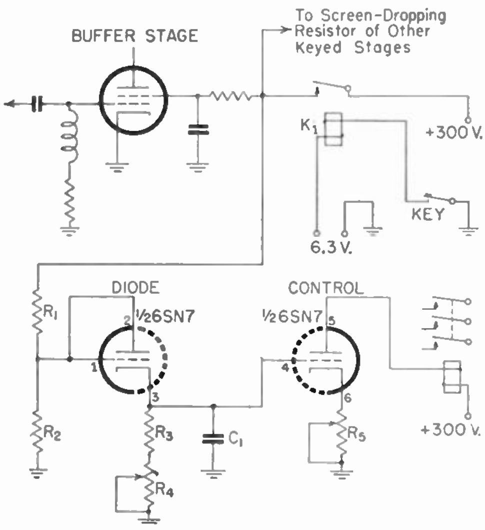


Fig. 6-10 — **Circuit diagram of the break-in system at W5VRP.**

C_1 — 1.0-μfd. 200-volt paper.
R_1 — 0.27 megohm, ½ watt.
R_2 — 0.1 megohm, ½ watt.
R_3 — 0.2 megohm, ½ watt.
R_4 — 1.0-megohm linear-taper potentiometer.
R_5 — 20,000-ohm potentiometer.
K_1 — S.p.s.t. 6-volt relay.

is connected back to the screen supply through the relay. Thus, the diode voltage is determined entirely by the values of the divider components and the supply voltage, rather than by a battery and the key-up cathode potential of a single r.f. stage, as is the case with the previous arrangement. The balance of the break-in circuit, except for minor changes to allow for the use of available components, is similar to that described by W5LVD.

— *John Althouse, W5VRP*

"CORKEY" — A TUBELESS AUTOMATIC KEY

At least part of the general improvement in amateur sending can be traced to the healthy sound of skillfully-handled electronic keys. Since the time of the first article on electronic keying,[1] automatic bug circuitry has advanced continuously, and two articles[2,3] have reduced the design of the device to such elegant simplicity that

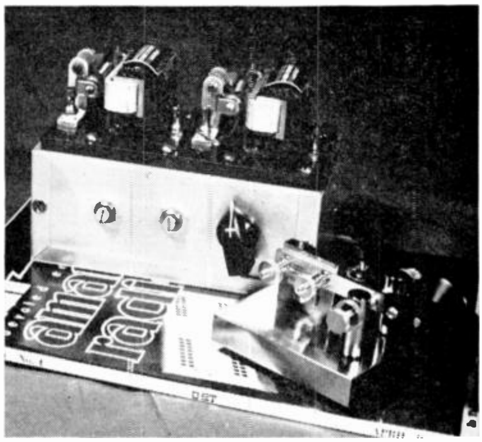


Fig. 6-11 — **"Corkey," complete with battery power supply, is built in a 5¼ × 3 × 2-inch chassis. The key lever mechanism, a separate unit, was built by W3FQB with electronic-keying requirements in mind. An ordinary bug key can be suitably modified if your mechanical ability and facilities aren't up to building your own.**

further progress in the electronic direction seems nearly impossible. Simplification of useful radio gear is an amateur principle, however, and the purpose of this article is to outline a tubeless automatic key, scarcely larger than a mechanical bug, that shares all of the desirable characteristics of its electronic ancestors.

Several features previously pointed out as mandatory in any modern automatic key are:

1) Single speed control. The circuit should not require ganged potentiometers; speed should be controlled by a single variable element, and the dot/dash and dot/space ratios should be preserved during speed adjustments.

2) Self-completion. Instantaneous contact of

[1] Harry Beecher, "Electronic Keying," *QST*, April, 1940.
[2] F. A. Bartlett, "Further Advances in Electronic-Keyer Design," *QST*, October, 1948.
[3] Richard H. Turrin, "Debugging the Electronic Bug," *QST*, January, 1950.

the key lever in either direction of its swing should result in formation of a complete dot-space or dash-space, and it should be impossible to begin another such cycle until the preceding one has been completed.

3) Simple key lever. Multiple lever contacts are a source of trouble and difficult to construct. The key lever therefore should be essentially a single-pole double-throw switch; the rotor of the lever should be grounded.

These precepts and the idea of eliminating tubes altogether guided experiments using two sensitive relays alone. (A description of one tubeless keyer[4] appeared several years ago, but this particular circuit, admirable for its simplicity, included only one of the three virtues: the simple lever.) The basic circuit shown in Fig. 6-12 was finally developed. Fundamentally, the operation

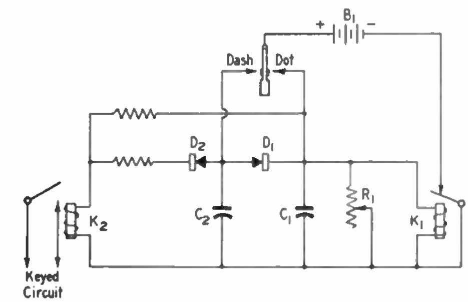


Fig. 6-12 — **Basic circuit of the tubeless automatic key.**

is a direct analogue of the keyer devised by Bartlett[2] (a review of his article is strongly recommended), with the exception that the timing and keying relays, K_1 and K_2 respectively, are energized directly by the timing condensers rather than by tube plate currents.

When the key lever connects with the dot contact, C_1 is charged almost instantaneously by the battery, and K_2 closes to begin the dot; charging of C_2 is prevented by the two diodes, D_1 and D_2. At nearly the same time, K_1 closes, disconnecting both battery and key lever from the circuit. C_1 now discharges slowly through R_1 and the two relay paths, and when the voltage across C_1 has decreased sufficiently, K_2 opens. After an additional period of time equal to the dot length, during which the voltage across C_1 decreases further, K_1 opens, reconnecting the battery. If the lever has been returned meanwhile to neutral position no further action occurs, but if the lever is still in the dot position the cycle repeats.

The action is similar for dashes. To provide a dash cycle twice as long as the dot cycle, diode D_1 effectively parallels C_1 and C_2 when the lever connects with the dash contact; diode D_2 furnishes extra current to the keying relay, closing the keying contacts for a larger fraction of the cycle and so forming a dash of proper duration. Both dot and dash speed depend on the time constant of the circuit, which is made continu-

[4] Harris Adams, "An Electrostatic Key," Hints and Kinks, *QST*, April, 1946.

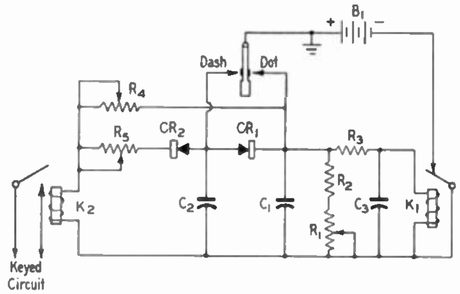


Fig. 6-13 — **The practical keyer circuit.**

C_1 — 20-μfd. electrolytic.
C_2 — 25-μfd. electrolytic.
C_3 — 2-μfd. paper.
R_1 — 10,000-ohm potentiometer (Clarostat AM-30-V).
R_2 — 2000 ohms, ½ watt.
R_3 — 10,000 ohms, ½ watt.
R_4 — 25,000-ohm potentiometer.
R_5 — 75,000-ohm potentiometer.
B_1 — 22.5-volt miniature battery (Burgess XX15E).
K_1, K_2 — Sensitive relay, 5000-ohm (or larger resistance) coil (Struthers-Dunn).
CR_1, CR_2 — Selenium rectifier (see text).

ously variable by means of speed control R_1.

In view of direct relay operation by the condensers, the key has been named "Corkey," an abbreviation for "condenser-operated relay key." It has all of the desirable features listed earlier.

The complete circuit is shown in Fig. 6-13, and the interior of the relay box is shown in Fig. 6-14. The relays used in the model need not be duplicated exactly, but they should be sensitive relays having good bearings and coil resistances of 5000 ohms or more and should be so constructed that both armature travel and spring tension are adjustable. In lining up the circuit initially, it will be found that the relay settings affect both keying speed and dot and dash lengths, so that armature travel and tension should be adjustable to allow the keying characteristics to be brought within convenient range of the normal potentiometer adjustments. The relay settings need be made only once.

Diodes CR_1 and CR_2 are made from a single 75-milliampere selenium rectifier. The rectifier, as purchased, has six plates. It is carefully pried apart into two sections, a two-plate section being used for CR_1 and a four-plate section for CR_2. The speed control, R_1, is much more satisfactory if a tapered potentiometer is used having a fast

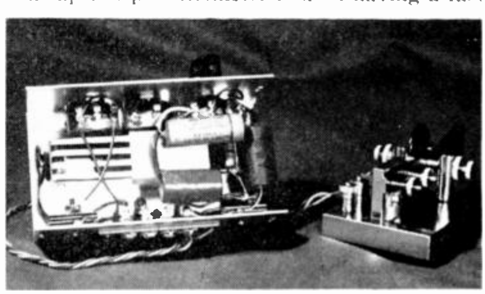


Fig. 6-14 — **In this under-chassis view, the control with the knob is the speed control; the other potentiometers are R_4 and R_5 (Fig. 6-13) used in the initial key adjustment but afterwards left alone.**

taper at the zero end; keying speed will then be a nearly linear function of control setting. The potentiometer specified works nicely. Potentiometers R_4 and R_5 control dot length and dash length, and almost anything will serve for these.

The most difficult part of the lining-up process is proper selection of the two electrolytic condensers. Theoretically, these should have equal capacities to make the dot cycle just one-half as long as the dash cycle, but the voltage drop in CR_1 during charging requires that C_2 be somewhat larger than C_1. The values given are representative, and final adjustment in any particular case must be made experimentally.[5]

The battery is a small hearing-aid type that was chosen because it would fit conveniently inside the relay box. Even at maximum speeds the current drain is only a few milliamperes, and in normal use the battery should last nearly as long as its shelf life. Some constructors may wish to dispense with the battery and substitute some form of external power supply. While operation should be satisfactory under these conditions part of the convenience and portability of the keyer stems from the absence of extra wires dangling from the rear, and this advantage is lost if the battery is eliminated in favor of an external supply.[6]

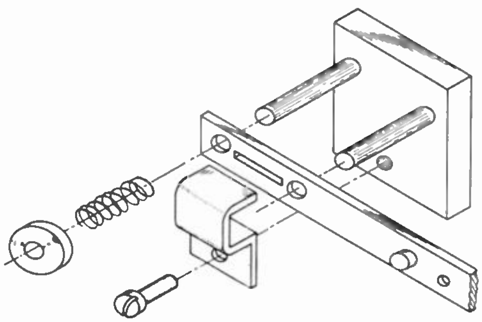


Fig. 6-15 — Exploded view of key lever mechanism.

As work on the circuit progressed, it was felt that a new key lever would be an attractive companion for the electrical part, and the "paddle" shown in the photograph is the result. The armature of the lever, as shown in Fig. 6-15, uses two edges of a vertical block as fulcrums, while two compression springs furnish the restoring force, tending to keep the lever in a neutral position. The tongue, a sliding fit in the armature slot, acts as a bearing and positions the armature so that the holes at each end of the slot will clear the spring-support screws. All metal parts except the contacts were made of brass and were nickel plated afterwards at a local plating shop. Making the key lever requires some machine work, but the mechanism is straightforward, and the finished key has a satisfactory "feel" that is difficult to achieve in the usual homemade design.

— *G. Franklin Montgomery, W3FQB*

[5] Newly-purchased electrolytics, or those that have seen infrequent use, may change capacity appreciably for a time after being put into service. To minimize this change it will be helpful, before trying them in the key, to "form" the condensers by connecting them across a 25-volt supply for about half an hour.

[6] Inasmuch as the speed and spacing depend on maintaining rather exact voltage relationships, a regulated supply probably would be necessary.

SIMPLE CODE-PRACTICE AIDS

NEWCOMERS who are in need of a code-practice set-up should not overlook a simple system that employs the station receiver — providing it has a beat oscillator — a pair of headphones and a key. With the key and 'phones connected in series and then plugged into the receiver 'phone jack, the receiver is tuned to a steady signal such as that transmitted by a broadcast station. The b.f.o. and the tuning dial of the receiver are then both adjusted until a tone of the desired frequency is audible in the headset. If the receiver has a selectivity switch, it is usually possible to clear the beat note of any bothersome modulation that rides through the receiver. Even without a selectivity adjustment available, it is possible to adjust a receiver so that a perfectly usable tone is obtained. Naturally, the tone so generated is interrupted by the key for code-practice work.

— *George E. R. Jarrett, RM2, USNR, W6HCU*

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THE gadget shown in Fig. 6-16 is a simple means for using any receiver equipped with a b.f.o. as a code-practice "oscillator." [This H&K details the mechanics of installing the code-practice tip described in the preceding kink. — ED.] Simply plug P_1 into the 'phone jack on the receiver, a key into J_2, and the 'phones into J_1. Close the key and tune in a steady signal, such as WWV or the carrier of a broadcast station. Open the key and the 'phones go dead, close it and the signal comes through again. From here on, use the unit as you would any oscillator.

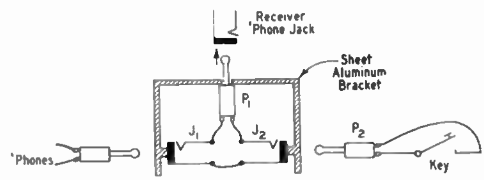


Fig. 6-16 — Here's the way one Novice solved the problem of obtaining a code-practice oscillator. J_1 and J_2 are open-circuit 'phone jacks, and P_1 and P_2 are ordinary 'phone plugs.

The two jacks and the plug are mounted on a small bracket made of sheet aluminum. The two jacks must be insulated from the bracket. The entire gadget cost me only 95 cents, and was well worth the time it takes to build.

— *George B. Jeffrey, WN9OXH*

CODE-PRACTICE OSCILLATORS

AN AUDIO SIGNAL for code practice may be obtained by owners of National receivers that are equipped with accessory sockets by using the circuit shown in Fig. 6-17. The parts for the oscillator are small, so all may be built into the top

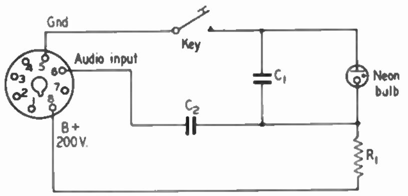


Fig. 6-17 — Circuit for an audio oscillator that can be connected to the accessory socket of receivers such as the National NC-173. The neon bulb is a Type NE-2.
C_1 — 0.001-μfd. mica.
C_2 — 100-μμfd. mica.
R_1 — 6000 ohms, ½ watt.

of an octal multiwire plug such as the Amphenol 86-PM8. Two leads for connecting the key are brought through the top of the plug.

The oscillator frequency may be varied by changing the size of either C_1 or R_1, or the applied voltage. Any voltage between 100 and 350 should be suitable, and the current drain is so little that the unit may be connected to any of the voltages available at the accessory socket without fear of either overloading the supply or impairing receiver operation.

— *A. D. M. Lewis, W8LOT*

Shown in Fig. 6-18 is a simple code-practice oscillator that should be of assistance to anyone studying for the ham examinations. It has sufficient output to drive a small permanent-

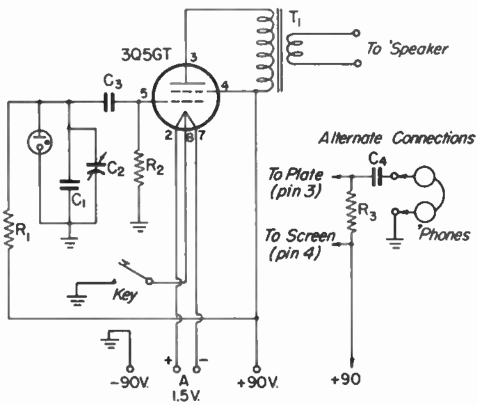


Fig. 6-18 — Circuit of a simple code-practice oscillator.
C_1 — 25-μμfd. mica.
C_2 — Broadcast-type receiving variable. Approx. 480 μμfd. max.
C_3, C_4 — 0.005-μfd. mica.
R_1, R_2 — 1 megohm, ½ watt.
R_3 — 5000 ohms, 1 watt.
T_1 — Output transformer, single plate to voice coil (Stancor A-3877).

magnet 'speaker, or if desired, it can be used with high-impedance headphones.

The only adjustment required is of C_2, which can be "salvaged" from an old broadcast set. With power applied, tune C_2 for the desired tone output. The neon bulb can be of the midget variety, similar to those found in the ARC-5 receivers.

— *Harold A. Rogers, W2VDQ*

CODE-PRACTICE OSCILLATOR WITHOUT PLATE SUPPLY

Fig. 6-19 shows an easy-to-build code-practice oscillator that does not require a plate supply. A check of amateur parts catalogs shows that the unit can be built for approximately $6.00, which

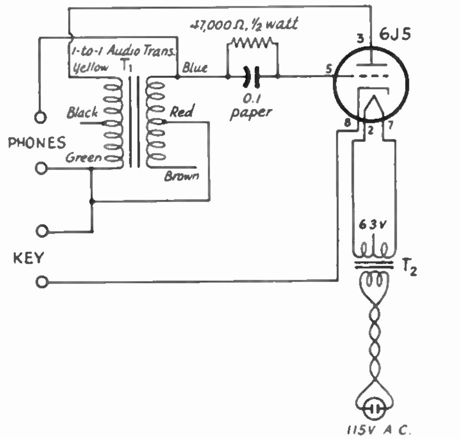


Fig. 6-19 — Circuit diagram of the code-practice oscillator.
T_1 — 1-to-1 push-pull interstage transformer (Stancor A-4711).
T_2 — 6.3-volt 1.2-amp. heater transformer (Stancor P-6134).

is substantially less than the cost of most commercial oscillators. It is essential that high-impedance headphones be used with the circuit for maximum performance.

— *Lewis G. McCoy, W1ICP*

NEON-BULB TONE MODULATOR

Another application for a neon bulb, particularly suited to the Novice interested in 2-meter c.w. work, is a tone modulator. Fig. 6-20 shows the circuit diagram of such a device. T_1 is either a plate-to-single-grid or a plate-to-push-pull-grids transformer, depending on the speech amplifier input. The value of C_1 can be changed to obtain a different tone.

— *Lewis G. McCoy, W1ICP*

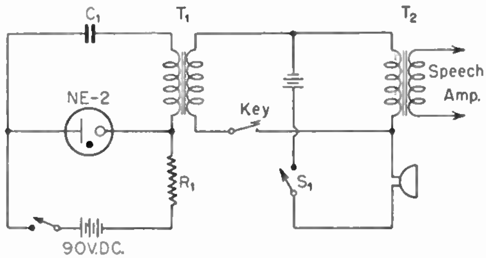


Fig. 6-20 — Circuit diagram for the tone modulator.
C_1 — 0.002-μfd. paper.
R_1 — 1.5 megohm.
T_1 — Plate-to-line transformer.
T_2 — Microphone transformer.

7. Hints and Kinks . . . for V.H.F. Gear

AUTOMATIC BAND-SCANNER

Fig. 7-1 shows the automatic band-scanning device used at W9ZHL. A low-torque synchronous motor is geared to the converter knob.

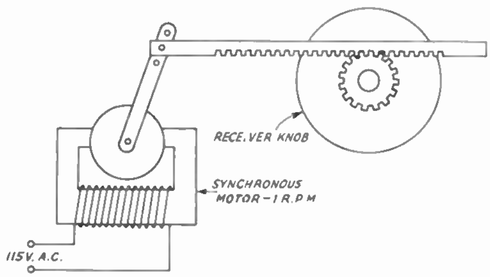


Fig. 7-1 — **W9ZHL's system for automatically monitoring a v.h.f. band.**

Revolving at one r.p.m., this rack-and-pinion arrangement scans 50.0 to 50.3 Mc. in 30 seconds, returning to 50.0 in the following 30 seconds. With the b.f.o. on and the audio turned low, enough sound is made to attract attention when signals appear.

FINDING THE 420-MC. BAND

If you're a 2-meter operator, locating the 420-Mc. band is no great problem, in view of the harmonic relationship between 144 and 432 Mc., but a fellow just getting started may have some trouble being sure he's on the right frequency. W2MWB uses the oscillator in his TV set for this purpose. With receivers having a sound i.f. of 21.25 Mc., tuning to Channel 9 puts the second harmonic of the receiver oscillator on 426 Mc. Check points at 438 and 450 Mc. are available by switching to Channels 10 and 11, respectively.

CRYSTAL-CONTROLLED CONVERTER FOR 430 MC.

The block diagram of Fig. 7-2 shows a 430-Mc. crystal-controlled converter with some ideas that make for simple circuitry and a minimum of birdie trouble. A crystal (James Knights) oscillator on 63 Mc. serves two purposes. Used in half a 6J6 section it provides excitation for another 6J6 which doubles and triples to 378 Mc. It also feeds the other half of the 6J6 which operates as a second mixer on 52 to 58 Mc. The output of the second mixer works into an i.f. system that is tunable from 5 to 11 Mc. The 430- to 436-Mc. mixer uses a 1N21C crystal in a coaxial-line assembly salvaged from an R89 glide-path receiver. A similar coaxial assembly furnishes the 378-Mc. tank circuit for the output of the injection chain.

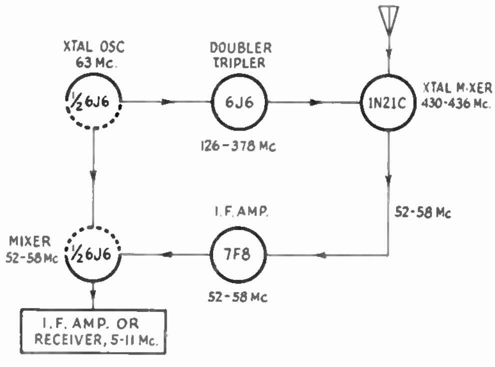


Fig. 7-2 — The W9MBI 430-Mc. converter.

Following the crystal mixer is a 7F8 i.f. amplifier, soon to be replaced by a 6BQ7. Thus, with only three tubes, we have a stable and sensitive low-noise converter for 430 to 436 Mc.

— *Clare B. Reynolds, W9MBI*

SIMPLE S.W.R. CHECK

Here's a variation on the twin-lamp idea that is particularly useful in v.h.f. antenna work. Make two pick-up loops using 2-volt 60-ma. pilot lamps. The loop portion can be a piece of Twin-Lead about an inch long, with the end away from the lamp bridged with wire. Couple one of these loops to the transmission line and adjust the power input to the line so that a fairly bright indication is obtainable with close coupling between the loop and line. Slide the loop along the line until the brightest indication is found, and fasten the loop in that position. A spring-type clothes pin is handy for this purpose.

Now run the other pick-up lamp along the line until the minimum brilliance point is found, and fasten it in place at this point. A good indication of standing-wave ratio is obtained in this way, and you can proceed with adjustments, trying always for the least possible difference in brilliance between the two lamps. When a change in matching is made the nodal points may shift, so the high- and low-voltage points should be found after each adjustment. If the work is done in the shade, or on a dark day, a glance at the two lamps is all that is needed in trying for minimum s.w.r. If you want approximate figures for the s.w.r., the bulb brilliance can be checked by varying d.c. input to a lamp through a filament rheostat. Such a voltage check will show that a 1.5-to-1 voltage ratio is easily discernible, and quite small steps in either direction can be observed readily.

— *E. P. Tilton, W1HDQ*

TUNABLE I.F. STRIP FOR V.H.F. CONVERTERS

Very few communications receivers have the tuning rate required for use with crystal-controlled converters in the v.h.f. bands. This problem can be solved by modifying a BC-454 receiver so that it tunes from 8 to 14 Mc. instead of the original 3 to 6 Mc. About the only difficult part of the modification is to change the r.f., mixer, and oscillator coils. A noise limiter and a.v.c. are added refinements that have already been described in *QST*.[1]

The coil modifications are shown in Fig. 7-3. To change the r.f. coil, first remove the coil from its shield can, and then remove the tuning slug by first yanking off the bakelite locking strip with needle-nose pliers. Next remove the winding by unsoldering the top coil connection only. Peel back the winding to the bottom and wind 12 turns upward, double-spaced, in the original wire grooves (*not* double the wire diameter). It will be necessary to cross over one groove per turn for this purpose, but the wire can be held in place by winding tight and drilling a new hole at the top of the winding. The slug is then replaced, and a ¼-inch hole for slug adjustment is drilled in the shield can and base. To add friction to the adjustment screw, melt a little wax and let it run down the screw. This will make a tight thread, and will make it unnecessary to replace the bakelite locking strips.

The mixer coil is changed by taking about half of the top pie winding off and resoldering it to the connector prong. The grid winding is unsoldered at the bottom coil connection and 13 turns are wound down from the top double-spaced like the r.f. coil. The slug is replaced, and the shield drilled for adjustment as before.

On the oscillator coil, leave the small feed-back winding exactly as it is. Unsolder the top connection of the tuned grid winding, and rewind 12 turns upward, double-spaced, starting at the feed-back winding. Replace the slug and drill the shield can for adjustment.

Replace the coils in the unit, and with the aid of a signal source, align the circuits in the conventional manner. The conversion at W8FKC resulted in a 7.5- to 14.1-Mc. tuning range. The tracking is as good as in the average communications receiver, and the over-all gain is excellent. The i.f. used at W8FKC is 9 to 13 Mc. for coverage of the 2-meter band, and from 9 to 14 Mc. for the 220-Mc. band.

This arrangement can also be used to make an efficient mobile v.h.f. receiver. It permits the use of crystal-controlled converters to gain the desired stability, and can be built very compactly, with the converter mounted alongside the i.f. strip in a surplus FT-220 receiver rack.

— *Ralph W. Burhans, W8FKC*

[1] Jordan, "New Life for the 'Q5-er,'" *QST*, Feb., 1951.

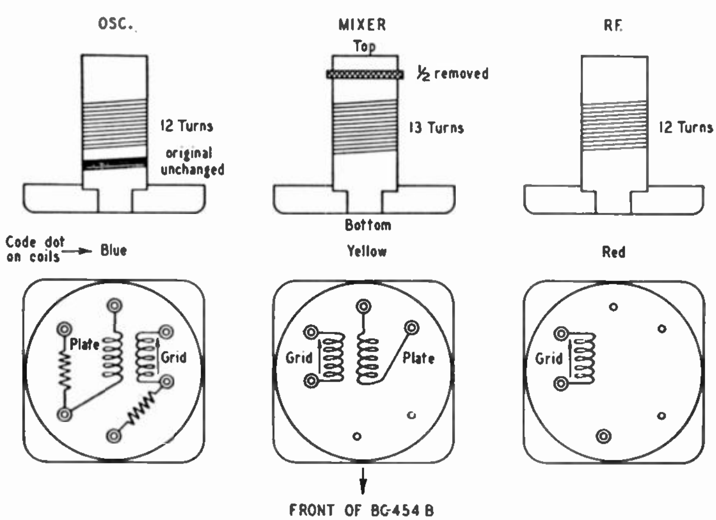


Fig. 7-3 — With simple modifications, the BC-454 "Command" receiver can be made into an excellent tuned i.f. and audio system for use with v.h.f. converters. The coil modifications shown here are described in detail in the text.

PLATE LINES FOR THE 9903

One of the most widely-used tubes for 420-Mc. work is the Amperex AX-9903. This dual tetrode is capable of 10 watts output as a tripler from 144 Mc., or up to 30 watts as a 432-Mc. amplifier. It has only one disadvantage: the glass support for the plate pins is fragile, as a number of 420-Mc. experimenters have found to their sorrow. This condition has been corrected by the introduction of an improved version of the tube, but meanwhile, many of us have 9903s we'd like to use without fear of breakage around the plate pins.

In applications where a flexible lead between the plate connection and the tank circuit can be used, this presents no problem, as flexible ribbon or braid can handle the job. But on 420 you don't use "leads" in the conventional sense, and very flexible materials don't make good tank circuits

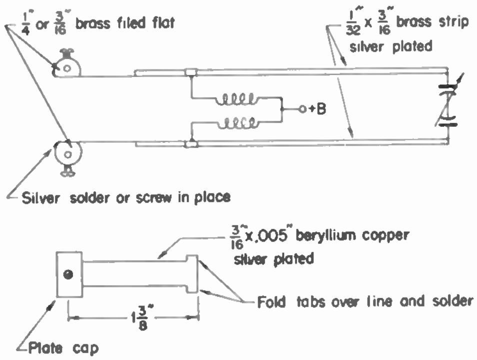


Fig. 7-4 — 420-Mc. tank circuit design for the AX-9903 suggested by W5AYU.

as a rule. A solution worked out here at W5AYU is shown in detail in Fig. 7-4. We made the major portion of the half-wave line of stiff brass stock, and provided a short flexible section cut from beryllium copper spring stock only 0.005 inch thick.

Tabs on the flexible portion fold over the brass strips, and are soldered in place. The plate connection is taken care of by small pieces of brass rod drilled to pass the 9903 plate pins. The flexible portion of the line may be silver-soldered to these connectors, if facilities of this type of soldering are available, or the brass may be drilled and tapped for small screws to hold the flexible strips in place. The complete assembly is silver-plated.

— *Burton D. Lee, W5AYU*

POCKET-SIZE V.H.F. BALUN

Coax has many advantages, and its use in v.h.f. work is increasing all the time. It simplifies and improves antenna coupling circuits of v.h.f. converters, but what of the losses in a long run of transmission line? A good many of us still don't like what we see in the "attenuation per 100 feet" column, so we hesitate to go all the way

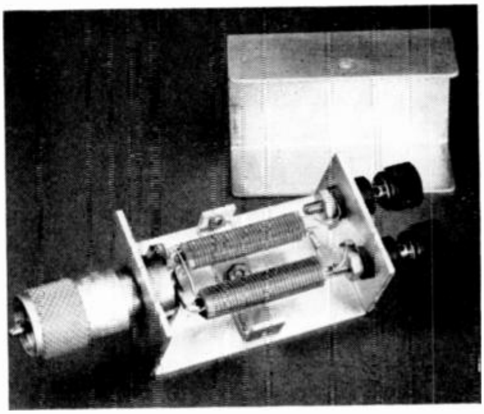


Fig. 7-5 — Interior view of the v.h.f. balun.

from the operating position to the antenna with coax. Result: The input circuits of our converters are draped with a variety of loops of coax cable to achieve optimum coupling between our balanced lines and our unbalanced antenna input circuits.

Illustrated in Figs. 7-5 and 7-6 is a neat little gadget that does away with the inconvenience and messiness of the coax balun in v.h.f. reception. It was made by W1DF for ARRL lab use.

It is built around a pair of standard TV balun coils (also called an elevator transformer) and they lend themselves almost ideally to amateur v.h.f. receiving applications. Designed to cover 54 to 213 Mc., they work well in the 50-, 144- and 220-Mc. ham bands. Checks on the air and

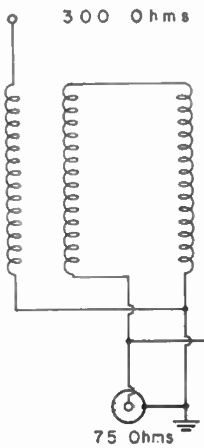


Fig. 7-6 — Schematic of the v.h.f. balun; coils are in series at one end, in parallel at the other.

with a noise generator show no measurable difference between the balun assembly and drape-type baluns for each band made of coax.

The W1DF model is housed in a handmade aluminum box 1 by $1\frac{1}{2}$ by $2\frac{1}{2}$ inches in size. Two feed-through posts are mounted at one end of the case and a coaxial fitting at the other.

SIX-METER COILS FOR THE HRO

The HRO and HRO-7 can be made to do quite well on 50 Mc. All that is necessary is to convert a coil set from some other band to the 50-Mc. band. Probably the best answer is to secure one of the Type 7AA coil sets for the 28-Mc. range, and convert your present 28-Mc. coil set to 50 Mc. The 7AA coil set is a worth-while improvement, in any case. With the regular coil set for the 28-Mc. range in place, our frequency standard gave an S-meter reading of S5 at 29.7 Mc. With the new 7AA coil set the same signal is over S9, and images are greatly reduced.

No changes need be made in the receiver itself, so anyone who attempts the work to be outlined here need have no fear that he will spoil his receiver's performance on the rest of the coil ranges. Take any high-frequency coil set, remove the units from the shield cans, and unsolder and remove the present coils. The shields and coil assemblies come off when the screws holding them are loosened; it is not necessary to remove the screws completely. If the parts are removed carefully it will be possible to restore the coil set to its original state later.

If the coil set to be converted is the usual dual-purpose coil (general-coverage and bandspread) there will be three trimmers in each section. Remove the trimmer mounted on the bracket inside the can, leaving the two that are side by side, as shown in Fig. 7-7. The unit converted was a general-coverage (only) set for the 7-Mc. range. This type of coil assembly has but one trimmer in each section, so another had to be added, as shown in Fig. 7-8.

The coils for 50 Mc. are made as follows:

1st r.f.:	Grid coil — 5 turns No. 14 enameled. Antenna coil — 5 turns No. 18 d.c.c. Windings coupled end to end, at cold end.
2nd r.f.:	Grid coil — 4 turns No. 14 enameled. Coupling coil — 5 turns No. 18 d.c.c., with one turn interwound in cold end of grid coil.
Mixer:	Grid coil — 4 turns No. 14 enameled. Coupling coil — 5 turns No. 18 d.c.c., with two turns interwound in cold end of grid coil.
Oscillator:	5 turns No. 14, tapped at 1 turn from cold end.

All coils are 13/32 inch in diameter. No. 14 coils are spaced one wire diameter, No. 18 coils close-wound.

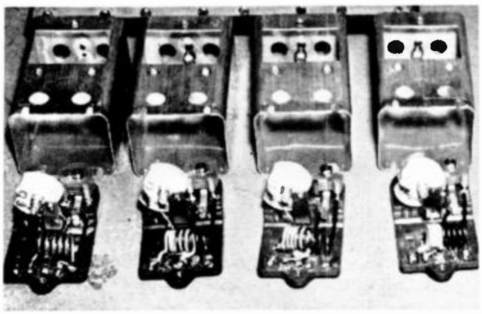


Fig. 7-7 — **The 50-Mc. coils for the HRO. From left to right they are the oscillator, mixer, second r.f., and first r.f. The trimmer mounted on the bracket at the left of each assembly is required only if the coil set to be converted is the general-coverage-only type.**

These coils are self-supporting, and are soldered to the terminal lugs with the shortest possible leads, after first being sure that the trimmers are wired to the proper lugs, as shown in Fig. 7-8. This conforms with the connections used in the 7AA coil set.

To align the coil units set all trimmers at approximately half scale. Feed a 50-Mc. signal into the receiver and, with the HRO tuning dial at 50 adjust the left-hand (band-set) trimmers of each stage in the following sequence: oscillator, mixer, 2nd r.f., 1st r.f. The oscillator should be on the high-frequency side of the signal. There is some pulling of the oscillator frequency as the mixer is adjusted, so this is best done by listening to background noise, or a noise generator, rather

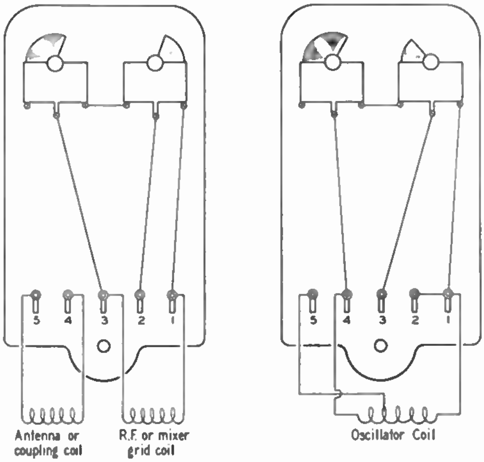


Fig. 7-8 — **Diagram of coil-and-trimmer assemblies, showing connections corresponding to Fig. 7-7.**

than to a signal. Adjust each stage for highest S-meter reading or loudest background noise.

Next set the signal source to 54 Mc. and the HRO dial to 450. Slowly and carefully adjust the left-hand (band-set) trimmer on the oscillator until the signal source is tuned in. Be sure that the oscillator is on the high side of the signal frequency. If more capacitance is needed to tune in the signal at 54 Mc., increase the setting of the right-hand (bandspread) trimmer. If less capacitance is required, decrease the setting of the bandspread trimmer. Repeat this process, working on the oscillator only, until 50 Mc. comes out at 50 and 54 Mc. comes at 450 on the main tuning dial.

Next move to the mixer and adjust that stage in the same way. Remember that the mixer is more readily adjusted by listening to random noise than to a signal. Because of the pulling effect of the mixer on the oscillator frequency, it will be necessary to make some slight readjustment of the oscillator when you are working on the mixer.

Following the same procedure, but now using the signal source, adjust the second r.f., and finally the first r.f. trimmers. This alignment is a slow process, but when it is performed carefully it will result in excellent tracking over the entire band. Final adjustment of the mixer and r.f. trimmers can be done with a noise generator, if desired.

It will be noticed that the suggested alignment procedure is the reverse of that usually employed, wherein the receiver is aligned first at the high-frequency end of the band and then at the low. The suggested procedure is desirable in this instance because some HRO receivers will go into oscillation around 53 Mc., and it is much easier to cure this condition by working from the stable low-frequency end.

If oscillation develops, try the following remedies: If your HRO is an old model with a center-tapped heater resistor, disconnect this resistor and ground one side of the heater circuit at several points throughout the receiver. By-pass the other side of the heater circuit to ground at several points, using 0.01-μfd. disk-type ceramic condensers. It may be necessary to add similar by-passes in the screen and plate circuits, particularly in the second r.f. and mixer stages. No set rule applies to all receivers: try one by-pass at a time until the trouble is corrected. Two or three will usually take care of it.

Do not let the comments relative to oscillation worry you. We never experienced any trouble below 52 Mc., and with present occupancy of the 50-Mc. band you can get going on 50 Mc. and cure any oscillation at the high end whenever you get around to it.

A preamplifier such as the Millen R9-er or the 6J6 outfit suggested in the 1950 *ARRL Handbook* will be helpful in bringing up weak signals. Image rejection is low, of course, as would be expected with single conversion and a 455-kc. i.f., but this is not a serious problem, so long as use of the 6-meter band is largely confined to the first few hundred kilocycles at the low end.

The important point is that we need more 50-Mc. occupancy, and here is an easy and inexpensive way around the receiver problem.

— *Loren G. Windom, W8GZ*

ANTENNA COUPLERS FOR V.H.F.

Coaxial-line feed from the transmitter and the use of some form of antenna coupler are practically standard procedure for the ham bands below 30 Mc., TVI being the problem that it is in most sections of the country. For the v.h.f. bands, however, the tendency has been to employ open-wire or Twin-Lead feed to the antenna, and to use nothing more than a turn or two of wire or a hairpin loop for coupling the energy from the tank circuit. These methods had the virtue of simplicity, if nothing more, whereas the use of coaxial line makes it necessary to include some form of balanced-to-unbalanced coupling device at the antenna.

Coax has many advantages, however. It can be run anywhere (underground, strapped to a steel tower, inside a piece of pipe); it is far neater in appearance; it is impervious to weather effects — to name a few of the reasons why more and more ham antennas are being revamped for coaxial-line feed. Now, with u.h.f. TV just around the corner, we have a factor that may ultimately swing the balance in favor of coax in a high percentage of v.h.f. installations. The first steps in reducing u.h.f. harmonics should certainly be the installation of shielding and coaxial-line feed.

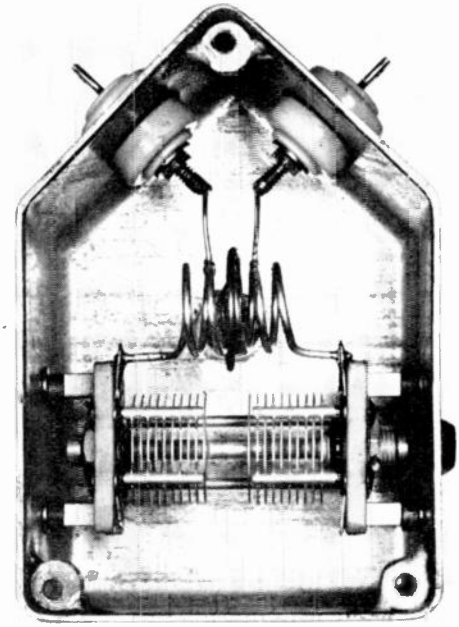


Fig. 7-9 — Interior view of the 2-meter antenna coupler described by W8DIL.

144-Mc. Coupler

The need for a bazooka, a half-wave section of coaxial line draped around an antenna system at the feed point, is one of the disadvantages of coax, and this is where the antenna coupler pictured herewith comes in. It may be seen from Figs. 7-9 and 7-10 that the unit is nothing new in principle; just the conventional antenna coupler to work from coax to open-wire line, adapted for 144-Mc. use and so designed mechanically that it may be mounted in the antenna system, if it is convenient to do so. It combines the functions of matching device and unbalanced-to-balanced coupler.

The tuned circuit, L_2C_1, is resonated at the transmitting frequency and matching is accomplished by setting the taps on L_2 at the proper point for the feed impedance to be accommodated. The specifications given in Fig. 7-10 and the mechanical arrangement shown in the photograph are proper for the feed point of the conventional 16-element array, or for working into a 300-ohm transmission line, in case it is desired to use the latter. Any load impedance can be handled by changing the tap positions — near to the center of L_2 for lower impedances; farther out for higher. Any coaxial line may be used, as it

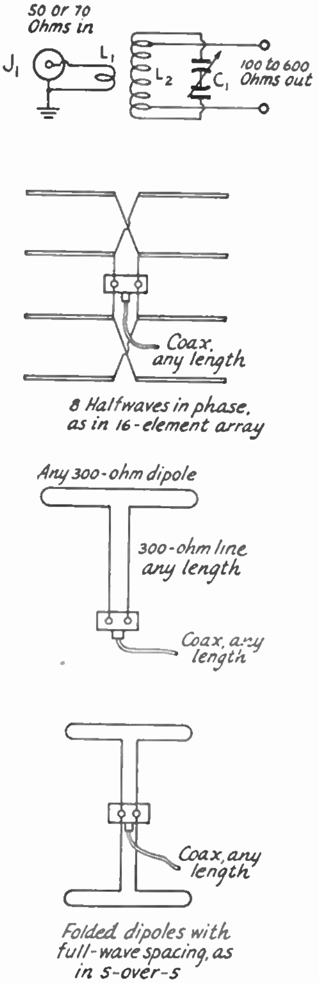


Fig. 7-10 — Schematic diagram and three possible uses for the 144-Mc. antenna coupling unit.

C_1 — 15-μμfd.-per-section split-stator variable, double spaced. May be made by sawing the stator bars of a Millen 21935 so as to leave 5 stator plates in each section.
L_1 — 1 turn No. 14 enamel, 7/8-inch diameter, around center of L_2.
L_2 — 5 turns No. 14 enamel, 1/2-inch diameter, turn spacing 1/8 inch. Taps at 1 1/2 turns in from each end for feeding midpoint of 16-element array.
J_1 — Coaxial fitting.

functions only as a nonresonant link from final to coupler.

If the coupler is used in the conventional way inside the shack, the box in which the coupler is mounted can be anything that will provide satisfactory shielding. The unit pictured is designed to be a part of the antenna system itself, so a lightweight aluminum box that can be waterproofed readily is required. Many suitable cases can be found; the one in question was purchased on the surplus market. It is known as Terminal Box NAF-1128-3, 4 1/2 by 3 by 2 1/2 inches in size. A rubber gasket can be cut to fit the cover, and the hole that passes the tuning condenser shaft can be made watertight by the use of a rubber grommet. Cracks around the mounting screws and the feed-through bushings can be sealed with lacquer.

To put the coupler into service it is merely necessary to adjust C_1 for resonance, changing the position of the coupling loop at the transmitter to set the loading at the proper value. If one wishes to make this adjustment from a position remote from the antenna it is a simple matter to fit the shaft of C_1 with a pulley and make the adjustment by means of a fishline. If the feed impedance of the array is not known it may be necessary to adjust the position of the taps on the coil. The optimum point of attachment is that at which the least retuning of C_1 is needed to restore resonance when the antenna is connected to the feed-through terminals.

Several 2-meter operators in the Detroit area have gone over to this method of feed, and improved performance has been observed in the antenna system in every case. If you've a March, 1950, *QST* handy, turn to page 59 for a picture of two of these units in use in the 64-element horizontal-vertical 2-meter array of W3RE, Washington, D. C.

— *John E. Sterner, W8DUL*

50-Mc. Coupler

Like the antenna coupler for 144-Mc. described by W8DUL in the foregoing section, the one for 50 Mc. shown herewith follows standard practice outlined many times before in *QST* and the *Handbook*, so only the basic details are given here. The 50-Mc. coupler is connected to the transmitter output by means of a coaxial line of any convenient length. The coupling loop, L_2, should have a reactance at the operating frequency of approximately the impedance of the coaxial line from the transmitter. It is resonated by means of C_2, which in this unit runs at about 25 per cent of maximum capacitance. The taps on inductance L_1 are set up for 300-ohm Twin-Lead, but their position may be varied to take

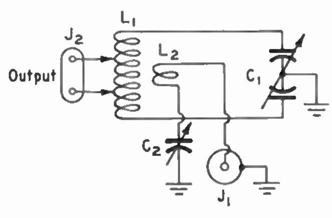


Fig. 7-11 — Schematic of the 50-Mc. antenna coupler.

C_1 — 50-μμfd.-per-section (National TMK-50D).
C_2 — 50-μμfd. variable (Hammarlund MC-50M).
L_1 — 6 turns No. 12 tinned, 2-inch diam., spaced 1/4 inch. Tapped at 2 and 4 turns.
L_2 — 4 turns No. 16 tinned, 1-inch diam., spaced 1/4 inch. (B & W Miniductor No. 3013.) Mount inside of L_1.
J_1 — Coaxial fitting. J_2 — Crystal socket.

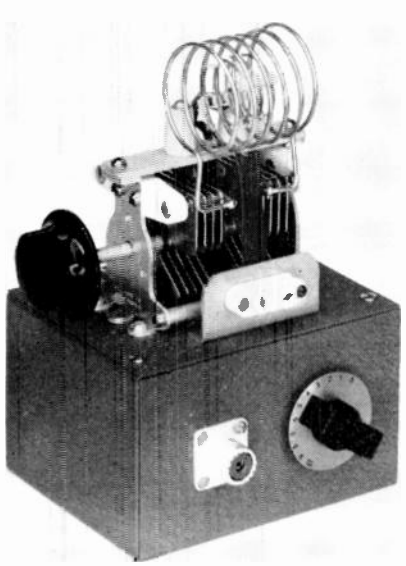


Fig. 7-12 — The 50-Mc. antenna coupler is mounted on the top plate of a standard utility box, with the series-tuning capacitor inside.

care of any balanced-type transmission line.

A standard 3 × 4 × 5-inch utility box makes a convenient base for the coupler, the principal components mounting on the top plate. The series-tuning condenser and the coaxial fitting are mounted on the side panel. The ends of L_1 are soldered to the lugs on the main tuning capacitor, and the coupling loop is supported by stand-offs fastened to the strap that ties the two end plates of the tuning condenser together. The leads from the input jack are made of 72-ohm transmitting Twin-Lead.

The antenna coupler should be adjusted for minimum standing-wave ratio on the coaxial line, as indicated on an s.w.r. bridge connected between the transmitter and the coupler. Adjust C_1, C_2 and the positions of the taps for minimum s.w.r. If no s.w.r. indicator is available, adjust first C_2 and then C_1 for maximum loading, varying the coupling at the transmitter end for the loading desired. The position for the taps can be found by moving them out from the center of the coil until maximum loading is achieved.

The coupler can be used at any point between the transmitter and the array, including mounting the coupling unit at the array itself, if provision is made for weatherproofing the installation. The range of the tuned circuits as given is great enough to permit the use of the coupler in the 28-Mc. band also, if the builder so desires.

If the transmitter is well designed as to TVI prevention, the antenna coupler may be all that is needed in many locations. If TVI is severe, the installation of a low-pass filter in the line between the rig and the coupler may be necessary.

— *E. P. Tilton, W1HDQ*

THE "69-ER" 2-METER BEAM

The 2-meter array shown was built in an effort to come up with a low-cost job that anyone could build. We call it "The 69-er" because that figure represents its total cost (yes, cents!), the only purchased material being some aluminum clothesline. Its driven section consists of three folded dipoles, stacked a half-wave apart, and fed at the bottom with 300-ohm line. It may be used with or without reflectors, though the performance is improved when reflectors are added.

Each half of the folded dipoles is 38 inches total length, and the entire driven portion of the array may be made from a single piece of wire. The

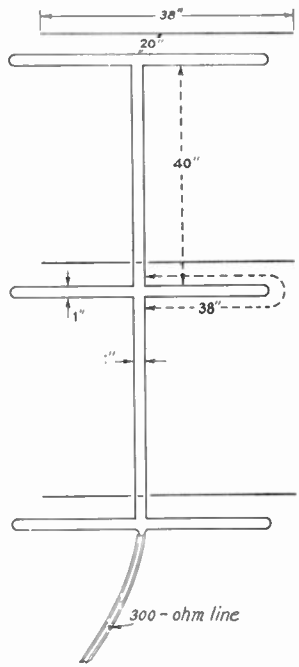


Fig. 7-13 — A low-cost stacked array for 144 Mc. built by W9LJP.

frame is of wood, with the wire mounted on small blocks of polystyrene separated from the frame by small stand-offs. The dipoles are 40 inches apart. Reflectors are spaced a quarter wavelength (20 inches) in back of the driven elements.

Only three sections have been used to date, but we are going to try stacking up to six sections. With three, the power in each dipole seems about the same. Going to greater numbers of driven elements may make it necessary to feed the system at its center to achieve current balance and optimum performance.

— *Warren Hill, W9LJP*

COAXIAL GRID CIRCUIT FOR 4X-150A AMPLIFIER

A squib in April, 1953, *QST* mentioned that we were running a 4X-150A amplifier straight-through on 432 Mc. This resulted in a batch of

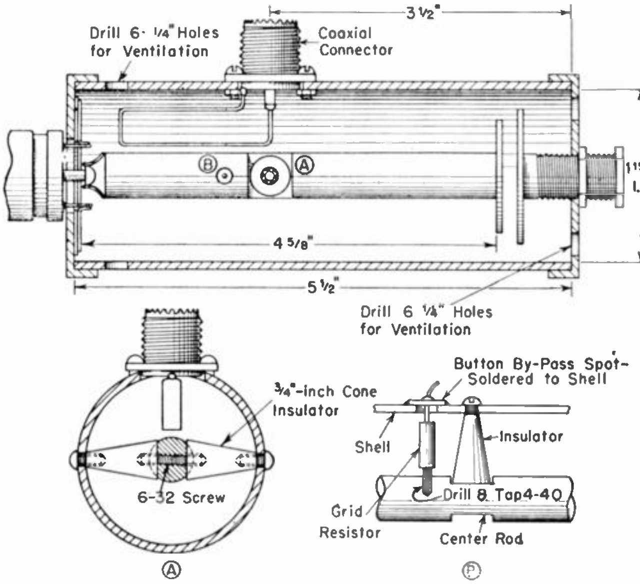


Fig. 7-14 — **Details of the coaxial-line grid circuit for a 4X-150A amplifier used on 420 Mc. by W1QVF. Modifications of the surplus gold-plated tank are given in the text.**

letters asking, "What do you use for a grid circuit?" Fig. 7-14 gives the details (the plate circuit of our amplifier follows the design by W1PRZ in May, 1951, *QST*). The grid circuit is made from the coaxial tank from a war-surplus item known as the "gold-plated special" test oscillator.

Modification of the tank for our grid circuit application is done in this fashion: (1) Cut it down to 5½ inches. (2) Turn down the disk on the inner conductor to 1¼ inches diameter. (3) Drill ventilation holes, as indicated in Fig. 7-14, in the end plate and at intervals around the outer conductor near the grid end. (4) Mount the output coupling loop and coaxial connector. (5) Mount the inner conductor on stand-off insulators (see Detail A). The inner conductor must be filed flat, or hammered slightly out of shape, to make room for the ¾-inch cone stand-offs. (6) Mount the grid resistor and its feed-through by-pass. The inner end of the resistor is soldered to a 4-40 screw, and the inner conductor is tapped so that this can be screwed into it (see Detail B).

Where the amplifier is to be grid-modulated with a TV signal, the grid resistor is replaced with an r.f. choke consisting of about 12 turns of No. 22 wire on a 1-watt resistor. The output coupling loop is made of copper or brass strip, ¼ inch wide and 4 inches over-all length. This is soldered to the connector and adjusted to suitable shape before mounting the connector in place.

— *Tom McMullen, W1QVF*

USING CRYSTAL-CONTROLLED CONVERTERS WITH COLLINS 75-A RECEIVERS

Some time ago, W8NOH built the 2-meter crystal-controlled converter described in *QST* for September, 1951, and in the 1952 and 1953 editions of the *Handbook*. It was fine so long as he kept his general-coverage receiver, but when he acquired a Collins 75A-2 the crystal-controlled converter went back on the shelf. The converter was designed to tune upward from 7 Mc. on the communications receiver, and that meant only 500 kc. of the band could be covered on the 75A-2.

A tunable converter that had seen service prior to construction of the crystal-controlled job was hauled out, but it took only a few minutes' struggling with its wandering oscillator to convince him that this approach to v.h.f. was no longer for him. Once you've used crystal-controlled reception you're not likely to be satisfied with anything less — but how to do it with the limited tuning range of the new receiver?

But how about the two highest ranges on the 75A-2? To cover both 11 and 10 requires movement of the bandswitch, but it gives a tuning range of 26 to 30 Mc., the four megacycles needed for 6 or 2. That would require an injection frequency of 118 Mc., which could be reached with the same order of frequency multiplication originally used by changing the crystal frequency to 6555.55 kc. Next, a check of the surplus crystal stock turned up one at 6540. A few swipes on the ground glass moved this to 6556, close enough. No changes other than retuning the circuits of the converter were needed to get oscillation on 19,688, and multiply progressively to 59,004 and 118,008. The discrepancy was within the range of the zero-set adjustment on the 75A-2, so it was possible to read frequencies in the 2-meter band right on the nose!

Next, and last, all that was needed was to remove a few turns from the mixer and i.f. amplifier plate windings so they would resonate at 26 Mc., and W8NOH was ready to go. Not a birdie in the whole tuning range, stability like on 7 Mc., and a 12-db. improvement in signal-to-noise ratio over that of the wobbly old tunable job.

OVERTONE OSCILLATOR WITH CAPACITIVE FEED-BACK

If you've had trouble getting overtone oscillators to work properly, it's probably because of difficulty in controlling regeneration. This is usually done with a tap on the tuned circuit, or by adjusting the position of a separate feed-back winding. Feed-back may also be controlled by the capacitive bridge method, as shown in Fig. 7-15. This hint is taken from *The Mike and Key*, bulletin of the Sacramento Amateur Radio Club, edited by W6PIV. The circuit is by W6EFT.

From the diagram it may be seen that the crystal is connected between the triode grid and a point part way up the by-pass system in the

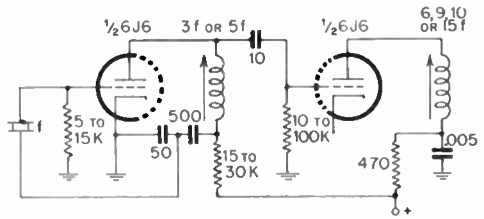


Fig. 7-15 — **Schematic diagram of an overtone oscillator circuit supplied by W6PIV, in which the regeneration is controlled by tapping the crystal up on the plate circuit by means of a capacitive divider system.**

plate circuit. The values shown are usually satisfactory for crystals between 6 and 9 Mc., but either of the capacitive elements can be varied to produce the desired amount of feed-back. Decreasing the larger or increasing the smaller capacitor results in more feed-back. Otherwise, the circuit is similar to overtone oscillator circuits carried in the ARRL *Handbook* for several years. When used with a dual triode, the second half of which is operated as a doubler or tripler, it provides a very simple means of obtaining up to 15 times the crystal frequency with a single tube.

OVERTONE-OSCILLATOR TIPS

The economies effected through the use of overtone crystal oscillator circuits have caused what amounts to a major revolution in amateur v.h.f. transmitter design. Most users are well pleased with their results, but some run into difficulties now and then. W5FEK reports that he has used several versions with no trouble of any kind, but a number of his acquaintances have not been so fortunate. Examination of several oscillators that refuse to be crystal-controlled has convinced him that long by-passing leads are usually at the bottom of this trouble.

The same principle applies in case a separate feed-back winding is used. (See Fig. 17-1 in recent editions of the ARRL *Handbook* for examples.) The by-pass (C_2 in Fig. 17-1) must maintain the tap on the coil, or the bottom of the coil when a separate feed-back winding is used, at ground potential, if feed-back is going to be controlled by the feed-back winding. For third-overtone operation the adjustment of feed-back should not be particularly critical, and any crystal that will oscillate on its fundamental should work on its third overtone. For fifth or higher overtones, however, adjustment of regeneration may be quite tricky with *any* circuit, unless the crystal is particularly suited to overtone operation. It should be possible to get at least the fifth overtone out of practically any crystal, by careful adjustment and proper layout.

— *W1HDQ*

FEED LINE FOR 420 MC.

The 420-Mc. transmission line problem at W2QED is solved as shown in the sketch of Fig. 7-16. We have a high antenna with a long feed line, and losses were just about nullifying the effect of the height until we put in the line shown. Made of two No. 10 wires spaced one inch apart, the line is shorted twice at both ends with copper disks. This permits it to be pulled up tight between metal brackets at the top and bottom of the long vertical run, without introducing any form of insulator. A short, flexible section of spaced line at the top connects to the array itself, while the power is fed into the line from the transmitter through a coaxial line and a bazooka. The points of attachment are varied for maximum-power indication in a remote-indicating field-strength meter, also shown in the sketch. This is mounted several wavelengths away from the 32-element array, providing a reliable check on the effect of any adjustments made in the shack, an important factor, as meter indications at the transmitter itself can be very misleading at this frequency.

— *Ken C. Carter, W2QED*

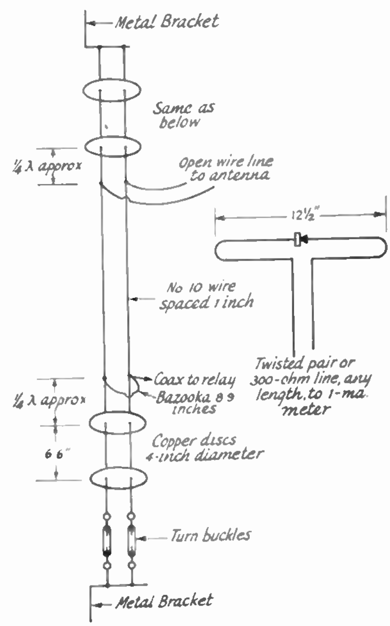


Fig 7-16 — **At the left is a grounded feed line used for the long vertical run up to W2QED's 420-Mc. beam. At the right is a folded dipole with a crystal rectifier which serves as the pick-up portion of a remote-indicating field-strength meter.**

432 AND 144 MC. WITH ONE TANK CIRCUIT

Want to try operation on 432 Mc. without building a separate rig for that band? Fig. 7-17 shows how it can be done. What's more, it is done with a 3E29 tube, which should be good news to fellows who are deterred from going on 432 Mc. by the high cost of tubes that are designed for u.h.f. service.

A single plate circuit is made to serve for both bands, as a quarter-wave line on 144 and a three-quarter wave line on 432. The three-quarter wave method on 432 has an advantage over the half-wave tank circuits used previously, in that the r.f. voltage minimum is at the end of the line. With the half-wave line the plate voltage must be fed in at a point along the line where the r.f. voltage is at a minimum. This is satisfactory for low-*C* tubes like the 832A and 9903/5894A, but with an 829B or 3E29 the voltage node is actually inside the tube.

A 30,000-ohm resistor is added in series with the regular 5000-ohm grid leak for tripling, and the grid drive should be increased when this is done. The screen voltage is lowered until the plate input is not much over the rated plate dissipation for the 3E29, or about 45 watts. The plate circuit works on either band by the simple expedient of adding or removing the shorting bar on the plate line.

Considerably better efficiency is possible if the tube and line are shielded, as radiation losses are quite high with an open layout. We used a 3 × 3-inch shield over both line and tube. The output coupling loop is mounted above the shorted end of the line. Dimensions given are for the 3E29, but the idea should work nicely with the 832A, 9903 and other tubes normally used in 432-Mc. work, with a suitable lengthening of the line. There would be nothing to prevent the adaptation of the idea to the grid circuit, too, and we can visualize this making possible a single amplifier that will work effectively on 144, 220 and 420 Mc., with only the adjustment of the shorting bars (and the modification of the grid and screen voltages) involved in changing bands.

— *Robert J. Loofbourrow, W5HPC*

STACKED DIPOLES FOR "VERTICAL" AREAS

A rotatable antenna can be a nuisance, especially during a v.h.f. contest, when it is often necessary to swing a sharp beam around again and again, just to work stations within a radius of 25 miles or so. While there is nothing new in the idea, we feel that 2-meter operators in the vertical-polarization areas could make good use of the vertically-stacked system shown in Fig. 7-18. The system has been used here at W2GYV

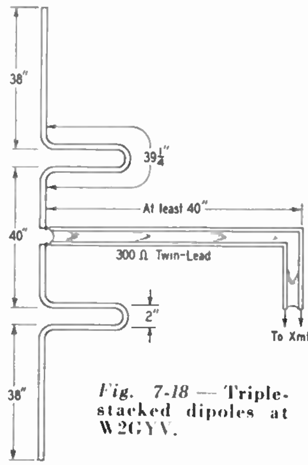


Fig. 7-18 — Triple-stacked dipoles at W2GYV.

for some time with good results. The antenna is made solid enough so that it can be supported at the cold ends of the phasing sections. These low-voltage points are fastened to the supporting pole without insulation, and are grounded for lightning protection. The triple stack is fed at the middle of the center section with 300-ohm line without serious mismatch.

— *Lawrence F. Jeffrey, W2GYV*

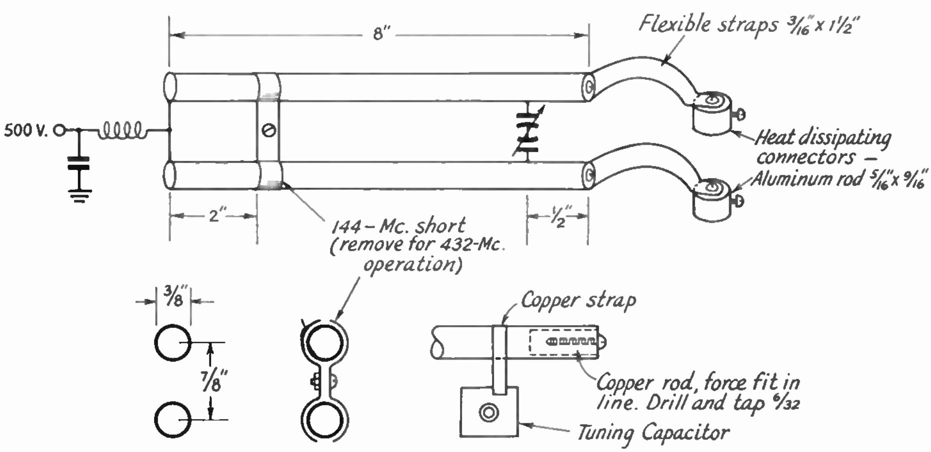


Fig. 7-17 — Two-band tank circuit used by W5HPC for operation on 432 and 144 Mc. with a 3E29 tube. The removable shorting bar converts the line from ¾-wave operation at 432 Mc. to ¼-wave at 144.

8. Hints and Kinks . . .

for the Antenna System

ANTENNA GROUNDING SYSTEM

Shown in Fig. 8-1 is the circuit diagram of a switching system that automatically grounds the antenna whenever the station equipment is turned off by the master control switch. S_1 is a d.p.s.t. switch that feeds 115 volts a.c. to the power circuits, and S_2 is a s.p.s.t. job that does the antenna grounding. The switches are arranged

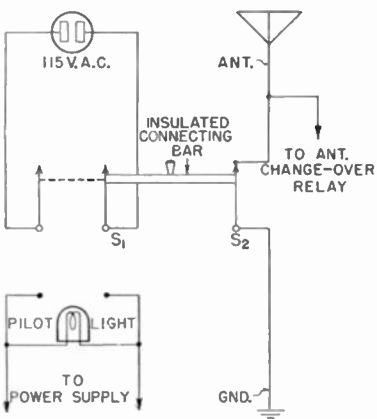


Fig. 8-1 — A switching circuit that automatically grounds the antenna when the main power switch is opened.

mechanically so that S_2 opens when S_1 is closed. An insulated connecting bar joins the control levers of the switches to permit the simultaneous manipulation of the two circuits.

The switches should have a power rating in keeping with the power level of their respective circuits, and S_1 should be enclosed to prevent accidental contact with the a.c. line.

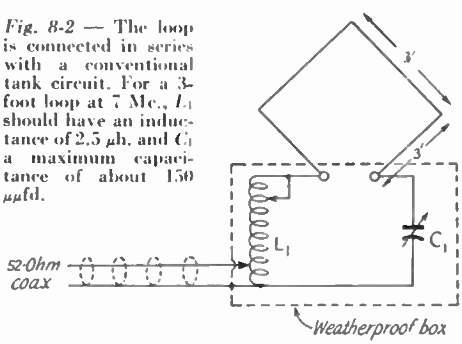
— *E. M. Brownlee, VE2APO*

HAM-BAND TRANSMITTING LOOPS

The antenna system to be described in this article probably won't interest proponents of the "long wire — strong signal" theory. However, it should have a definite appeal for apartment dwellers and home owners with small lots. Inspiration for this system came from a description of a similar antenna in GE *Ham News*, July-August, 1950. The idea apparently failed to impress the average ham. However, it seems to have definite advantages where space is at a premium.

Most of the work at W4LW was done in the 40-meter band, and the following data are based on operation in that band. The essential elements for 40-meter operation are shown in Fig. 8-2. Coil L_1 is provided with two taps — one for varying the total inductance, and one for selecting an input impedance equal to that of the coax line. The coil L_1, condenser C_1, and the loop all form a circuit which is resonant at the desired frequency. L_1 and C_1 are mounted in a protective box provided with a coax fitting for the transmission line and two feed-through connections for the loop. The loop is mounted in a horizontal plane in order to avoid the null which occurs at right angles to the plane of the loop.

Fig. 8-2 — The loop is connected in series with a conventional tank circuit. For a 3-foot loop at 7 Mc., L_1 should have an inductance of 2.5 μh. and C_1 a maximum capacitance of about 150 μμfd.



Adjustment is as follows:

a) Substitute a 52-ohm dummy load for the antenna system and adjust transmitter for proper loading.

b) Remove dummy load and replace the loop antenna assembly.

c) Set the tap for the coax connection at about 3 turns and tune C_1 to resonance at the

Fig. 8-3 — If you live in an apartment house or are having trouble with TVI, this compact horizontal loop for 7 Mc. may be your answer.

transmitter frequency. (If necessary, reduce inductance of L_1 by shorting turns with the second tap.)

d) Vary the position of the coax tap (retuning C_1 each time) until proper loading is indicated.

The position of the coax tap is a fairly critical adjustment and must be set to the nearest ¼ turn for best results. An s.w.r. indicator would be very helpful, although it *can* be done by "cut and try."

Once the correct position of the taps on L_1 is determined, it will be desirable to solder the connections. Poor connections will drastically reduce the effectiveness of the antenna. For the same reason, the connections to the loop from L_1 and C_1 should be of low resistance.

Engineers who have been consulted about this antenna system say that its effectiveness will depend upon the ratio between ohmic losses and the radiation resistance. The installation at W4LW uses No. 12 wire for both the loop and for winding L_1.

While specific values for the W4LW installation have been given, these are not necessarily the optimum values. Considerable variation can be made provided that the circuit composed of C_1, L_1, plus the loop, is tuned to resonance with the transmitter frequency and that an impedance match is provided for the transmission line.

It would be desirable to make the loop as large as possible, with corresponding reduction in the inductance, L_1. The ultimate would be to reduce L_1 to just enough to match the coax line impedance. The larger the loop is made, the greater the radiation resistance. Also, a wider band of frequeneies can be covered.

The small loop illustrated in this article showed narrow-band characteristics. It was not found advisable to use it more than 20 kc. either side of the frequency for which it was originally tuned. If the loop is located within easy reach of the operating position, or furnished with a remote-control system, this is not a serious handicap. However, we got very tired of running up two flights of stairs to adjust the W4LW version!

An unexpected by-product of this antenna system is freedom from TVI. Although the loop was located about ten feet from a TV antenna, a transmitter with 100 watts input had no effect on TV. This effect was double-checked by trying the loop as a receiving antenna. There was a marked reduction in local QRN, and interference from the horizontal sweep oscillator of a neighbor's TV set disappeared entirely.

With a transmitter output of about 40 watts, reliable contacts have been made with this antenna system up to 1000 miles. Three contacts have been over 2500 miles.

The possibilities of this antenna system have not been explored fully. However, two facts have been established: it works, and it is a wonderful subject for conversation during QSOs!

— *Capt. R. R. Hay, USN, W4LW*

HOMEBUILT AIR-DIELECTRIC COAXIAL LINES

The construction of air-dielectric coaxial lines has always been a difficult task by the old bead-and-rod method. Shown in Fig. 8-4

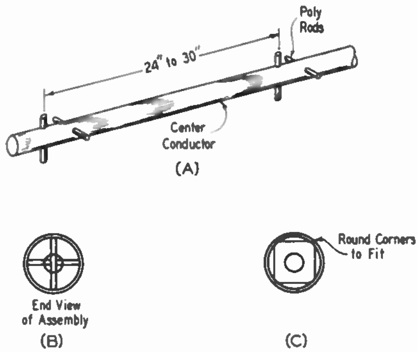


Fig. 8-4 — A simplified method of making your own air-dielectric coaxial lines from surplus aluminum.

is a method that simplifies their construction and permits them to be made with tools available in almost every ham shack.

Ordinary aluminum tubing is used for the outer conductor, and either solid rod or small-diameter tubing for the inner. The method of spacing the inner conductor from the outer is shown in the diagram. If tubing can be used for the inner conductor, it is drilled with pairs of holes spaced approximately as shown in Fig. 8-4A, and polystyrene-rod spacers are inserted. The spacers are cut so that their length is equal to the inside diameter of the tubing used for the outer conductor. The ends of the rods are rounded smooth with a file or sandpaper. They are threaded through the holes and cemented in place.

If rod stock is to be used as the center conductor, the spacers are made in the form of a wafer, as shown in Fig. 8-4C, with dimensions adjusted to fit the inside of the outer conductor. In either case, the spacers should be arranged so that the first one is about 6 inches in from the end of the line, and the rest are equally spaced throughout the line.

Fortunately, the dimensions of much of the surplus tubing available fit very well the ARRL *Handbook* formula for obtaining lines with characteristic-impedance values of 33, 50, 65, 75, and 100 ohms. For example, 1-inch o.d. tubing with a center conductor of ½-inch o.d. tubing has a surge impedance of approximately 68 ohms. The *Handbook* formula may be used to obtain other impedance values using 3/16- and ⅜-inch center conductors.

— *Paul H. Sprowls, W4ALR*

RAINPROOF SHIELD FOR TRANSMISSION LINE CONNECTORS

An excellent weather shield for exposed transmission line couplings can be made from flexible molded-rubber tube pullers (GE type). These tube pullers are available free of charge at many electronics stores, for advertising purposes.

The coax or Twin-Lead is merely fed through the puller and the small end is taped securely to the transmission line just above the coupling.

To change transmission lines or check the coupling, just fold back the larger end for easy access.

If a permanent weatherproof connection is desired, the tube puller may be inverted and the large end completely filled with melted wax. When the wax hardens, the coupling may even be used under water with no ill effects.

— *M. A. Ellis W4LTV*

NEON-SIGN TRANSFORMER USED AS MOUNT FOR VERTICAL ANTENNA

Burned-out gas tube (neon sign) transformers can be purchased from some electrical contractors for around one dollar each. These transformers are housed in a sturdy steel box that is fitted at each end with a large high-voltage porcelain insulator. The mounting of one of the boxes on a mast provides an ideal base for a vertical whip or ground-plane antenna. The units are now known to be sturdy enough to support 14-Mc. verticals (quarter-wave) and there is every reason to believe that they will stand up when used with a 7-Mc. quarter-wave job.

The transformer I adapted is a 350-v.a. unit manufactured by Dongan, but Acme makes one of slightly different design that would serve just as well. Either of the transformers is large enough to permit internal mounting of a tuning or a matching unit. Since there is a feed-through at either end of the case, it would also be possible to use the assembly as the center mount for a dipole.

— *Christopher Noble, W5PFG*

SOLDERING FEEDERS TO THE ANTENNA

A common method of tapping the feeder to an antenna is shown in A of Fig. 8-5. The heat applied in soldering this type of joint tends to anneal the copper wire at points *A* and *B* at either end of the wrap, and may ultimately cause the antenna to snap during some period of unusual strain. Electrically the joint is OK, but mechanically it may be hazardous.

B of Fig. 8-5 illustrates a better mechanical way to connect the feeder. First the feeder is wrapped twice around the antenna wire, then once around itself to form a strain-relief loop which holds the feeder wire without pulling on the actual contact wrap. Then the wrap itself is started by winding two rather wide-spaced turns, followed by six turns close-wound. Adding two more wide-spaced turns completes the wrap, and it's ready for soldering. High-grade rosin-core solder (no other flux) is applied *only* at the two center close-spaced turns, taking special care to keep both solder and heat confined close to these two turns and away from either end of the joint.

Similarly, C of Fig. 8-5 shows a good way to dead-end the antenna in an eye-type insulator. First, a "round-turn" is taken through the eye; that is, the antenna wire is looped twice through the insulator before bringing it out to wrap around itself, thus forming the dead-end. According to old power-line lore, four turns of this wrap following a round turn will hold all the wire will hold. However, in this case, four or five double-spaced turns are followed by four or five close-spaced turns to give even more mechanical strength and permit soldering a feeder to the antenna without danger of annealing the antenna wire at critical point *A*. The feeder should be looped once through the insulator eye and wrapped around itself once or twice to take any possible strain off the soldered antenna joint. The end of the feeder wire is then interwound with the spaced turns of the antenna dead-end and soldered *only* at one or two turns in the center of the spaced wrap. It would be a good idea to hold point *A* with pliers while soldering to keep heat well away.

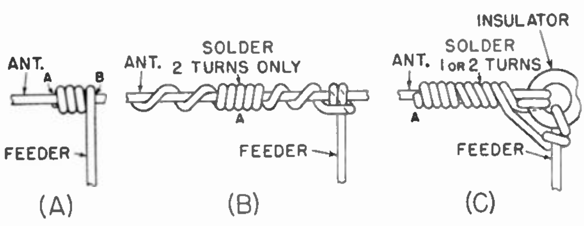


Fig. 8-5 — Correct (B) and incorrect (A) methods of connecting a feeder to an antenna. C shows an approved system for dead-ending an antenna in an eye-type insulator and also shows how the feeder should be attached.

The feeder-tap joint shown in B was used in an old single-wire-fed Hertz, one end of which was tied to a very unstable tree. This antenna was recently taken down and the joint carefully examined. It showed no signs of deterioration, and was apparently as strong as ever after nearly 21 years aloft.

— *Don Derendorf, W8EGI*

ANTENNA FEED-THROUGH PANEL

Fig. 8-6 illustrates a device I am using to feed my antennas through the wall of the house without defacing the wall or modifying the window glass in any way. It is designed primarily for

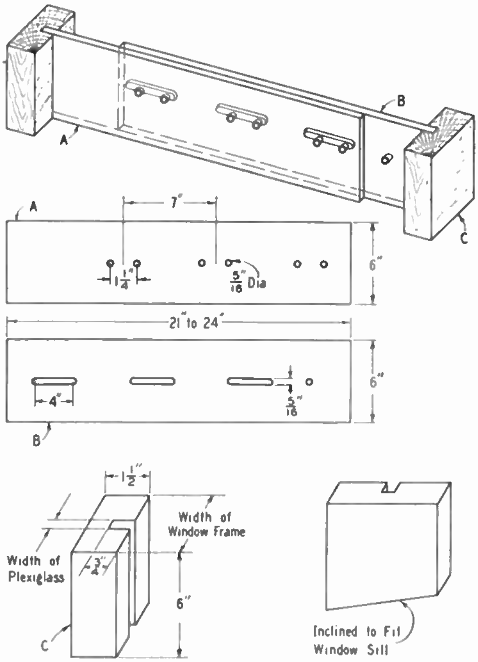


Fig. 8-6 — A "portable" feed-through panel for bringing the antenna leads into the shack. Adjustable to fit windows of several sizes, it is a neat way to eliminate an ordinarily messy problem without defacing the window or its frame.

the ham who is renting, and consequently can make no modifications to the property; and who, by virtue of his profession, has to move often.

The material used is plexiglas salvaged from an obsolete aircraft, but the commercial product is available in most art stores at a nominal cost. It is more flexible and far easier to machine than polystyrene. The two end pieces are made of wood.

It differs from the usual windowpane feed-through panel in that it is made to fit the window frame and sill closely, and in that it may be adjusted to fit almost any window. Thus it allows not only changing from house to house, but changing the position of the rig within the house.

The method of construction and use is evident from the drawing. Dimensions are only approximate. They can be modified to fit the individual case. The hole and groove diameters are for the small feed-through insulators. If larger ones are used, there is ample room for repositioning the holes and enlarging the grooves. Not shown in the drawing, but yet of practical value, are several pieces of rubber weatherstripping cemented to the tops and bottoms of each of the panels, extending to the ends of the wooden blocks. This provides a weather-tight seal.

— *Arthur W. Coffland, W1RVE*

FEEDER-SPREADER HINTS

Some newcomers may not be familiar with the established practice of making feeder spreaders. Inexpensive substitutes for the commercial jobs can be made with ordinary 3/8-inch wooden dowels. Cut the dowels into lengths that are 1 inch longer than the spacing of the proposed transmission line and then drill a clearance hole for the wire at each end of each spreader. The holes should be located 1/2 inch in from the ends of the rods and should provide a snug fit for the wire. Next, dip the spreaders in hot paraffin.

Dowels can usually be bought at a local hardware outlet for approximately 10 cents per 3-foot length. Thus, it is possible to make spreaders for a 6-inch line at a cost of only a nickel apiece.

— *Jack C. Andrews, W9YWE*

Toni hair curlers that are to be used as feeder spreaders can be held securely in place with fast-drying model airplane cement. Just apply cement on each side (where the wire passes through) and over the ends of the curler and then allow adequate drying time. After the cement has hardened the feeder will break before the tie gives way.

— *Ken Cary, WØIXM/2*

Discarded plastic spools from photographic roll film make excellent feeder spreaders for those who desire open-wire transmission lines. Several companies are using this type of spool in most of the popular sizes.

One of the best for this purpose is the spool used with the film required by the Polaroid Land Camera. These spools are already slotted at the ends, and result in a transmission line spaced about 3 1/2 inches. Real estate offices use this film for quick photos of houses, etc., and use a lot of it. Ask them to save the empty spools for you.

— *Don Langbell, VE6EL*

IMPROVED FLUTTER PREVENTION FOR BEAM ANTENNAS

The insertion of wood strips inside antenna elements to prevent flutter as described in the Hints and Kinks section of April, 1949, *QST* has one disadvantage. While effective in preventing flutter, the strips rattle around inside the elements, causing considerable noise.

When my beam was taken down for cleaning recently ,I tight-slipped some soft rubber grommets spaced a foot or two apart along the entire length of the 5/16-inch-square strips. The strips were then reinserted in the elements and the beam reassembled. Now, in addition to being flutterproof, the beam is also rattleproof.

— *William Vandermay, W7DET*

TWO IMPROVEMENTS IN ALL-METAL BEAM CONSTRUCTION

Anyone who has made an all-metal rotary array by running the elements through a boom made of dural tubing knows that this method leaves a lot to be desired. The elements vibrate in the wind and soon wear themselves loose, even if they were originally driven into the holes in the boom. Worse, the abrasive effect of aluminum and its alloys soon wears the elements thin enough at the points of contact so that they break under wind or ice loading.

This is easily corrected by the use of simple "U"-shaped clamps that can be cut from ordinary soft sheet aluminum. Where thin-wall conduit is used for elements these may be the pipe clamps used for mounting the conduit when it is used for electrical work. Two of the size that fits the elements are used at either side of the boom, with two more that fit the boom running over the top of it, as shown in Fig. 8-7.

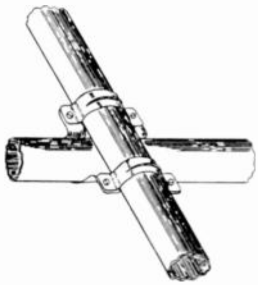
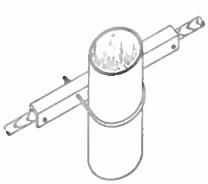


Fig. 8-7 — **A really rugged method of fastening beam elements to a boom in an all-metal array. Pairs of pipe clamps back-to-back do the job. (*Suggested by W2AOE*)**

The clamps may be made from strips of aluminum $\frac{3}{4}$ inch or more in width. Make them such a length that they do not quite meet when mounted in place. Pulling up on the screws then results in a very strong and absolutely rigid joint. An easy way to judge the right size is to cut samples from thin soft sheet metal such as copper, then make them to size from the sample. Laying out all of them side by side on a single sheet of aluminum and drilling the holes before cutting and bending greatly simplifies the operation. Credit for the above suggestions should go to W2AOE and W1JEQ.

If you haven't already put up your all-metal job you may prefer the system used by W5KQD. George uses a short length of 24ST channel stock as a cradle, bolting the elements to this, and attaching the channel to the boom by means of "U" bolts as shown in Fig. 8-8. The "U" bolts or

Fig. 8-8 — **Another method of mounting the beam elements. Aluminum channel brackets and "U" bolts are used in a neat and rigid assembly. (*Suggested by W5KQD*)**



clamps may be bought in various forms in hardware or auto-accessory stores. This system has two advantages over the through-the-boom method. It leaves the boom at full strength, and it permits adjustment of the spacing. The elements, of course, may be mounted above or below the boom.

— *E. P. Tilton, W1HDQ*

TORQUE PROTECTION FOR ROTARY BEAM ANTENNAS

Considerable torque is developed when the wind blows against a beam antenna, as evidenced by the attempts the beam makes to "head up" into the wind. If you use a fairly long shaft to couple power from the drive mechanism to the antenna itself, you've probably noticed the way the antenna swings back and forth in a gale. In time, the torque thus developed can do considerable damage to the drive shaft, or to the pins used to make joints between sections of the shaft. This was the case at W1PID, where telescoping sections of pipe locked together with self-tapping screws are used between the drive mechanism and the antenna. Investigation revealed that the shanks of the screws were slowly but surely chewing into the slots of the pipe, making a sloppy joint instead of the original snug fit.

A simple shock mount for the rotator box, as shown in Fig. 8-9, solved the entire problem. Now, when the wind blows, the beam swings, but the entire assembly of antenna, drive shaft, and rotating mechanism swings with it, and the torque is dissipated in a pair of screen-door springs, which also serve to return the antenna to its original heading.

The shock mounting is accomplished as follows: The rotator box is raised an inch or more off its platform, and a ball bearing is rolled into a

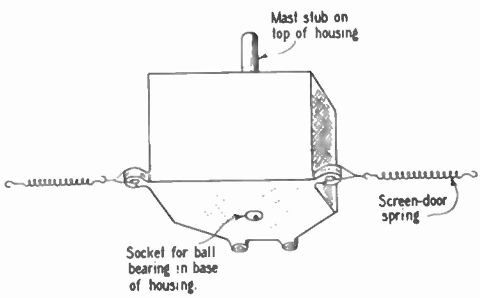


Fig. 8-9 — **Shock mounting the rotating mechanism of a beam antenna reduces the effects of torque produced by wind. This system, used by W1PID, provides excellent protection and assures that the beam will return to the original direction after each gust.**

socket in the base directly under the rotator bearing. If your platform is wood, it would be advisable to slip a piece of flat metal under the bearing to reduce friction. The entire rotator box will now swing readily. Attach the springs to the front corners of the rotator box, where they will have some slight mechanical advantage in pulling the assembly back to its original position. The springs should be stretched horizontally and away from each other in a straight line, with the far ends fastened to something solid.

Other spring-mounted arrangements can no doubt be worked out to fit individual needs. The size, type, and position of the springs will determine how much "cushioning" is obtained. A "soft" cushion will permit a greater arc of swing, and proportionate reduction of the damaging effects of torque. A hard cushion will hold the beam steadier, but with proportionate increase in the shock factor. Here is one precaution: There should be a bearing installed near the bottom of the lowest section of pipe so that when the springs are performing their function they will not pull the rotator box out of line and bend the pipe. Every support using multiple pipe sections should have at least two well-spaced bearings anyway.

— Gorham Cluett, W1PID

YOUR BEAM — WILL IT STAY UP?

Quite often we hear of a beam that withstands several severe windstorms and then tumbles down in a comparatively light breeze. This generally baffles the builder, but a close examination will disclose that some of the fundamental rules in the use of metals have been violated.

Nearly everyone is familiar with the fact that iron and steel will rust readily on exposure to the weather, so proper steps usually are taken to prevent rusting, either by painting or applying a protective coating of some other metal. Few, however, realize that under certain conditions other metals — for instance, aluminum — may become badly corroded.

In the case of our broken-down beam, we find that the tubular aluminum elements have been bolted together with brass screws and nuts. At each of these joints, the aluminum has been badly corroded and finally weakened to such an extent that the light breeze caused failure. A great many of the otherwise excellent beams have called for the use of brass bolts or clamps with aluminum tubing. Nor are the hams alone

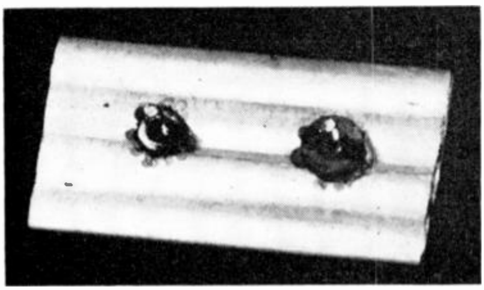


Fig. 8-10 — A sample of flattened aluminum tubing with two steel screws and brass nuts attached. After 3 days in a salt fog at 95° F corrosion has progressed in the aluminum at the points of contact with the brass. The steel has, of course, also rusted.

in this undesirable practice. Some of the commercial television antennas, including rotators, fall into the same error and may be expected to give trouble after installation.

Why is this condition bad and what can be done to overcome it? Let's go back to our high school chemistry, or maybe the days when we used wet batteries to operate a telegraph line with the fellow up the street. Remember those wet batteries used two dissimilar metals, usually zinc and copper, immersed in a conducting solution or electrolyte such as one containing copper sulphate. The combination gave an electromotive force of something over one volt, and as we used the battery the zinc was gradually used up or corroded while the copper was unattacked. The zinc was the negative terminal and the copper positive.

In like manner, any two dissimilar metals in contact with each other in the presence of an electrolyte will form a small galvanic cell and the more negative metal will be attacked or corroded. All metals can be arranged in a series according to the individual potential attributed to each. The e.m.f. developed by any particular couple or combination is the sum of the potentials of the two metals. The greater this e.m.f. the greater the tendency toward corrosion. Table VIII-1 shows the electrochemical series for the more commonly used metals and the potential of each.

In instances of outdoor exposure, the required electrolyte is supplied by atmospheric humidity or rain. Industrial and urban atmospheres contain small amounts of sulphur dioxide from fuel combustion which will slightly acidify the moisture. Marine atmospheres contain salts which will provide the necessary conducting electrolyte.

Reference to the table shows that aluminum and copper (brass is an alloy of copper) are far apart, and considerable galvanic corrosion can take place in moist atmospheres when these metals are in contact with each other. The aluminum is the most negative of the combination and will be attacked with resulting loss of strength. The table will suggest other poor combinations but aluminum-copper is one of the worst offenders.

What can be done to guard against this condition? If you live along the southern seacoast of the United States or in similar hot marine atmospheres, all possible protective measures should be used. For a dry inland climate, the danger is not as great and less stringent measures will be satisfactory.

For some of the beam elements, anodized tubing can be used if procurable. This is aluminum treated by a process that can hardly be undertaken by the amateur but provides a thin nonconducting skin of aluminum oxide on the surface of the metal. A joint across such a layer is insulated and galvanic currents cannot flow. Unless mechanically broken down or scratched, the skin will have an insulation breakdown of the order of 500 to 1000 volts. Where electrical conducting joints are required such tubing should not be used unless proper steps are taken to break through the insulation.

The screws, bolts, and nuts can be made of steel with a more protective coating such as a zinc plate, or galvanized coating. Cadmium or nickel plate can also be used. All of these plated steel parts are much better than brass, but still not entirely preventive.

As a final precaution, the joint should be painted to keep out moisture and the electrolyte

TABLE VIII-1

Magnesium	−1.55 volts	Tin	−0.14 volts
Aluminum	−1.33 volts	Lead	−0.12 volts
Zinc	−0.76 volts	Copper	+0.34 volts
Chromium	−0.56 volts	Silver	+0.80 volts
Iron	−0.44 volts	Platinum	+0.86 volts
Cadmium	−0.40 volts	Gold	+1.36 volts
Nickel	−0.23 volts		

required for corrosion. Here again the degree of protection required dictates the materials used. For highest protection, a first coat of zinc chromate primer should be used followed by one or more coats of good outside paint. The zinc chromate, besides serving as a prime coat, also provides a "passivating" action to aid further in corrosion protection. For less severe climates, the outside paint alone may be used.

Similar precautions should be taken on indoor construction if one lives in a part of the world subject to destructive atmospheres or if equipment is used in basements where relative humidity is high. Nickel-plated brass or steel hardware is nearly always satisfactory on steel chassis. On aluminum, the same treatment as for beams should be followed.

Many small steel parts are plated with either cadmium or zinc for protection. Cadmium is generally to be preferred but at present is little used because of cost. Zinc, either in the form of coatings or die castings, is subject to another form of attack known as "white powder corrosion." This is not an electrolytic effect but a direct chemical attack by certain atmospheres, principally marine. As the name implies, a white powder is formed on the surface and is quite pronounced under the most adverse conditions. It can be prevented or delayed by treatment with certain passivating solutions but this is beyond the scope of home operations. However, if the parts you buy have an iridescent appearance they have been so treated. Cadmium is not subject to the same form of corrosion except under rather unusual conditions.

As might be expected from Table VIII-1, magnesium is a worse offender than aluminum as regards electrolytic corrosion. Since it is also of lower strength than aluminum and its alloys, and larger sections must be used for equal rigidity, it is not generally advisable to use it for amateur construction of antennas. Magnesium is a metal also readily attacked in almost all atmospheres and should not be used without adequate pretreatment, prime coats and final painting.

Another fact not generally recognized is that stainless steel is not corrosion-resistant unless it has a good polished surface. If dirt or scale is present, electrolytes can go to work and readily start destructive corrosion.

It is hoped that these few simple rules of the materials engineer may help to keep more beam antennas in the air and more hams on the ground.

— *Raymond W. Woodward, W1VW*

BEARING FOR LIGHTWEIGHT BEAMS

If you have no need for the small dynamotor that came with your SCR-274-N receiver, the base and frame inside of which the "works" are assembled can be utilized as a lightweight wall bearing for holding the rotary mast of your beam antenna to the side of the house. Remove the end covers, the castings, and the armature. Next chop out the field winding by forcing a cold chisel between it and the inside of the case. A few good whacks with a hammer should break the coil loose from its moorings. Remove all of the screws that extend through the side of the case into the "sleeve" formed by the removal process, and you are all set. The "bearing" will pass the pipe supports used in most beam installations, and may be packed with rags and grease to take out any undesired play between the pipe and the sleeve.

— *Richard M. Smith, W1FTX*

SIMPLE GROUND-PLANE ANTENNA FOR 28 MC.

Restricted space, army post regulations pertaining to antenna construction, and the need for an omnidirectional antenna were all instrumental in the development of the antenna set-up shown in Fig. 8-11. The strain insulators that support the 100-inch vertical wire are located at the upper and the lower edges of a

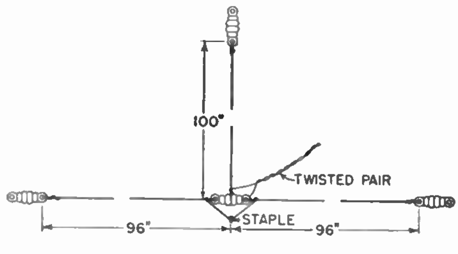


Fig. 8-11 — The "Gizmo" antenna supported on the side of a building. Coaxial cable may be used for the feed line in place of the twisted pair.

building and the two 96-inch radial wires run along the base of the wall. The *twisted pair* used to feed the radiator may not provide the best match in the world, but does serve as an economical feed line for an exceedingly economical antenna.

This simple vertical job probably will be more effective for work with 28-Mc. mobiles than will any existing horizontal radiator (except for a rotary beam) that you happen to be using. In my own case, it was observed by W3QHG (mobile with a vertical whip) that my fixed-station signal went from down-in-the-noise to a solid S6 when the regular center-fed horizontal was replaced by the vertical — or as I call it — the "Gizmo" antenna. This test was made over a 4-mile path and a second check, 16 miles farther along the line, showed that the Gizmo was still getting out.

— *Albert S. von Trott, W3UIX/3*

COMPACT ANTENNA FOR LOW-POWER TRANSMITTERS

Illustrated in Fig. 8-12 is a compact antenna that can be used in lieu of more elaborate affairs in cases where space limitations make it necessary to get by with the absolute minimum. At W2CEI this antenna has been used with gratifying success even though it is merely run under the rug on the floor!

A length of RG-59/U coaxial cable is used as a quarter-wave antenna, capacity loaded. Note that the inner conductor of the cable is grounded, while the outer braid is "hot," being connected to the antenna terminal of the BC-458 transmitter. In the usual antenna, a quarter of a wavelength at 7 Mc. works out to something over thirty feet, but when the arrangement shown here is used, the length required shrinks noticeably because of the low velocity factor of the cable. RG-59/U was selected because it has the lowest velocity factor of most readily-available cables. The theoretical length required using this cable is 23 feet, but the added capacity gained by running the antenna under the rug caused the resonant length to be shorter by about two feet. Half of the theoretical length can be used if a variable inductance is used as a loading coil as shown in the diagram. Thus,

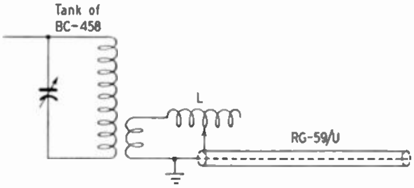


Fig. 8-12 — A makeshift antenna for installation where space is at a premium. Loading coil *L* may be omitted if the full electrical quarter wavelength is available.

an "under-the-bed" antenna for shut-ins could be made.

At W2CEI, with 100 watts input to the transmitter, current into the line measures 10 amperes, and while it is not known whether more power than this could be used, the antenna performs well at this and lower power.

— *Maurice Basal, W2CEI*

ANTENNA WIRE BY THE MILE!

If the present high cost of antenna wire is interfering with plans for your new rhombic, try using electric fence wire. This is copper-clad steel wire, and you can buy about a half mile of it for ten dollars.

— *Ed Stephenson, W1SCO*

BASE-FED VERTICAL HALF-WAVE ANTENNA

It is usually much easier, from a mechanical viewpoint, to base feed a vertical antenna than to feed it at the center. The electrical problems involved are usually tougher to handle with base feeding, especially when the antenna is to be fed at a high-impedance point, as is the case with a half-wave whip.

The system shown in Fig. 8-13 was worked out as a very satisfactory solution to the problem. In addition to giving the desired impedance match, it permits the use of coaxial cable at the output

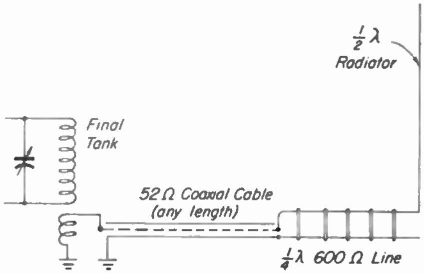


Fig. 8-13 — W4FPK solves several problems at once with this base-fed vertical half-wave antenna. Either RG-8/U or RG-11/U coaxial cable may be used.

of the transmitter so that a low-pass filter can be inserted to eliminate TVI, and requires no antenna tuner. A quarter-wave section of 600-ohm line is used as a matching transformer to give a step-up ratio. This is simply an inverse use of the system frequently used to feed the radiator of a beam antenna where center feed must be used with open-wire feeders. In our case the transformer is used to secure a step-up to about 5000 ohms. The system is, of course, applicable to either vertical or horizontal antennas when end feed is required.

The installation of a low-pass filter in the coaxial line resulted in subsequent elimination of TVI, and the vertical antenna seems to be very effective for DX work in the 14-Mc. band.

— *R. J. Miller, W4FPK*

METAL BEAMS AS RADIALS FOR GROUND-PLANE ANTENNAS

Those who already have a relatively wide-spaced all-metal 14-Mc. beam may also enjoy the efficient benefits of a 21-Mc. ground-plane simply by adding a 21-Mc. vertical (quarter-wave) to the system. The vertical must be insulated from the beam so that the latter may serve as the ground radials for the system.

In my case a 12-foot length of aluminum tubing is fed with a length of RG-8/U having the shield connected to the metal beam. The set-up is 45 feet above ground and has a measured s.w.r. of 1.1 to 1.

— *W5MIS*

PAINTING ANTENNA MASTS

Now is the time to repaint that antenna mast. It will add years to the life of the mast, and to your own when the neighbors find out that a mast can really be a thing of beauty!

Before starting the job, the surface should be prepared. Blistered and cracked paint should be removed to provide a smooth, clean surface. Then, when selecting the paint, avoid the cheaper varieties. In most cases they will merely deteriorate rapidly, cracking, blistering and chalking, making it necessary to do the whole job over again in a short time. A marine paint such as is used on boats is ideal for the purpose, but outside house paint will also do the trick.

Most masts and towers are painted white, and while white paints all look pretty much alike, there are important differences to keep in mind when selecting the paint for the job. The white can be either a lead base or zinc oxide. The lead-base paint will perhaps last a bit longer, but will darken with age. The zinc-base paint is whiter, but is more brittle than the lead. An ideal paint for the purpose is a mixture of 60 per cent titanium oxide and 40 per cent zinc oxide in a pure linseed oil base. This mixture provides flexibility plus tremendous tinting strength and whiteness. This means good coverage with one coat and longer lasting qualities. Such a formula can be purchased ready-mixed.

To increase the lasting quality of the paint still further a good grade of outside varnish such as Valspar should be added to the mixture. Use one cup of varnish per pint of paint.

When thinning your paint it is best to use linseed oil instead of turpentine. The linseed oil makes for toughness, resilience, and binding. Turpentine will wash the binder from the paint and make it chalky and flake from the surface.

— *Louis H. Hippe, W6APQ*

IMPROVING THE 14-MC. PATTERN OF 7-MC. ZEPPS

Many of us have to rely upon a 7-Mc. half-wave Zepp antenna as a general purpose antenna. One disadvantage of this practice is that the radiation at right angles to the line of the antenna is practically nil with the system tuned for 14-Mc. operation.

This disadvantage can be overcome without affecting performance at any other frequency by dropping a 14-Mc. half-wave section from the center of the horizontal flat-top. Connected at this point the new vertical member will have no noticeable effect on the loading at any frequency but will cause the antenna to radiate an omnidirectional vertically polarized signal at 14 Mc., so eliminating the previous gap in the coverage.

It needs to be said that one does not get something for nothing, and that the amount of power radiated at right angles to the modified antenna is subtracted from the power formerly radiated in other directions.

— *W. A. Roberts, G2RO*

LIGHTWEIGHT "GUY WIRES"

Monofilament fishing-line leader, made of Du Pont nylon, sold in 100-yard rolls for approximately $4.80, makes lightweight guy lines that are easily handled, nearly invisible and free of properties that affect antenna radiation patterns. The type having a diameter of 0.032 inch and a test strength of 40 pounds is being used here at W9FKC to guy a 33-foot vertical and has been through winds up to 60 m.p.h.

— *Myron Hexter, W9FKC*

CATWALK FOR BEAM ADJUSTMENT

Anyone who has plans for a new rotary beam antenna will be interested in the rugged mounting arrangement shown in Fig. 8-14. It is the final realization of a dream that many hams have had, namely a rotary beam that is both safe and easy to adjust while it is in its operating position.

The photograph shows the details of the mounting at the top of a 50-foot pole. A catwalk is built between two 10-foot crossarms, with two

Fig. 8-14 — **A solution to the old problem of how to adjust the beam while it is 50 feet above ground. The secure-looking individual on the catwalk is W4BAD.**

more crossarms providing a guard rail and additional support for the entire structure. The thrust bearing that supports the antenna is mounted at one end of the structure, so that by merely rotating the antenna, almost any part of it can be reached from either one end of the catwalk or the other.

An 18-foot ladder is used as the boom, and the elements are mounted on 12-foot lengths of kiln-dried fir 2 by 3.

— *George Tamer, jr., W4BAD*

TENSILE STRENGTH TESTS ON TWIN-LEAD

If you've been curious as to the ability of Amphenol 300-ohm Twin-Lead to support itself when used as an 80-meter folded dipole, you'll be interested in the lab tests made by W4CVO. Les, who has successfully used such a homemade antenna for over two years, found that the ribbon has a breaking or tensile strength of 110 pounds, which is approximately equivalent to that of the common variety of soft-drawn No. 14 copper wire.

HOMEMADE STRANDED ANTENNA WIRE

Need some stranded enameled antenna wire in a hurry? If you have some old No. 26 or No. 28 enameled wire kicking around the junk pile, take five or six strands of it, each of the required length, tack one end of each to a convenient post, and loop the other ends through a screw eye. Grip the threaded portion of the screw eye in your hand drill, stretch the wire out a bit to prevent snagging, and turn the crank on the drill until you've made about 100 turns in the wire. It works out fine.

— *Jack Nelson, W2FW*

SHOCK ABSORBER FOR FLAT-TOP ANTENNAS

If you've ever used a flat-top antenna supported between two trees, you've probably had the sad experience of seeing one or more of the insulators shattered when the trees whip around in random directions during high winds. After losing several antennas in this way, I solved my difficulties by placing an automotive valve spring "in series" with the end insulator and the wire that holds the antenna to the tree. The spring takes up the initial shock when the wind tosses things about, and thus far has prevented any further breakage.

— *Grover Hunsicker, WØBDE*

COMBINED CLEAT AND COUNTERWEIGHT FOR ANTENNAS

Shown in Fig. 8-15 is a neat and inexpensive way to accomplish a favorite antenna protective stunt, namely the use of a counterweight to keep the flat top flat yet with sufficient "give" to

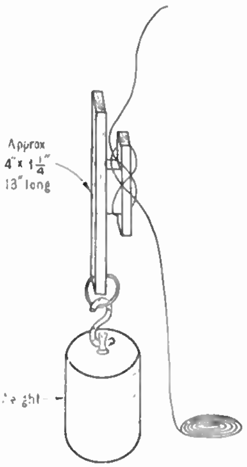


Fig. 8-15 — **A neat arrangement for using a counterweight to keep the antenna halyards snug.**

avoid breaking under sudden strains. In the usual installation, the counterweight is merely tied on the end of the halyard. Then, when it becomes desirable to lower the antenna for any purpose, the weight must be removed before the halyard can be released.

The combined weight-and-cleat arrangement illustrated makes the operation a lot easier and eliminates fussing with weathered knots that usually have to be pried apart or cut before they'll come loose.

— *H. W. Lippincott, W2DH*

AUTOMATIC ANTENNA SWITCHING

Although relays can be used for quick switching of antenna from receiver to transmitter when working voice-controlled break-in, it is much nicer to do it electronically. Two circuits used for this purpose at W2UNJ are shown in Fig. 8-16. The circuit at A is along the lines of that de-

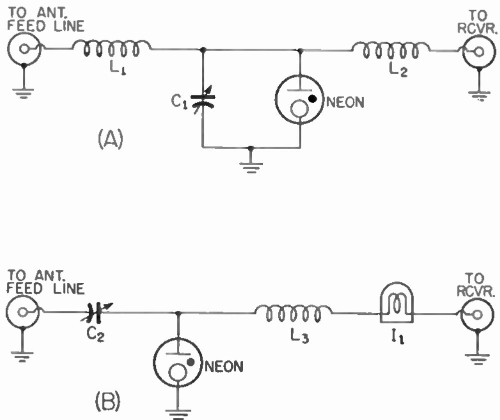


Fig. 8-16 — **Two TR ("transmit-receive") switch circuits that have been used by W2UNJ. The circuit at A uses two large inductances, L_1 and L_2, a small condenser, C_1, and a neon bulb. The circuit at B uses only one coil and adds a small flashlight bulb for added protection of the receiver.**

C_2 — 50-μμfd. variable.
L_3 — 90 turns No. 28 enam. on ¾-inch diam. form (for 3.9 Mc.).
I_1 — 6–8 volts, 150 ma.
The neon bulb can be ¼-watt with a low-powered rig and 2 or 3 watts with a high-powered transmitter.

scribed by W2OUA (Cronin, *QST*, June, 1952). The system at B is presently in use at W2UNJ. The circuit C_2L_3 should be low-C and tuned for maximum received signal. It is broad enough to hold over a 'phone band without retuning. The neon bulb must have the resistor removed, of course, and a ¼-watt neon will suffice for 75 watts or so. The pilot lamp is a safety fuse to protect the receiver in case of failure of the "TR" switch. In some cases it may be necessary to shield the TR circuit to prevent the radiation of harmonics and subsequent TVI, but this hasn't been found necessary.

— *William Rust, W2UNJ*

PRESERVATIVE FOR WOODEN MASTS

A very convenient, effective, and easy way to "seal" and waterproof a telephone pole or other wooden mast that is to be set in the ground is to paint it with automobile chassis black. This paint has a very high percentage of asphalt, and after the job has been completed the brush can be cleaned with kerosene.

This paint can be obtained from almost any auto supply store for about $1.75 per gallon. A more expensive grade is also available, but for this purpose the cheaper variety is good enough.

— *W. E. McCormick, W5KMA*

9. Hints and Kinks . . .

for the Mobile Rig

SAFETY-FIRST RULES FOR MOBILEERS

Mobileers are reminded by W9LQP that injury can result if gas escaping from an uncapped storage battery is accidentally ignited.

— • • • —

If your portable or mobile operation takes you into areas where dynamite caps are in use or storage, it will be well to heed the following warning published in *The Safety Energizer:* "Information and tests show a real danger of exploding electric dynamite caps exists when using a radio transmitter within 20 feet of an uncoiled wire on the cap."

— *W9KXK*

MOBILE RECEIVING HINT

In many mobile installations the transmitting antenna, mounted at the rear of the car, is used as a receiving antenna as well, instead of using the original receiver antenna. To do this it is usually necessary to run a long lead from the rear of the car up to the receiver. If this lead happens to be a high-capacitance affair, it may add enough shunt *C* across the receiver input terminals to detune the r.f. stage far beyond the range of the antenna trimmer provided in the set. If this is the case, the sensitivity of the receiver will seem lower than when the original antenna is used.

A simple cure is to put enough fixed capacitance in series with the antenna lead to limit the effect of the shunt *C*. At W1KDK/A1KDK, a 200-$\mu\mu$fd. tubular ceramic condenser effected the cure. With this condenser in series with the center conductor of the RG-59/U cable used to run between the whip and the receiver, it was again possible to peak the antenna coil in the receiver, restoring it to its original sensitivity.

— *Theodore Simmington, jr., W4JOT/A1JOT*

USING BLOWN INDUSTRIAL FUSES AS LOADING-COIL FORMS

Blown industrial fuses that are ordinarily discarded by factories, construction concerns, etc., can be modified for use as mobile-antenna loading-coil forms. The fuse best suited for this application is one having a diameter of 1¾ inches, a length of 6 inches, and an electrical rating of 600 volts at 150 amperes.

To prepare a fuse for use as a form, it is necessary to remove the end bells so that the lime-dust contents and the copper fuse blades can be discarded. The contact arms must be cut from the end bells and the label should be removed from the tube.

Fig. 9-1 shows before-and-after sketches of a modified fuse. Notice that the finished job has a

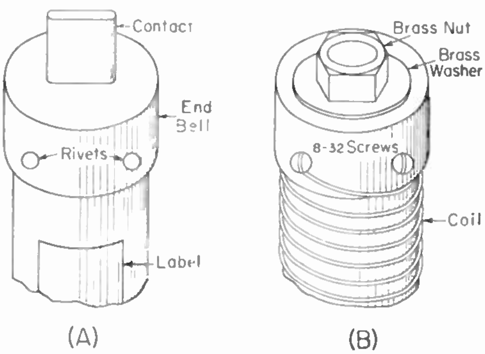


Fig. 9-1 — (A) shows one end of an industrial fuse before modification, and (B) shows the same unit adapted for use as a mobile-antenna loading coil.

brass nut and a brass washer brazed to each end bell. The brazing operation can usually be handled by a local welder. Naturally, the nuts used should match the threads of the antenna sections. Type 8-32 machine screws are used to tie the end bells and the tube together and also serve as the termination points for the loading winding.

Loading coils of the type just described can be turned for almost negligible cost and, as a result, it is advisable to prepare a number of fuses at one time. This procedure will save a trip to the local welding shop each time that a new form is needed.

— *Kenneth M. Rude, W6TEN*

COMPLETE DATA ON THE PE-103A DYNAMOTOR

Although many mobile hams use the PE-103A surplus dynamotor, very little technical information on the unit is available.

The PE-103A is a component of a military radio station primarily intended for mobile use. It was originally employed to furnish 500 volts at 160 ma. and 6 volts for filament current and auxiliary equipment. Of course, in the last-mentioned use, the unit is not the source of the power but since the battery current flows through its control circuits, the filaments and other equipment are protected from overload. The dynamotor proper, which has provisions for both 6- and 12-volt input, provides the 500-volt plate supply in which most of us are interested.

3E3, the high-voltage circuit breaker. The contacts of this unit and *3E4*, the low-voltage circuit breaker, are in series with each other and with the ground ends of the 6- and 12-volt starter-relay coils. Thus, the starter relay selected by the 6/12-volt switch is energized and delivers primary current to the proper low-voltage winding on the dynamotor.

The "hot" ends of the starter-relay coils receive current through the filament protective circuit breaker, *3E5*. This unit has its contacts and coil internally connected in series. Thus, if one of the three circuit breakers opens, the starter relay will open and stop the dynamotor.

The B-plus lead from the high-voltage commutator is connected in series with the coil of *3E3* and terminates at Pin 8 of the output socket.

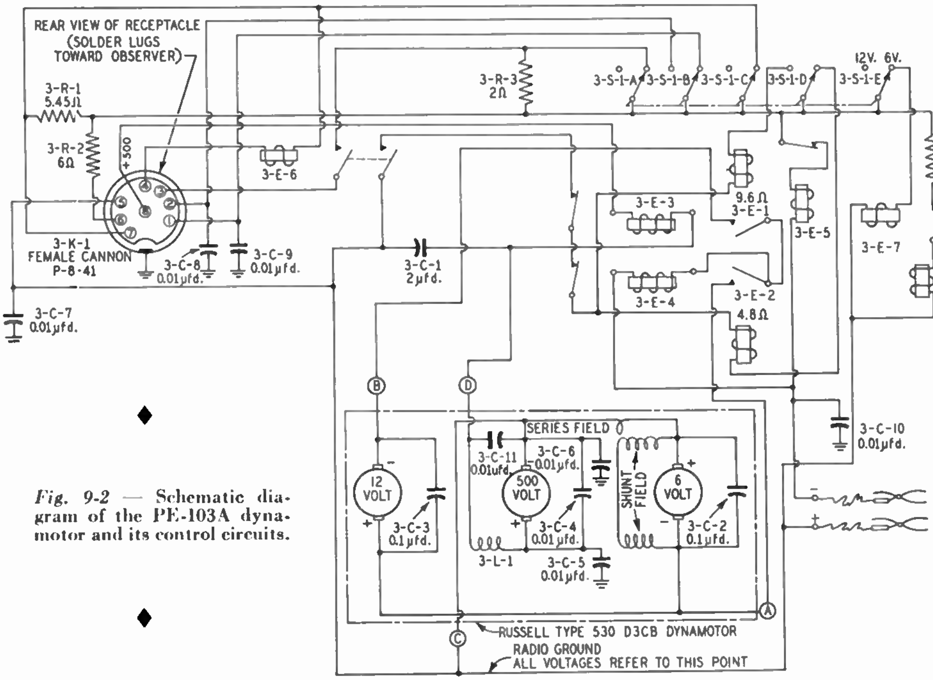


Fig. 9-2 — **Schematic diagram of the PE-103A dynamotor and its control circuits.**

The control circuits may be briefly described as follows: All units utilize three circuit breakers, but those bearing serial numbers below 4711 do not have high-voltage protection. This is the essential difference between early and later models. The latter incorporate a high-voltage circuit breaker to protect the transmitter against overload, a low-voltage circuit breaker to protect the dynamotor armature against overload, and a third such device to guard against filament overload when filament current is drawn through the control circuits of the PE-103A.

By connecting Pin 4 of the output socket to Pin 5 (see Fig. 9-2), which is radio ground, the circuit through the coil of control relay *3E6* is completed. One moving arm of this relay, which is grounded (we refer to radio ground here and in all cases following, but this is usually identical with physical ground), grounds one contact on

This circuit breaker is supposed to open when more than 220 ma. passes through the circuit. The "hot" primary lead of the PE-103A passes through the coil of *3E4* and then to the contacts of the 6- and 12-volt starter relays, *3E2* and *3E1* respectively. Here, a current of over 40 amperes will open the circuit breaker.

For those who use these dynamotors, two conversions may be necessary or desirable:

1) Relay *3E7* may be permanently de-energized in order to prevent a steady 15-ma. drain on the car battery when the circuit breakers are left on. This relay was used to prevent accidental application of 12 volts to the 6-volt dynamotor winding. It may be "silenced" by disconnecting the heavy lead fastened to the post at which the primary lead marked "plus" terminates.

2) When used in a vehicle, the negative terminal of whose battery is grounded, the following

changes should be made: Remove the larger of the two end covers on the dynamotor which exposes the 12-volt and high-voltage commutators. The latter are nearest the center of the armature. Remove all wires from the positive brush binding terminal and connect them to the negative brush.[1] Now it is only necessary to ground the primary cable, marked positive, while the one marked negative is connected either to the positive battery terminal or the battery terminal of the voltage regulator. The latter connection allows you to observe the current drawn by the dynamotor on your dashboard ammeter.

Three of the problems most frequently met, and their remedies, are discussed below.

1) Apparently, a good many of the high-voltage circuit breakers are oversensitive and will kick out considerably below their 220-ma. rating. This can be very annoying and can kill your carrier on modulation peaks, etc. The remedy is simple. Connect a 47-ohm ½-watt resistor in parallel with the circuit-breaker coil terminals. These are the terminals to which are fastened the wires that protrude from the body of the breaker in question. Sensitivity will now be at a more useful level, approximately 250 ma.

2) The same circuit breaker mentioned above is likely to give offense in another and more serious manner. It has been my experience and that of personnel in the field that moisture often causes a short circuit between the circuit-breaker coil and contacts as a result of insulation breakdown. When this occurs, activating the control relay *3E6* causes the dynamotor to turn over very slowly with little or no high-voltage output, and it may continue to turn even when this relay is de-energized. If such symptoms develop, you can be fairly certain of a short circuit as mentioned. Confirm your suspicions by measuring the resistance from the coil of *3E3* to both of its contacts. This resistance should be infinite; several hundred ohms indicates a short.

A temporary repair, eliminating high-voltage protection, may be effected by removing the circuit-breaker contacts from their series connection with the *3E4* contacts, leaving the latter alone in the circuit. Thus you will still maintain protection for the dynamotor armature. A permanent solution requires the removal of the defective unit and either its repair or replacement. To do this, unfasten all connections to the bakelite terminal board on the rear housing of the circuit breaker and remove the two screws on the switch side and the one at the base of the bakelite strip. The unit may then be slipped out. If you feel brave enough to attempt a repair, you must first remove the bakelite terminal strip. Then, to open the circuit-breaker housing, remove the two screws in back which are sometimes covered with pitch or a similar material.

3) The last common ailment likely to be encountered is a gradual diminution of high-voltage output. The probable cause is lack of lubrication, especially if this precaution has been neglected. Do not be too eager to grease the bearings since this is usually unnecessary and may do more harm than good if improperly executed. First try a few drops of oil in the two oilers, located at either end of the armature under the covers.

Richard Shongut, W2QFR

[1] Conversely, connect the negative brush wires to the positive brush.

STOW CLAMP FOR MOBILE ANTENNAS

The accompanying drawing, Fig. 9-3, shows a small homemade clamp that is used to stow a 28-Mc. whip whenever the car is to be garaged. In this particular case the clip is held in place by a

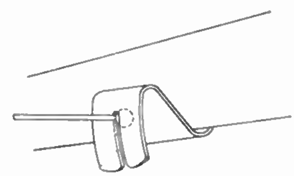


Fig. 9-3 — Drawing of the antenna stow clamp used by W8TXE/4.

strip of chrome trim located on the side (at the rear) of a '52 Buick. However, almost all of the late models have at least one length of trim that can be used to secure the clip. Nice thing about the system is that it requires no mounting holes.

— *Lt. Col. M. M. Kovacevich, W8TXE/4*

MOBILE-ANTENNA MOUNTING HINTS

Many of the new cars are equipped with a pair of back-up lights. If one of the lamp assemblies is removed, it usually provides an opening that is ideally suited and located for the mounting of a whip antenna. The light may be returned to its proper place when the car is either sold or traded in and, as a result, there is no unsightly hole remaining to decrease the resale value of the car.

— *Loren R. Norberg, W9PYG*

At least one of the late Pontiac models has an Indian head emblem fastened to each of the rear fenders. Remove one of the emblems and you will find a hole that is just right for mounting the mobile antenna. You may even find that the local radio supply house has a base for the radiator that can be fastened to the fender by the three screws which originally held the emblem in place.

— *Robert M. Resconsin, W1TRF*

MORE ABOUT THE PE-103 DYNAMOTOR

Many owners of PE-103 dynamotors have the impression that it is necessary to reverse the high-voltage brush connections if the dynamotor is to be used in a car which employs a negative-to-chassis battery installation. This is only true if the user wishes to take a hot 6-volt lead from Terminal 7 of the output socket and if the microphone push-to-talk switch is connected directly between Terminals 4 and 5 of the same socket. Actually, it is not necessary to reverse the high-voltage brushes if the filament voltage for the transmitter is taken directly from the car battery and provided that an external relay is used to complete the circuit between Terminals 4 and 5 of the dynamotor output plug. One side of the field coil for the relay may be grounded. When using this alternate system, the PE-103 is connected with the positive and negative input terminals connected to the positive and negative terminals of the battery and high-voltage is obtained between the chassis (ground) and Terminal 8 (positive) of the dynamotor output plug.

The above simple modification of the PE-103 control circuit is especially well suited to mobile installations which place the transmitter under the dash and the dynamotor at the rear of the car.

— *George Hart, W1NJM*

EXTENDING WHIP ANTENNAS FOR MOBILE USE

The arrangement shown in Fig. 9-4 is a handy way to add precious length to your existing mobile whip antenna. In some instances it is useful to extend ordinary broadcast whips to sufficient length to make them usable with the transmitter.

A polystyrene rod is drilled at one end to slip over the top of the whip antenna. The other end of the rod is tapped to take the extension. The length of the rod is then usable as a form for a loading coil. Connection to the whip and to the extension is made as shown in the sketch.

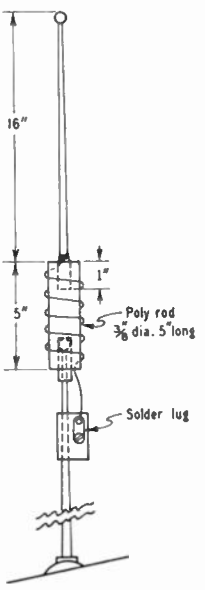


Fig. 9-4 — Handy method for extending the length of a whip antenna used for mobile work. The dimensions shown may be changed to suit individual applications.

This arrangement has given good results in a 28-Mc. mobile installation, and should be of interest to those who already have b.c. whips mounted on their cars.

— *John Jarnefeld, W4MBH/9, ex-W2KFC*

THE "HOT-ROD" MOBILE ANTENNA

Several amateurs have described high-Q loading coils for 75-meter mobile antennas and have given all the theory on why high Q improves the efficiency of the antenna. In spite of this, some hams seem to prefer long, low-Q coils on lossy forms and will not fuss and fool around with improvements. Perhaps one reason for this is that, even with their low-Q coils, they already know how futile it is to try to QSY more than a few kilocycles from the antenna's resonant frequency.

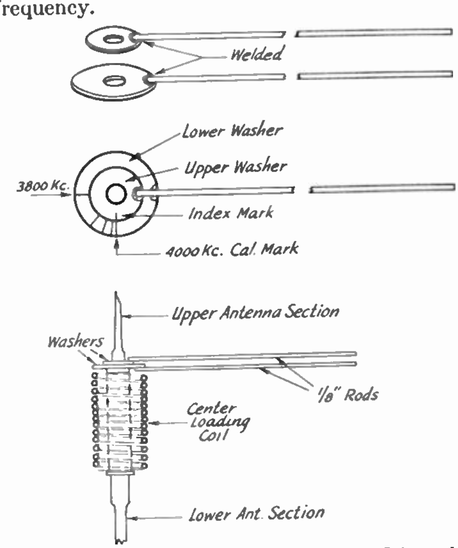


Fig. 9-5 — Details of rod construction. Dimensions can be varied to suit the whip diameter and the builder's convenience. Adjustment of rod lengths is described in the text.

During the past couple of summers I have found out what kind of results you can get with extremely high Q (400–500), and why the theory says you should radiate your power in the form of radio waves instead of dissipating most of it in the form of heat. (Feel your coil after a long transmission.) But it is not the purpose of this kink to try again to sell you on the virtues of high Q. Instead, here is an idea for quick, easy retuning with a range wide enough to let you operate anywhere you choose in the 75-meter band, regardless of Q. It is a simple gimmick, and it really works.

The device amounts to an adjustable hat, and as such adds to the capacitance of the top section, reduces the amount of inductance required and increases the current flowing in the antenna. A tunable hat is to a fixed-tuned mobile antenna what a VFO is to a crystal transmitter. And whether you enjoy the advantages of high Q or not, the inconvenience of stopping the car for ten seconds to retune your antenna is more than compensated for by the satisfaction that you can operate anywhere in the band. You can easily do it while the other guy is calling CQ.

If you have one of the common two-section center-loaded antennas, find or make two brass

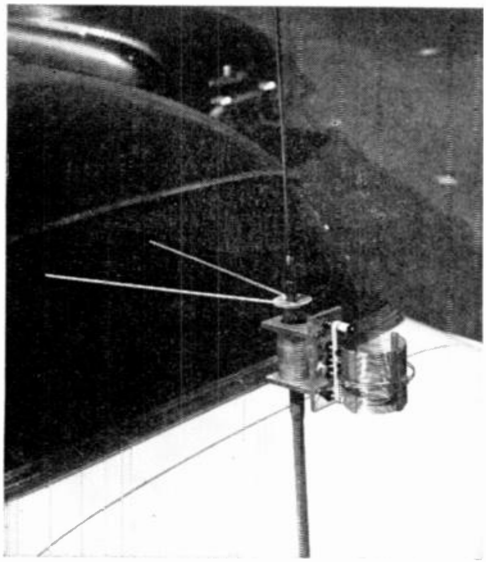


Fig. 9-6 — The "Hot-Rod" installed on W8AUN's car. The rods are kept over the car body to avoid personal damage, while the coil is kept clear of the rods and the antenna itself to reduce losses. The high-*Q* coil in this antenna is a standard B & W plug-in transmitting type, turns taken off as necessary to resonate; the ink just goes along for the ride. This view shows the 75-meter coil in place.

washers that will fit the threaded end of the upper section of your antenna. This will probably require a 3/8-inch hole in each washer. The outside diameter of the washers can be 1 1/2 inch or so. Next, braze or silver-solder a 1/8-inch rod to the side of each washer out near the edge and extending radially. The rods should be at least 15 inches long and should preferably be of steel.

Turn the smooth sides of the washers together and install them under the top section of your antenna above the coil. Set the two rods together, straight and so close to each other that the antenna will think there is only one rod there.

Now, adjust the system to resonate at the high-frequency end of the band, or as high as you will ever want to operate. (A grid-dip meter for this job is such a big help that if you don't have one you had better stop right now and go beg, borrow or steal one.) With the transmission line connected and everything intact, you will undoubtedly find the resonant frequency too low. You have to get rid of some of that coil. Then, when you get close you have your choice: either prune the rods or prune the coil. But remember, you will probably be sorry if you trim those rods shorter than a foot or so. Don't be afraid to take those nasty, power-consuming turns off your coil. The chances are the more you take off the higher the *Q* will go, and believe me, that's good. When you have the antenna resonated at 4000 kc., for example, make an index mark on the edge of the top washer, and an adjacent calibration mark on the edge of the lower washer.

Now, here comes the magic. Loosen the upper antenna section and rotate the washers a little so as to separate the rods and produce an angle between them. Presto! the second dimension appears and we have a "surface" like a triangular piece of sheet metal between the rods. The resulting increased capacitance brings the resonant frequency down. The larger the angle the lower the frequency. With the aid of the grid-dip meter, calibration marks can be made on the edge of the lower washer for the 25-kc. points, for example, or for your crystal frequencies. Of course, the apparent "surface" increases very rapidly at first as the angle is increased, and then more slowly as calibration proceeds around to the minimum frequency point, which occurs with the rods at about 90 degrees to each other. Thus the calibration marks will be all "squinched" up at the high-frequency end.

If you desire, you can make the rods shorter to allow a narrow range of adjustment that is less critical. However, if you travel around the country you will find it desirable, if not necessary, to work the whole band. Electrically, it does not seem to matter very much which way you aim the rods, but if you are a high-*Q* man with your coil out away from the mast, you will not let the rods interfere with the field of the coil. Another

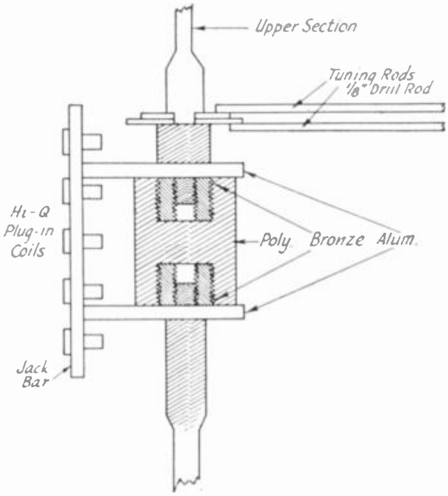


Fig. 9-7 — Construction details of the mounting for the rods and plug-in coil.

consideration is that the height is just about eye-level on big guys, and so, whether you are tall or short, it may be healthier for you to turn the rods over the car body and out of the way.

I might add that I cupped the washers just a trifle so as to make the edges meet first and then clamp together with a springy action. I also had the whole works cadmium plated. Plating makes it pretty as well as protecting it from corrosion. The hardware we hang on the bumpers of our cars attracts enough attention and too much criticism even at best. If you can make it pretty and kid 'em into believing you bought it at a store, at least they'll think you're not the only one who's crazy!

— *A. P. Dinsmore, W8AUN*

REFLECTIVE-TYPE CALL SIGNS

For the ham who likes to let other mobile hams know his call letters both night and day, try making your call letters out of "Scotchlite" reflective sheeting, manufactured by the Minnesota Mining and Manufacturing Co.

At K6DK, I made my call letters out of the No. 2272 (red) 1-inch-wide sheeting. The adhesive backing makes it simple to apply on the rear bumper or other surfaces. The results are really startling. At night, the call letters can be seen clearly for a great distance when the light from approaching headlamps strikes the material.

The wide-angle Scotchlite No. 2272 comes in 50-yard rolls at a cost of approximately $11.00. Clubs could purchase a roll for sale to individual members. The same material also comes in silver (2270), gold (2273), yellow (2271) and grey-blue (2276).

— *T. A. Sprink, K6DK, ex-W2CH*

ANTENNA CHANGE-OVER CIRCUIT

Quite a few of the local gang were experiencing trouble with the antenna relay in their mobile installations. When in the receiving (de-energized) position, vibration of the contacts caused poor receiver performance. The circuit shown in Fig. 9-8 solved this problem.

Standard practice has been to ground one side of the antenna link coil and to pipe the "hot" side of the line out to the antenna through coaxial cable. In this circuit, the "cold" side of the link is lifted from ground and is brought out to another insulated terminal which is then connected to the receiver antenna post. The relay grounds the "cold" side of the link when transmitting, at the same time grounding the receiver antenna circuit. When receiving, there are no intermittent relay contacts to cause trouble. This arrangement caused no apparent loss in signal strength in receiving. A matching network could be added between the transmitter and receiver, if needed.

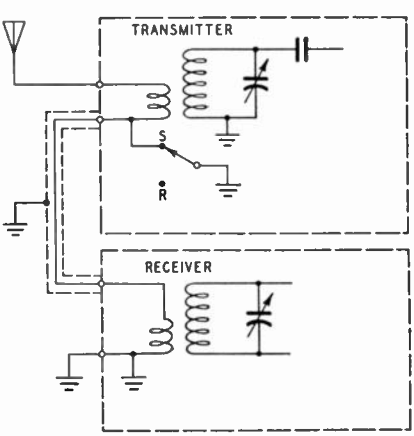


Fig. 9-8 — A simple method of avoiding troubles in antenna change-over relay circuits in mobile rigs.

— *Loyd J. LeBlanc, W5CRI*

ADJUSTABLE CENTER-LOADED MOBILE ANTENNA

Much use has been made of center-loaded whip antennas for 75-meter mobile work, and in several models a shield can is placed around the loading coil. In most instances, satisfactory operation with this arrangement is obtained over only a small frequency range. The gadget shown in Fig. 9-9 is a simple way to make the antenna system adjustable for peak performance at whatever spot in the band you choose.

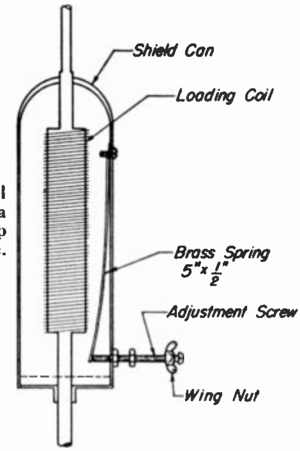


Fig. 9-9 — Novel method of making a center-loaded whip antenna adjustable.

An adjustable capacitance is added inside the shield can, with a tuning screw brought out through the side. The "condenser" is made of spring brass, 5 inches long and ½ inch wide. It is fastened near the top of the shield can with a 6-32 machine screw. Form it against the can, and then at the lower end use a long 6-32 screw with a wing nut and a lock nut for adjustment. Turning the screw in adds capacity, permitting adjustment over a large portion of the band.

— *Grover Hunsicker, WØBDE*

CONVERTING THE GONSET TRI-BAND TO 40 METERS

Your Tri-band converter need not be made obsolete by the opening of the 40-meter 'phone band if you are willing to invest a few hours in minor modifications.

The high-frequency oscillator covers two ranges, 5000 to 5450 kc. for 75 meters, and 7300 to 9200 kc. for 20 and 10 meters. The second and third harmonics of the 7.3- to 9.2-Mc. range are used to provide the 1440-kc. i.f. frequency at 20 and 10 meters, respectively. This range can also be used on its fundamental frequency to provide an i.f. for 40-meter operation. The only change necessary, therefore, is to tune the grid circuit of the r.f. amplifier to 40 instead of 20 meters.

Various methods have been considered but the simplest appears to be the addition of an inductance in series with the 20-meter r.f. amplifier coil. For normal 20-meter operation, the added inductance is shorted out with a low-capacity switch. With this system the antenna is overcoupled at 40 meters. However, operation is satisfactory and only a very simple switching circuit is necessary. The modifications are shown in Fig. 9-10. The steps involved in the modification may be enumerated as follows:

1) Remove the high-frequency oscillator trimmer capacitor from its front mounting bracket. This position will be used for the 20/40 bandswitch. Drill a ¼-inch hole on the rear panel, topside and midway between the 6BH6 and 6C4 tubes and about 1 inch above the chassis. The trimmer is mounted in this hole and heavy solid copper wire soldered between its stator terminal and the stator of the main oscillator tuning capacitor.

2) The hole in the bracket where the oscillator trimmer was located is enlarged to ⅜ inch. A low-capacity s.p.s.t. switch, S_1 of Fig. 9-10, is installed in this position. We used a filed-down version of a tone control switch to fit into the limited space.

3) The ground on the 20-meter r.f. coil must be lifted. This is most easily accomplished by removing the screw through the grounding bracket nearest the center of the chassis, bending the bracket up, and replacing the screw to hold the components in place under the chassis. Insulating material or paper may be used to keep the bracket isolated from ground. The 20-meter coil will be held rigidly in position with the one remaining grounding bracket.

4) The new coil, L_1 in Fig. 9-10, consists of approximately 25 turns of No. 26 enameled wire wound on a ⅝ × 3/16-inch powdered-iron coil form. An adjustment of the number of turns will be necessary if an air core is employed or because of variations in permeability of iron core. Don't forget to have the antenna connected when resonating the circuit. L_1 is soldered between the grounded and floating brackets of the 20-meter r.f. coil.

5) One contact of S_1 is wired to the floating bracket on the 20-meter coil while the pole of the switch is soldered to ground via a ground lug installed near the switch bracket.

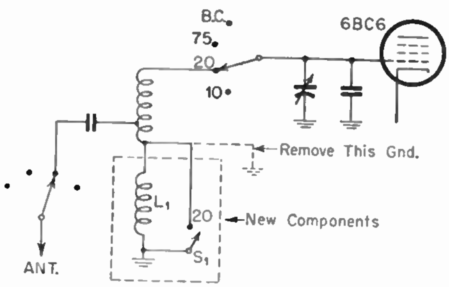


Fig. 9-10 — Circuit diagram showing the modification which permits 40-meter operation with the Gonset Tri-band converter. W3HTF describes the conversion and the new components in the accompanying text.

With the bandswitch set to 20 meters and S_1 in the open position, the 40-meter band will appear between 60 and 90 on the white scale when the pointer is close to vertical.

— *H. Lukoff, W3HTF*

• • •

The Gonset Tri-band converter used here at W4DXD was quickly modified for 40-meter 'phone operation by inserting a coil in series with the 20-meter r.f. amplifier coil. The new inductor consists of 36 turns of No. 24 enameled wire wound on a ½-inch diameter polystyrene form. A s.p.s.t. switch is used to cut the new coil in and out of the circuit.

— *Elder T. Holbrook, W4DXD-VYX*

[Editor's Note: When installing the coil recommended by W4DXD, remember to lift the ground referred to in the description of W3HTF's modification.]

The Gonset Tri-band can be easily converted for 40-meter 'phone operation by adding a d.p.d.t. switch and a 100-μμfd. variable padder to the original circuit. One section of the switch is used to disconnect the 180-μμfd. padder that is normally tied across the 75-meter r.f. coil, and the other half of the switch is used to connect the 100-μμfd. capacitor across the oscillator coil. The new components may be mounted on the back plate of the converter.

After modification, the Tri-band is set up for 40 meters by rotating the regular bandswitch to the 75-meter position and by throwing the d.p.d.t. switch to the position which does the jobs outlined above. Of course, the 100-μμfd. oscillator padder must be adjusted for maximum converter output at the proper i.f. frequency.

When the converter is operated at 40 meters, it draws more plate current than it does when tuned to any of the bands for which it was originally intended and it is therefore advisable to check the plate voltage after the conversion has been made. Make certain that at least 100 volts is applied to the unit.

— *Grover Hunsicker, W5BDE*

MANUAL CONTROL OF GENERATOR CHARGING RATE

A simple method for control of the charging rate of an automobile battery is depicted in Fig. 9-11. The system has three features that should be of interest to the mobile enthusiast: (1) the generator automatically charges at full rate whenever the transmitter is activated by the push-to-talk switch; (2) the generator charging rate may be manually controlled by the operator; (3) voltage-regulator noise is eliminated because the regulator is removed from the circuit when desired.

K_1 is a 6-volt relay and S_1 is a s.p.d.t. toggle switch. The relay is installed with the field winding connected in series with the 6-volt lead to the microphone switch and with the *normally-open* contacts connected between the rotor arm of the s.p.d.t. and ground. When installing the system, the generator lead that connects to the "F" terminal of the regulator is disconnected and then returned to the toggle switch. The remaining contacts of the toggle switch are connected to the "F" terminal of the regulator and to the 4-ohm wire-wound potentiometer, R_1, respectively. When the switch is in the "up" position, the charging rate is controlled by the regu-

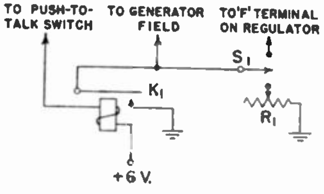


Fig. 9-11 — This modification of an automobile battery-charging system will eliminate voltage-regulator noise and will provide additional charging current when it is needed most — during transmitting periods.

lator and when the switch is snapped down, the charging rate is controlled by the potentiometer.

Any surplus relay with a 6-volt field can be used as K_1. The contacts need not be of the heavy-duty variety because the generator excitation current that flows through them is not of great magnitude. The points of the relay simply ground the generator field lead, thus adjusting the generator for full output for the duration of a transmission.

— *L. H. Beckwith, W8OGK*

IMPROVED STABILITY FOR THE ELMAC TRANSMITTER

Several fellows who use the popular Elmac mobile transmitter have reported frequency-modulation difficulties whenever operation is switched to VFO. After some experimenting, a very simple solution was found. Simply replace the 6AU6 oscillator tube with a Type 6AK6. No wiring changes are required. The new tube does have lower input and output capacitances than those of the 6AU6 and, as a result, the VFO calibration must be corrected by adjustment of the oscillator padder capacitor. Another slight advantage of the conversion is a 0.15-amp. reduction in heater current drain.

— *William E. Rose, W9KLR*

ELIMINATING GENERATOR WHINE

Mobile hams plagued by a high-pitched generator whine can usually solve their problem by installing a 500-μfd. 12-volt electrolytic condenser from the generator output terminal to ground. Correct polarity must be observed, of course, and will depend upon whether the car frame is positive or negative.

Do not connect the condenser to the field terminal of the generator because it will cause the voltage regulator contacts to fail.

— *Don Kadish, W1OER;*
Walter Cook, W1OED

Many cases of generator whine may be suppressed or eliminated merely by adding a coil and a capacitor to the generator circuit. The coil, close-wound with 20 turns of No. 12 enameled wire and having a diameter of ¾ inch, should be inserted in series with the generator output lead right at the output terminal of the generator. A 0.01-μfd. condenser should then be connected between the output-lead side of the coil and the case of the generator. This method of noise suppression seems to be much more effective than does the system which employs only capacitance for filtering.

—*Felix W. Mullings, W5BVF*

NOISE SUPPRESSION IN MOBILE INSTALLATIONS

In most cases the installation of simple suppressors is not enough when ham-band converters are to be used with the car radio. The search for offending points in the electrical system can be speeded up greatly by a systematic approach, rather than going about it hit-or-miss. The following procedure is the easy way to do it:

1) Fire up the car radio and connect a length of coaxial cable long enough to reach to all parts of the ignition system from the antenna terminal. Attach a "pee-wee" clip to the inner conductor of the coax. Ground the braid to the chassis.

2) Clip the pee-wee onto any suspected cable or wire or other object on the inside of the fire wall. If noise comes out of the 'speaker, bond or by-pass the offender as required.

3) Repeat the above process on the engine side of the fire wall.

4) Connect the converter to the car radio, and the coaxial cable to the converter. Repeat (2) and (3) above.

When finished, a noise limiter will be practically unnecessary.

— *Rod MacDonald, VE2FO*

To stop the electrical noise set up by the voltage regulator in an auto ignition system, connect a 10-ohm 1-watt resistor from the terminal marked "field" to ground. This will have very little effect on the operation of the generator, and will usually "kill" the noise effectively. The resistor should be installed right at the regulator, not at the generator.

— *M. J. Silvers, W4HUW*

3-WIRE 6-12-VOLT SYSTEM AS A MOBILE POWER SOURCE

Much of the surplus gear available was designed for 12-volt d.c. operation. To take advantage of this situation without having to rebuild the equipment, an extra generator, regulator, and 6-volt battery are used in the circuit of Fig. 9-12.

Preferably, the extra components should be identical to those already installed in the car, except the regulator, which must be one de-

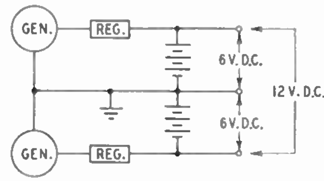


Fig. 9-12 — A 3-wire 12-volt system for mobile power supply that permits use of surplus gear without modification.

signed for the opposite polarity, and for the particular generator used. Distribution of the power can be almost any way desired, although it is suggested that the starter be run from one 6-volt battery, and the rest of the load off the other.

The photograph shows the method used to install the extra generator in a 1948 Chevrolet. The plate that supports the generator bracket is fastened on with modified head bolts. There are nuts underneath the plate against the head. The generator rests close to the intake manifold, and

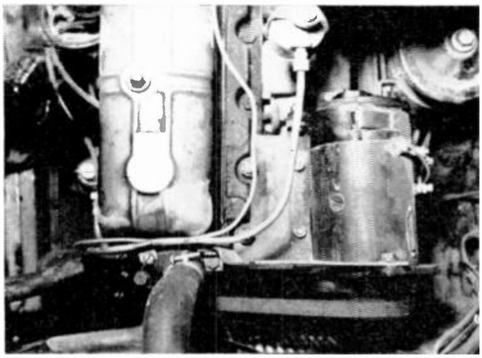


Fig. 9-13 — Installation of the extra generator.

is also supported by a brace from the water outlet. The brace for the original generator has an extension welded onto its brace. The regulator is mounted on the sheet-metal side a little below and to the rear of the oil filter. A bonding strap is run between the generator and regulator. The extra battery is mounted in a cut-down Plymouth battery carrier under the front seat.

— *K. B. Karns, WØMYH*

POINTERS ON INSTALLING MOBILE CONVERTERS

While most constructional notes and instruction sheets on converters devote some space to their installation, there are a few points that could stand more emphasis, if the ultimate in performance is to be derived.

1) When tapping the b.c. receiver to furnish the converter's power, it's a "stitch in time" to install a socket in which the converter's power cable is plugged, to facilitate subsequent disconnection for servicing. While you're at it, a relay to "kill" the plate supply at the vibrator while transmitting is quite worth while. Alternatively, the B+ lead to the converter may be routed through a spare pair of contacts on the transmitter control or antenna relay. Many mobile operators are forced to turn down the volume control on the b.c. set each time they transmit because of the lack of this feature.

2) All power leads should be shielded, to prevent pick-up of ignition noise. As an added precaution, it is well to by-pass each lead to ground with a disk ceramic condenser of 0.005 μfd. or so. If a noise-limiting system is used external to the b.c. receiver, its leads must be individually shielded (from each other), not only to prevent noise pick-up, but to prevent the very noise the limiter is intended to limit from by-passing the limiter through the capacity between leads.

3) If your particular b.c. receiver has "mechanical" pushbuttons, it is feasible to preset one button to the output frequency of the converter. If its pushbuttons are "electrical," i.e., if pushing the buttons substitutes preset tuned circuits for those tuned by the dial, a considerable improvement in both gain and selectivity will probably result from using the "manual" or "dial" position, as such sets are usually designed to receive local stations only on the preset positions, and use fewer tuned circuits when operating on a preset pushbutton. A difference of 20 db. in gain between pushbuttons and dial is not uncommon. If your car is equipped with a "Signal-Seeker" radio, better install a switch to disable the seeking mechanism when the converter is on, unless the converter puts out enough thermal noise in a narrow-enough band around its supposed output frequency to be "sought." Otherwise you may have to use both hands to tune in a desired signal on the converter.

4) To avoid impairing performance on the b.c. band, make the antenna lead from the converter to the b.c. set as short as possible, and of the lowest-capacity obtainable, such as is commonly used for antenna lead-ins on car radios. With the converter connected, but switched "off" (so that the b.c. antenna is switched through to the b.c. receiver), trim the antenna circuit of the b.c. receiver as prescribed for that model (usually around 1400 kc.) on a very weak signal, in order to compensate for the added capacity. Next, set the dial of the b.c. set to the converter output frequency, turn on the converter, and trim the output circuit of the converter, either with a signal generator coupled to the mixer grid in the converter, or with a signal picked up off the air. In the absence of both signal sources, tuning for maximum rush-noise should be satisfactory.

5) The converter's antenna trimmer should be peaked for maximum output at the center of the band with the antenna with which it is to be used, installed and connected the way it is to be used. Peaking at band center instead of at a point near the high end is recommended here, since we are concerned only with h.f. converters having a narrow tuning range ("percentagewise") with a high ratio of signal-frequency-to-i.f., making for little difficulty with tracking. If alignment is perfect at the center of the range, then reactive effects of the antenna and transmission line not taken into account in the design of the converter will cause but little tracking error at the edges of a narrow band.

6) One final kink: If the converter has a pilot light that glares too brightly at night, there is a simpler way to dim it than by inserting a resistor in series. Simply paint the inside of the jewel with pilot-bulb or fingernail lacquer of a complementary color; for instance, on a red jewel, use green lacquer.

I hope the foregoing will help somebody get better reception, for it is written, "If you can't hear 'em, you can't work 'em."

— *Basil C. Barbee, W5FPJ*

MINIATURE 10-METER EXCITER

The problem of obtaining sufficient grid drive to the final amplifier of a 10-meter mobile rig while using a minimum of precious plate current, filament current, and space was tackled recently with very pleasing results. After trying several circuits and variations thereof, none of which produced the desired results, a 6J6 dual triode was tried with one half of the tube operating as an oscillator-doubler from 7-Mc. crystals, and the other half as a doubler from 14 Mc. to 28 Mc.

With this circuit, and with a plate supply of 250 volts, the exciter delivered 7 ma. grid drive to a loaded 807 at an expenditure of only 21 ma. total plate current to the two sections of the 6J6. Plate voltage was reduced to 175 volts, which

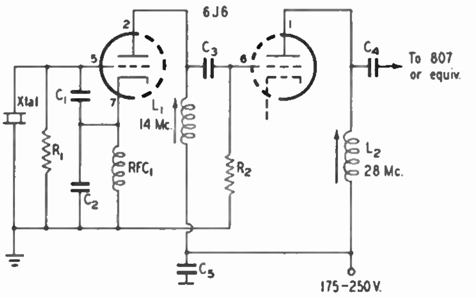


Fig. 9-14 — **Circuit diagram of a pint-size exciter capable of driving an 807 at 28 Mc. with a minimum of input to the exciter stages.**

C_1 — 25-μμfd. ceramic.
C_2, C_4 — 50-μμfd. ceramic.
C_3 — 20-μμfd. ceramic.
C_5 — 0.0022-μfd. mica.
R_1 — 47,000 ohms, ½ watt.
R_2 — 33,000 ohms, ½ watt.
L_1 — Slug-tuned coil for 14 Mc.
L_2 — Slug-tuned coil for 28 Mc.
RFC_1 — 2.5-mh. r.f. choke.
XTAL — 7 Mc.

produced 3.2 ma. grid current to the 807 with a total expenditure of only 14 ma. in the exciter.

The exact value of the parts specified does not seem to be critical, but good ceramic insulation should be used for both the coils and the tube socket. Changing to a bakelite socket and coil forms resulted in about 50 per cent less efficiency!

The coils were wound on small ceramic slug-tuned forms found in some surplus radio gear, but similar units are available commercially. The ones used measure ⅜-inch diameter and are 1¼ inches long.

A test model of the exciter was built on a small metal box measuring only 3 by 3½ by 1½ inches, and there was still plenty of space available for an 807 amplifier. This little 3-stage transmitter was loaded to 60 watts input without any trouble. It may not be the ultimate in compactness, but it shows what can be done with a few parts, very little space, and very little plate and filament current.

— *Theodore W. Rast, VP3TR (W6SMU)*

HOMEMADE POWER PLUG FOR THE PE-103

Since plugs to fit a PE-103 dynamotor seem hard to find, a couple were homebuilt in the following manner. The pins from an octal tube base are just the right size so a supply was obtained by cracking up a couple of old tubes. These pins have a flange near the base and the end is flared. The flared ends were carefully straightened out with a pair of pliers.

Next, a 1³⁄₁₆-inch diameter disk was turned from a piece of plexiglass a shade over ⅛ inch thick. A hole just slightly smaller in diameter than one of the pins was drilled through the center of the disk. A pin was placed in a vertical position with the flanged end up and the tip resting on the workbench. The plastic disk was rested on the pin with the center hole directly over the end of the pin. With the disk held steady by the left hand, a hot soldering gun was applied to the pin with the right hand until the plexiglass began to melt. Then the disk was pushed down over the pin to the flange. While the plastic was still soft the pin was pushed into the socket on the PE-103 and allowed to cool in place.

The position of the next pin was then marked simply by sighting through the clear plastic. Another hole was drilled and the next pin was set as before. Each succeeding pin was set the same way and each one was allowed to cool in the socket, thus assuring perfect alignment. The open ends of the pins projecting through the disk were then flared by a light tap with a center punch.

A second plexiglass disk was then turned with a shoulder cut on the circumference. It was drilled with larger holes to clear the pins and then it was cemented to the back of the plug so that the shoulder formed a groove around the rim.

Finally, a shell from a commercially-built plug was snapped onto the finished assembly and the result was a neat and serviceable plug.

— *C. A. Thunen, W6ACT*

REVAMPING AUTO RADIOS FOR 160-METER MOBILE

Many amateurs who wish to revamp a car radio for 160-meter mobile work are under the impression that an extensive modification is in order. Actually, the task is not nearly so difficult as would be expected and there are several types of receivers that can be done over in less than an hour. The following explains how easily and quickly the job can be done.

After the radio has been removed from the car, it should be opened and inspected. If the front end employs variable-inductance tuning, proceed as follows: First, locate the oscillator trimmer. This capacitor is usually mounted close to a converter tube (a 6SA7, 6A8, 6BA7, etc.) and is connected in parallel with a padder capacitance of approximately 300 μμfd. Remove the padder and replace it with one having a capacitance of approximately 250 μμfd.

The modified set should now be adjusted to the high-frequency end of the tuning range. Next, feed the output of a modulated signal generator to the antenna jack of the receiver and adjust the r.f. amplifier and the converter circuits for maximum response at 1900 kc. The set may now be reinstalled in the car and connected to the antenna. The antenna trimmer should now be peaked while listening to a weak signal located somewhere around 1800 kc.

Receivers employing variable-inductance tuning that we have converted have ended up with a frequency range of 600 to 1925 kc. Of course, the original calibration is off after the change but this is not objectionable after the pushbuttons have been set to their respective b.c. stations.

If the auto radio uses variable capacitors for tuning purposes it is possible to modify the tuning range merely by inserting a capacitance of approximately 100 μμfd. in series with the leads to the variables. This system does not permit complete coverage of the b.c. band and the sets we have worked with tuned 1100 to 2000 kc. after the revamping and the alignment had been done.

— *Fred Nazar, W8RNA*

FILTER AND CONTROL CIRCUIT FOR THE PE-103

Numerous PE-103 dynamotor units have been sold on the surplus market minus the mounting base, which contains various control circuits, overload relays, etc. The circuit shown in Fig. 9-15 has served as a very satisfactory substitute for the original set-up, and is in several ways easier to handle than the modifications which are necessary if the complete unit is to be used with anything but the original transmitter.

The main switch S_1 controls input to the dynamotor and to the filaments of both transmitter and receiver. The filaments of both units operate full time when this switch is closed, and by means of a double-pole double-throw relay, 6-volt input is applied to the 12-volt input winding of the dynamotor. This results in 250-volt 80 ma. output from the unit, suitable for operation of the receiver. When the microphone switch is closed, the relay changes the dynamotor input over to the 6-volt winding, resulting in 500-volt 160-ma. output, and at the same time switches the output from the receiver to the transmitter.

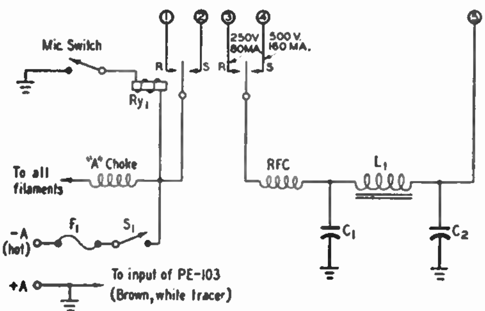


Fig. 9-15 — Filter and control circuits for the "baseless" PE-103 dynamotors. The terminals designated at the top of the diagram should be connected as follows:
(1) To 12-volt input lead of PE-103 (white with brown tracer).
(2) To 6-volt input lead of PE-103 (white with black tracer).
(3) +B to receiver.
(4) +B to transmitter.
(5) To +B from PE-103 (red wire).
C_1, C_2 — 8-μfd. 600-volt filter condenser.
L_1 — 4- to 10-hy. filter choke, 175 ma.
F_1 — 60-amp. fuse.
RFC — Ohmite Z-28.
Ry_1 — Double-pole double-throw relay. (Potter-Brumfield PR-110, 6 v. d.c.)
S_1 — S.p.s.t. toggle switch, 35-amp. rating.

All parts are mounted in a 5 × 10 × 3-inch chassis, with a bottom plate used as a cover. The end of the chassis has two sockets mounted in it, one a 4-prong unit for transfer of power to the transmitter, the other a 5-prong unit for the receiver and the relay control.

In my own installation, the dynamotor is mounted on the engine side of the fire wall, with the control box directly in back of it, inside the driver's side of the partition. This permits short leads and eliminates the need for shielding. In cars where the battery is mounted under the hood, short primary leads are also made possible. All "A" leads, and the ground lead, are made with No. 10 or larger wire.

— *George Hart, W1LIH*

MOBILE OPERATING CONVENIENCES

Trying to fish a crystal out of the glove compartment can be a nuisance. As a solution, take the plastic container that toothbrushes are sold in, remove the small partition near one end, and slip your favorite spare crystals inside.

— *Charles L. Wood, W2VMX*

Inexpensive steering-column flashlight holders, available at mail order and automobile parts stores, make excellent mountings for small mobile converters, control boxes and the like.

— *Edgar A. Sack, W3NRG*

INEXPENSIVE DYNAMOTOR RELAY

Starting relays for dynamotors are relatively expensive and difficult to obtain. An entirely satisfactory substitute can be made easily from a Ford automobile starter relay which costs only about $2.

The Ford relay *could* be used without modification, but it draws 6 amperes. To reduce this unnecessary drain, the coil should be rewound with No. 26 or No. 28 enameled wire.

To get at the coil, pry off the top of the unit with a bottle opener, and then remove the contacts with a wrench. The coil will then drop out. Remove 176 turns of the wire with which the coil was originally wound, and rewind the form fully (the original form is not filled) with No. 26 wire. This produces a coil that will draw only 0.35 ampere. If No. 28 wire is used the coil will draw about 0.20 ampere. Any larger-size wire will work, but will take proportionally increasing coil current.

The winding operation can be done by hand, or by placing a bolt through the axis of the coil form and then slipping the bolt into the chuck of a drill. Large washers will keep the nut and the head of the bolt from slipping through. The spool of wire can be slipped over a spindle such as the blade of a screwdriver clamped in a vise.

— *William Herzog, W9LSK*

MOBILE C.W. RECEPTION WITH THREE COMPONENTS

The usual method of adding a b.f.o. to the second detector of an auto receiver ordinarily involves quite a bit of effort and requires an additional tube. In most cases the receiver is so compact that the b.f.o. must be outrigged.

One method of obtaining b.f.o. action is to allow an i.f. stage to oscillate and beat with the i.f. signal. Usual means of introducing oscillation include adding capacitive coupling between plate and grid of the i.f. tube, or providing another winding on the i.f. transformer for feedback. Either scheme is messy and usually results in considerable detuning and critical wiring.

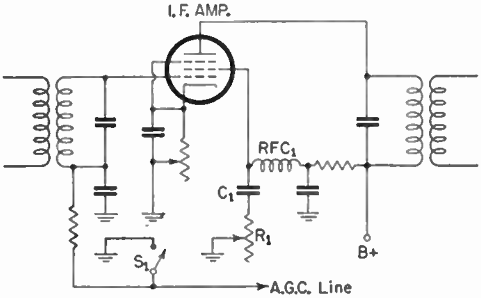


Fig. 9-16 — I.f. amplifier that permits c.w. reception with a converter-broadcast receiver combination.

C_1 — 0.05-μfd.
R_1 — 0.25-megohm potentiometer.
RFC_1 — 2.5-mh. r.f. choke.
S_1 — See text.
NOTE: All other components are original circuit parts.

A simple modification avoiding most of the difficulties and using only three components is shown in Fig. 9-16.

The screen lead is opened and a 2.5-mh. choke inserted. The screen is thus part of the oscillating circuit. Regeneration is controlled by the 0.25-megohm potentiometer which effectively determines the amount of by-passing at the screen. The values of the components are not critical, and will work with any i.f. frequency. In this particular case, 265 kc. was the i.f. frequency. The components were installed about 5 inches from the tube socket without noticeable effects. Normal 'phone operation is permitted by turning the potentiometer to zero resistance. At this point the i.f. stage acts exactly as it did prior to the conversion. C.w. is received by turning the potentiometer to a point somewhat after a "plop" is heard.

Grounding the a.v.c. line with a switch is absolutely essential. This had already been installed in the receiver when it was found that it resulted in considerable improvement in 'phone reception. The a.v.c. voltage had apparently reduced the receiver sensitivity by responding to the high average noise level, rather than the weak signal. The a.v.c. is normally grounded on all but the strongest 'phone signals. I use a 3-position switch with the following positions: Off, noise limiter on, noise limiter on and a.v.c. grounded. As an alternative, the a.v.c. ground switch could, of course, be mounted on the regeneration control. The beat frequency is fairly stable, and therefore voltage regulation is not necessary. Only a slightly noticeable change of frequency occurs as the engine progresses from idle to race.

Quite a number of auto radios have gain controls that can be manipulated to advantage. In my case (1951 Ford) the cathode resistor of the i.f. amplifier is a small screwdriver adjustable potentiometer to which I added a shaft and knob. The extra gain achieved by turning the potentiometer up is very noticeable with weak signals. If the gain control potentiometer is turned too far down, the i.f. amplifier may refuse to oscillate and function as a b.f.o.

— *H. Lukoff, W3HTF*

RELAY-TYPE CRYSTAL-SWITCHING CIRCUIT

A remotely-controlled crystal-switching circuit that is especially well suited for trunk-mounted mobile installations is shown in Fig. 9-17. The system employs a pair of 6-volt d.p.d.t. relays, 4 crystal positions and a 2-pole 4-position rotary switch. In operation, a particular cystal is automatically connected back to the grid of the oscillator tube merely by proper positioning of the remotely-located selector switch. Of course, the relays are mounted in the oscillator compartment of the transmitter. The relays used in the original installation are C. P. Clare midgets that operate

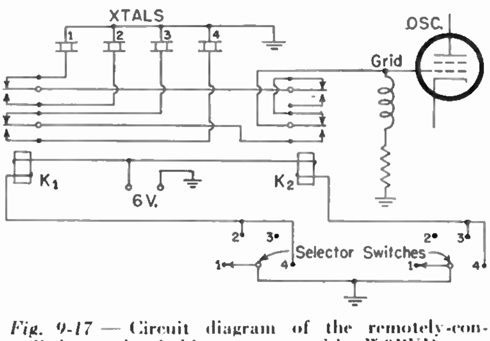


Fig. 9-17 — Circuit diagram of the remotely-controlled crystal-switching system used by W9PVD.

at a current drain of only 300 ma. at 6 volts. They were purchased in Chicago at a cost of approximately $1.50.

The frequency range covered by the four crystals should not exceed 100 kc. or so. An attempt to cover a wide band of frequencies will probably necessitate retuning of the transmitter and the antenna.

— *Gordon Lauder, W9PVD*

A B.F.O. FOR YOUR MOBILE

When a fellow goes mobile these days, for receiving purposes the custom seems to be purchase or construction of a converter that covers one, two, maybe three bands. Frequency coverage of the boughten jobs is obviously based on voice work, which is sound enough with

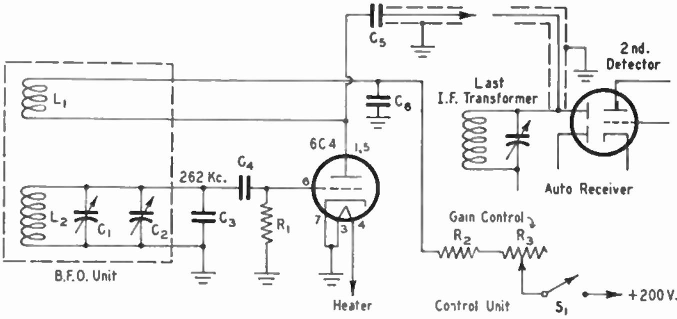


Fig. 9-18 — Circuit diagram of the 262-kc. b.f.o. unit.

C_1, C_2 — Trimmer and vernier capacitors in b.f.o. unit (Meissner 17-6753).
C_3 — 330-$\mu\mu$fd. silver mica.
C_4 — 100-$\mu\mu$fd. mica.
C_5 — 22-$\mu\mu$fd. mica.
C_6 — 0.01-μfd. disk-type ceramic.
R_1, R_2 — 47,000 ohms, ½ watt.
R_3 — 50,000 ohms, variable carbon.
L_1, L_2 — Pie-wound coils in b.f.o. unit.
S_1 — S.p.s.t. toggle switch.

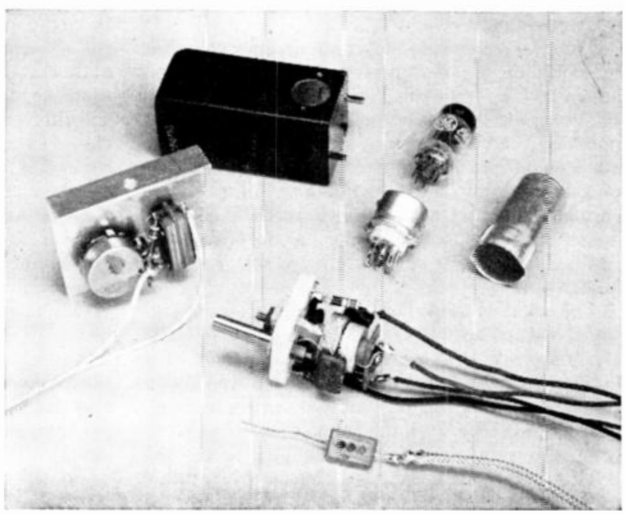
perhaps 99 44/100% of mobile operation taking place in the 'phone bands. However, most converters cover the entire 20- and 10-meter bands, and some even include the whole 3500-kc. band, instead of just the 'phone segments. But the non-voice coverage doesn't do any good because the trouble is there ain't no b.f.o. Fortunately, it's a mighty simple job to add one to your installation. All you need is a small oscillator at the automobile radio intermediate frequency, which will be around 260 or 265 kc. Such a unit is described herein.

A first idea to use pies from r.f. chokes for the inductances was discarded when thumbing through a parts catalog disclosed a b.f.o. unit which seemed to be ideal for the purpose, requiring only a bit of capacity added to bring the frequency down to that desired. It consists of the two necessary coils for an oscillator with a tickler circuit, a frequency-setting padder, and a small-capacity vernier control with knob, the whole thing in a medium-sized shield can. A miniature triode such as the 6C4, a switch, and a couple of condensers and resistors complete the job.

Building a suitable subbase assembly was the subject of several sheets of pencil doodlings until the obvious answer dawned — let the shield can be the chassis. By cutting down the length of the wood-dowel support for the pie-wound coils and mounting most of the miscellaneous components on the tie-points for the coils, there is room for the tube socket at the lower end of the shield. The whole job can then be mounted right on the case of the automobile receiver, as Fig. 9-20 shows. The fixed and variable plate resistors are mounted separately on a small bracket which can be screwed to the dash or converter case for convenience in control.

The variable plate resistor works — like a charm — as an r.f. gain control. Normally there would be difficulty in reception of c.w. signals because the usual converter-auto receiver system runs with the front end wide open and the a.v.c. would kick the gain of the system all over the place in accordance with the keyed characters, especially on stronger signals. Of course, feeding the 262-kc. signal from the oscillator into the diode detector causes, like any other signal, a rise in the a.v.c. voltage and a consequent reduction in gain. So the variable plate resistor, by controlling delivery of oscillator power, acts as a gain control for the receiver. On weak signals the control is turned to maximum resistance, producing minimum oscillator power and minimum a.v.c. action, so that the gain of the receiving system is high; at the same time, b.f.o. injection is low. Cutting down the resistance produces more power, more a.v.c. action, and thus a reduction in gain,

Fig. 9-19 — The innards, ready for temporary connection to the tube and power leads for a frequency check, which should be made with the coils in the shield can. When this is completed, the tube socket is mounted and wired. The coupling condenser and its shielded lead await their turn, last in the assembly process. The control unit is shown at the left.



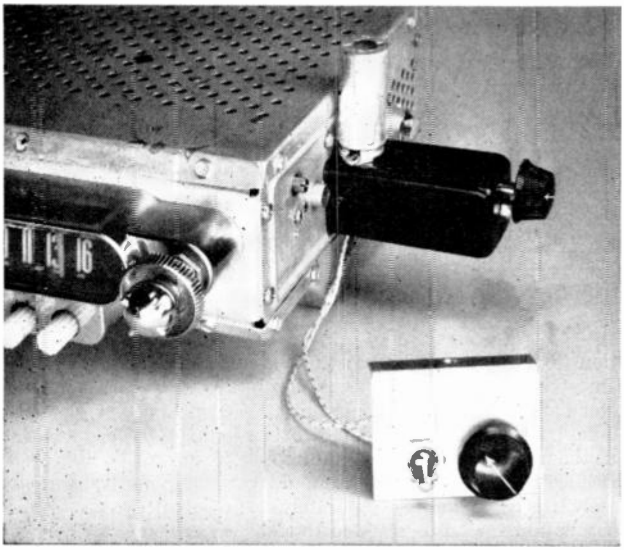


Fig. 9-20 — The b.f.o. unit mounts at a convenient spot on the auto receiver case. Choice of location will depend on underdash clearances and inside accessibility for fastening the nuts. The "gain" control is on a separate bracket for convenience in mounting near the converter controls.

which is ideal for stronger signals. Only a slight change in beat note occurs over the range of the variable resistor.

The circuit is standard. Fig. 9-19 shows the essentials of layout and wiring. To reduce the size of the coil mounting, remove the assembly from the can and the wood dowel from the ceramic mounting for the padders. Then remove the mounting bolt from the dowel; this is done by a pair of long-nosed pliers turning against the beads on the threaded shaft, in this case a left-hand thread. Use a coping saw to cut off approximately ⅜ inch of dowel; then drill the hole a bit deeper to reinsert the threaded bolt as if it were a self-tapping screw (left-hand thread, remember!). In all this operation be careful not to break the fine wire of the coil leads. After reassembly, check the travel of the screw on the end of the trimmer shaft to make certain it doesn't strike the pie windings when turned fully in; if it does, simply snip off the end with a pair of side cutters — it's too long anyway.

The grid resistor and all condensers except that for coupling are mounted on the cut-down coil assembly. Use shielded wire for the output; soldering the end of the braid to a suitable ground point in the can provides adequate support for one end of the coupling condenser — the other of course going to the plate pin of the tube. To ensure good contact with the auto receiver case for heater power, put a soldering lug on one of the can mounting bolts and solder it to the grounded heater pin.

The catalogs and data sheet on the b.f.o. coil say the range is 290–650 kc. Don't you believe it! By the grace of the grid-cathode capacity of a 6C4 and the trimmer condensers screwed down tight, the lowest this one could be made to reach was 410 kc. It's a simple matter, of course, to bring the frequency down by hanging across the grid circuit coil a fixed condenser of suitable capacity. It ought to be the same (330 $\mu\mu$fd.) on any unit, but it would be worth while to check before buttoning up the job completely. After you complete the coil assembly, wire it with temporary long leads to the tube socket so you can make frequency checks with the coils inside the can but without having to mount the tube socket. The simplest measuring system is to listen for harmonics of the unit on a communications receiver covering the broadcast band, with its b.f.o. on.

By the way, at one point in the range of the unit you'll hit the i.f. of your communications receiver, but that is easily identifiable since it is not tunable at the receiver.

Feed the unit's output, through C_5, to the antenna post of the receiver. Tuning the receiver dial will take you through a number of birdies, some loud and some weak; those weak ones are odd beats and should be disregarded. The genuine harmonics will have several times the volume of the miscellaneous birdies; the S-meter will show them up plainly. Log two adjacent loud beats; the difference in kilocycles on the b.c. receiver dial will be the fundamental frequency of the unit. Adjust the trimmer on the b.f.o. unit until the difference is 262 kc., more or less. If tightening the screw all the way down won't reach that low a frequency, of course you'll have to add a larger capacity to your grid circuit.

Installation is comparatively simple. This version used one of the numerous ventilation holes in the automobile radio case as one mounting, requiring the drilling of only one new hole. If you're lucky, you may not have to drill any new ones. Before you pick a location on the case, however, make certain you have inside access to the point where you have to apply the washers and nuts, and check clearances under the dash to make sure you can get the auto radio back in again!

Be especially careful in wiring the b.f.o. unit into the automobile radio. Routine methods are okay for the heater and power leads, but take care where you run the shielded wire for the output; the subchassis wiring of automobile receivers is pretty darned compact and since the whole thing is subject to vibration, you should make sure your shielded wire is held down at suitable spots so it won't jar over and ground one of the internal receiver circuits. Spotting solder here and there on the braid to ground points will keep it from moving around.

After installation, you'll need to retrim the last i.f. transformer in the auto receiver, since it is thrown off when you add the net reactance of the b.f.o. unit to the rectifier diode plate. This can be done by ear; tuning in a signal and peaking the trimmer on the i.f. transformer; or with a meter on the a.v.c. line. Then you should make final adjustment of the b.f.o. frequency by switching on the converter and receiver, tuned off any signal; switch on the b.f.o. and set its frequency by means of the screwdriver adjustment in the top of the can. You'll hear a "swish" as you tune through the frequency; set the trimmer to the center of this "beat."

If you're interested in figures, the following apply to the present installation, using a 20,000 ohms/volt meter to measure a.v.c. voltage. With no signal, only noise output from the converter, and b.f.o. off, the voltage is about 1.2. Switching on the b.f.o. with the "gain" control at maximum (variable plate resistor at maximum) causes a rise to 2.1 volts — just enough to cause a very slight drop in background noise in the 'speaker. Turning the gain down to minimum causes a further rise to over 4 volts, which is ample for the strongest incoming signal. Voltage applied to the oscillator plate is variable from 40 to 65, and over that range the plate current varies from 1 to 2 ma.

The a.v.c. is always in the system, but its effect can be minimized by use of the gain control. A switching arrangement to cut out the a.v.c. might be feasible in some cases, but not in the present one where the a.v.c. line is fed back to the converter, through the noise limiter installation, so that a.v.c. action is needed. While the c.w. reception isn't identical to that you get at home, neither is mobile voice reception — there just isn't enough selectivity built into the set.

— *John Huntoon, W1LVQ*

TWO NO-HOLE DETACHABLE ANTENNA MOUNTINGS

GEAR that can be used either on the car battery or on a 115-volt a.c. supply is becoming more popular every day. Obviously, an antenna that can be installed on the car and removed readily is very useful in these varied applications. A couple of demountable no-hole-in-the-car antenna ideas are shown in Figs. 9-21 and 9-22.

The first one was cooked up on the spur of the moment when we decided to take one of these universal 2-meter rigs along on the trip to the Houston ARRL National Convention. The mount could hardly be simpler — a coaxial fitting attached to a small strip of aluminum, bent so as to slip into the crack between the inside beading and the main frame of the car window. The sponge-rubber weatherstripping in the car door flattens out around the aluminum strip and the coaxial line when the door is closed. Pressure against the mounting plate holds it in position, and the plate can be bent slightly after it is in place, to align it exactly vertical. By leaving a small amount of slack in the coax, the mount may be left in place as the car door is opened and closed. It can be detached and stowed away in less time than it takes to tell, leaving no trace of the mobile "installation" it serves. The whip can be removed from the fitting and used with the portable rig wherever a.c. is available for its operation, as in overnight stops.

Cross-country mobileer W6RLB visited ARRL Headquarters one day, exhibiting a rooftop mount that is ideal for the fellow who wants this effective type of mobile antenna, yet quakes at the thought of drilling a hole smack in the middle of the top of the family car. This is not quite as detachable as the first suggestion, but it is probably a better antenna, as it can be put in the center of the car top.

As Fig. 9-22 shows, it is made from the top of a tin can, a sheet of flashing copper and two coaxial fittings. One fitting is mounted in the top of the can, another in the side, and the two inner conductors are connected together inside the assembly. The can is cut about an inch high with three or four tabs extending a half inch or so for soldering to the copper sheet. The sheet is then fastened to the car top with plastic tape.

No direct electrical contact is needed between the plate and the car top, as the capacitance between the two simulates an actual ground connection. As a protection against scratching the car top, the bottom surface of the plate may be covered with the same plastic tape. If a lightweight whip is used, a strip of ⅜-inch tape around the edge of a 4- by 6-inch plate will hold the assembly firmly in place for months. Both the whip and the coaxial line may be detached for other uses whenever they are needed.

— *E. P. Tilton, W1HDQ*

« *Fig. 9-21.*

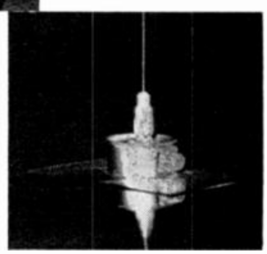


Fig. 9-22. »

COLLINEAR ANTENNA FOR 2-METER MOBILE

Novice WN2ALR sends in an antenna hint for 2-meter mobile operators who want something better than the conventional quarter-wave roof-mounted rod. The idea, a brainchild of W2RUI, with WN2ALR's car and rig for the guinea pig, is shown schematically in Fig. 9-23. The usual quarter-wave rod is made of stiff material so that it will support the phasing section and half-wave radiator above it. The phasing section and radiator are made as a detachable unit that can be screwed onto the top of the rod when the added coverage they provide is needed. The phasing line can be formed into a circle to cut down its over-all dimensions.

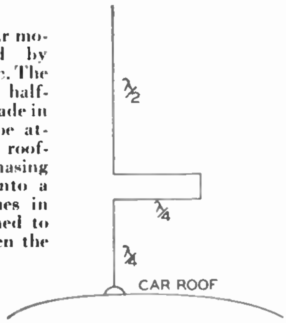


Fig. 9-23 — **Collinear mobile antenna used by WN2ALR on 145 Mc. The phasing section and half-wave radiator are made in one unit that can be attached to the usual roof-top antenna. The phasing section is formed into a circle about 6 inches in diameter and fastened to the insulator between the two radiators.**

LOOP-TYPE ANTENNA FOR 75-METER MOBILE

A mobile antenna for 75 meters always presents quite a problem. It must be an electrical quarter wave at least and, since a physical quarter wavelength is impractical, some form of loading invariably is used. The part of any antenna that contributes the most to the radiated energy is that carrying the most current. Unfortunately, in a quarter-wave vertical this is the lower part. The placing of the loading coil at the bottom end results in most of the high current flowing through this coil, the current diminishing to zero at the top of the antenna. Therefore, various methods of center and top loading to bring the maximum current points higher up in the antenna have been used with fairly good results. However, it seemed possible to turn the antenna upside down and have the high current at the top. To accomplish this, the top of the antenna is grounded and the bottom insulated. This was approximated by bending the top of the vertical antenna down and grounding it at the tip of the windshield post. The other end was mounted on the insulator of an antenna mount formerly used on a Jeep. Where the antenna comes through the back of the car, a hole has been cut and a piece of polystyrene mounted for the rod to feed through. The antenna rod itself is composed of sections that screw together and it can be disassembled very easily.

The antenna system is tuned to resonance by a series tuning condenser connected between the antenna and the output terminal of the final amplifier, as shown in Fig. 9-24. An r.f. meter with a 3-amp. scale also is connected in this circuit at this point to read antenna current. The parallel fixed and variable condensers were used as an expedient to secure the proper capacitance but, of course, a variable of appropriate maximum capacitance will serve equally well.

The tuning of the transmitter is conventional in every way. A milliammeter is plugged into a grid jack and the final amplifier grid circuit tuned to resonance, as indicated by maximum grid current. The plate circuit is then adjusted to the characteristic dip and the antenna tuning condenser adjusted for maximum antenna current. In this particular installation the current runs about 3 amperes with 45 watts input to the final amplifier.

It is evident that the antenna and the body of the car in reality form a one-turn loop resonated by the condenser. The directional pattern theoretically should have a sharp null at right angles to the direction of travel of the car. In practice, however, this has been found to be so sharp and the remainder of the pattern so broad that not too much directional effect is noticed. An interesting sidelight is that the windshield post itself carries so much r.f. that an r.f. indicator consisting of a microammeter in series with a 1N34 crystal has been mounted on the dashboard and connected across about 10 inches of this post to give an indication at the driver's seat. This indicator is mounted below the dash just to the left of the steering post.

After the installation had been completed, a test run was made from Mobile to Tuscaloosa, Alabama, a distance of slightly over 200 miles. From departure at 9 A.M., until arrival about 2 P.M., continuous communication was maintained with the home station. Many other amateurs joined in the test and excellent reception was reported by all of them, some as far away as Arkansas and Georgia. The results have exceeded our expectations and we believe other amateurs may get some ideas from the design to help carry on their own experimenting.

— *Harold L. Mitchell, W4IBZ*

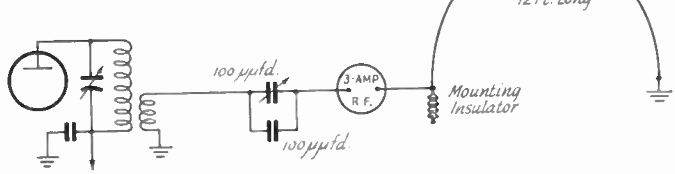


Fig. 9-24 — **Sketch of the loop antenna and tuning and coupling system. The coupling coil in this instance has 3 turns 2 inches in diameter.**

10. Hints and Kinks . . .

for Test Equipment

HARMONIC AMPLIFIER FOR BC-221 FREQUENCY METER

THE BC-221 frequency meter has a variable oscillator covering either 125–250 or 2000–4000 kc., plus a low-drift 1000-kc. crystal oscillator. Although the accuracy, dial, and stability are excellent for its original uses, its utility for frequencies above 30 Mc. is considerably improved by the addition of the harmonic amplifier shown in Fig. 10-1. The harmonics of the crystal are then audible every megacycle up to 300 or more, and by switching to "xtal check" and tuning the oscillator in the usual manner, sum-and-difference frequencies are generated. For instance, with the variable oscillator set at 200 kc., which may be accurately done by beating with the crystal, notes may be found every 200 kc. from 144 to 148 Mc., while when switching to "xtal only" only the megacycle markers remain. Similarly, when the variable oscillator is tuned to 2500 or 3500 kc., beats are evident every 500 kc. If a frequency at 144.101 Mc. were to be measured, the signal could be brought to zero beat with the variable oscillator at, say, 3101 kc. The tuning rate will be the same as it is on the fundamental frequency, but the percentage accuracy is limited mostly by the stability of the crystal. A vernier adjustment to set the crystal to zero beat with WWV would be handy. No impairment of the normal functions of the meter was noticed after the amplifier was installed.

— *Henry H. Cross, W1OOP*

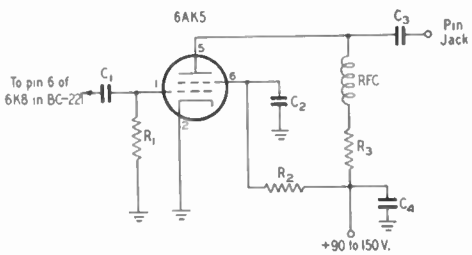


Fig. 10-1 — Schematic diagram of a harmonic amplifier for the BC-221 frequency meter to extend its range to 300 Mc. The unit can be built on a small bracket and attached to the side of the chassis.

C_1 — 100-μμfd. mica.
C_2, C_4 — 0.001-μfd. mica.
C_3 — 5-μμfd. ceramic.
R_1 — 3 megohms, ½ watt.
R_2 — ½ megohm, ½ watt.
R_3 — 1000 ohms, ½ watt.
RFC — 15 turns No. 22 enam. close-wound on ½-watt resistor of any high ohmic value.

NULL INDICATOR FOR THE BC-221

THE UTILITY of the BC-221 frequency meter can be increased considerably by the addition of a null indicator that gives positive indication of exact zero beat between the crystal and the heterodyne oscillator or the signal from a near-by transmitter. A 6E5 "magic eye" tube can be added without circuit complications, as shown in Fig. 10-2.

In operation, the wavemeter is tuned until the eye shows the greatest opening. This method is much more reliable than merely listening for zero beat in the headphones, and is especially

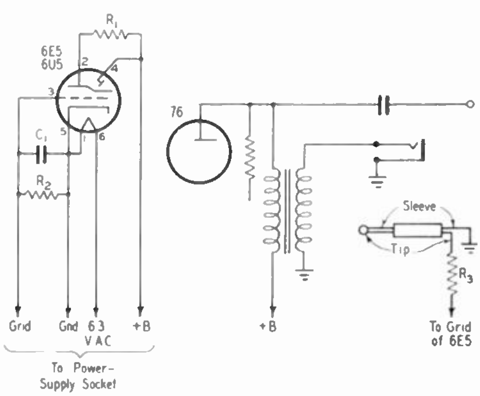


Fig. 10-2 — Circuit for using a 6E5 electron-eye tube as a null indicator with the BC-221 frequency meter. The connections at the base of the 6E5 are shown at the left, with the method of connection to the output transformer in the BC-221 at the right.

C_1 — 0.001-μfd. mica.
R_1, R_2 — 1 megohm, ½ watt.
R_3 — 47,000 ohms, ½ watt.

useful when the incoming signal is weak. In such case, when the beat approaches zero, the last few cycles become inaudible, but they are clearly visible on the eye tube.

The 6E5 could be mounted inside the wavemeter cabinet, but in the interest of keeping heat to a minimum for added accuracy, I mounted it externally with provision for connecting it to the wavemeter circuit through the headphones jack, as shown. The 6E5 itself is mounted on the top of the wavemeter cabinet. The small parts used in the circuit can be mounted inside the tube-socket cover. Power is obtained from a separate output socket on the power supply used to operate the wavemeter, with the +B lead being tapped into the circuit ahead of the VR tubes to obtain the full 250 volts for the plate of the 6E5. The connection from the 'phone plug to the grid of the 6E5 passes through an extra terminal on the power plug, with R_1 mounted on the power socket.

The addition of this gadget has made a big improvement in my BC-221, and it is hoped that others will be able to derive the same benefit from it.

— *W. A. M. Wood, VE4MW*

MEASURING-CUP BAND SPOTTER

It is not necessary to build or buy an elaborate frequency meter for most amateur purposes, especially when the transmitter is crystal-controlled. Much simpler means can serve the purpose just as well. For example, you could hardly want a simpler circuit than that shown in Fig. 10-3. And as the photographs show, the construction is equally simple. Assembled in a 15-cent measuring cup, this gadget will go a long way toward filling the initial frequency-measuring needs of the Novice licensee. It will also serve the

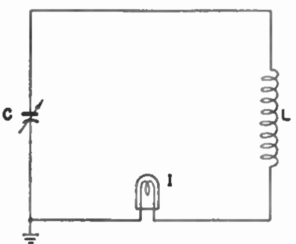


Fig. 10-3 — Circuit diagram of an absorption wavemeter covering the 3.4- to 15-Mc. range.

C — 300-μμfd. variable (National ST-300).
L — 22 turns No. 20 wire, 1-inch diam., 1⅜ inches long (B & W Miniductor No. 3015).
I — 60-ma. dial lamp (pink bead) mounted in bayonet-type bracket (Johnson 147-630).

old-timer in many ways when he builds or adjusts transmitters in any ham band from 3.5 to 14 Mc. The cost of the entire unit is less than five dollars, and this figure can be reduced by over fifty per cent if you happen to have a suitable tuning condenser in your junk box.

The measuring-cup wavemeter is nothing more than a tuned circuit covering 3.4 Mc. to 15 Mc.

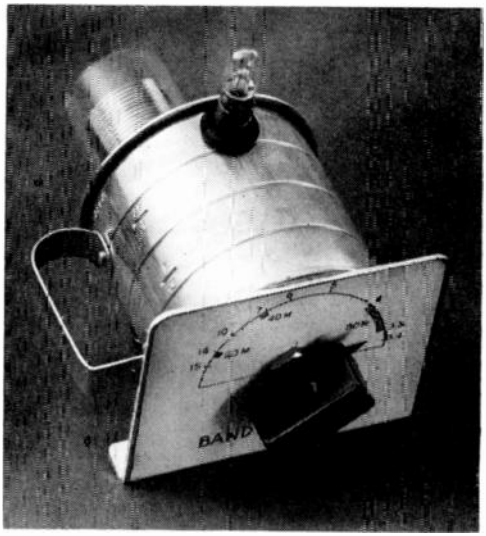


Fig. 10-4 — One of the handiest "tools" in ham radio is the absorption wavemeter. This unit, built around an aluminum measuring cup, is designed to fit the requirements of the Novice licensee or old-timer. Construction is simple — the entire assembly is held together with one nut.

with a flashlight bulb in series with it to serve as a resonance indicator. When the coil in the wavemeter is coupled to a transmitter delivering anything from a few watts of r.f. up to a kilowatt and the condenser is tuned so that the wavemeter is resonant at the frequency of operation, the lamp will light. The unit is calibrated so that the frequency at which the power is being generated is read directly from the dial.

Construction of the wavemeter is extremely easy. The measuring cup is used to provide support for the tuning condenser and the calibrated dial, incidentally providing a mounting for the indicator lamp and a handle for the entire unit. The lamp is insulated from the cup by mounting it in a grommet-lined ½-inch hole drilled at the top where it will not interfere with the rotation of the plates of the tuning condenser. The calibration scale is pasted to the face of an aluminum bracket measuring 3½ inches wide and 2⅝ inches high, with a ½-inch lip bent under the cup to form a mounting "foot." This prevents the gadget from rolling off the desk or shelf when stored.

The coil is cemented inside a Quartz-Q coil form 1⅝ inches in diameter and 1⅞ inches deep (Millen 46100). Thus the coil is protected from damage and the operator is protected from the high voltage in the transmitter. The form is mounted ½ inch behind the rear rotor bracket of the tuning condenser by a machine screw and a spacer. The 6-32 screw fits one of the tapped holes that bolt the ceramic spacer bar to the bracket. An insulated tie-point is slipped under one of the rear stator connectors of the condenser to serve as the junction point between the tuned circuit and the indicator lamp. One wire from the lamp goes directly to the rotor terminal on the

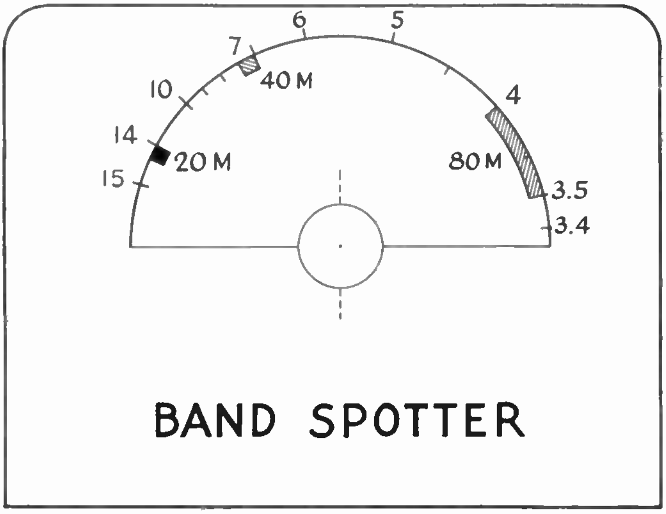


Fig. 10-5 — Actual calibration of the wavemeter. This drawing may be cut out or traced and pasted to the face of the aluminum bracket provided the parts listed below Fig. 10-3 are used in the construction.

rear of the condenser, the other to the insulated tie-point. The coil is connected from the stator terminal of the condenser to the lamp at the insulated tie-point.

If you use the same parts we specify below Fig. 10-3, and wire the unit with approximately the same lead lengths shown in the photographs, you will be able to use the calibrated dial scale reproduced in Fig. 10-5. It can be cut out and pasted on the aluminum bracket, or traced onto another sheet of paper. If other parts are used, the wavemeter can be calibrated by using a grid-dip meter in conjunction with a calibrated receiver.

Using the meter is also easy. Assume for a minute that you have tuned up your transmitter, but are not sure that its output frequency is in the desired band. With the transmitter turned on, hold the wavemeter so that the coil is within a few inches of the plate tank coil of your output stage. Turn the tuning dial slowly until the indicator lamp lights, showing that the wavemeter circuit is tuned to the same frequency as the transmitter output. Don't get too close to the tank circuit or you may burn out the indicator lamp.

The same procedure may be followed for any tuned circuit in which power is flowing. Whenever the wavemeter is tuned to the same frequency as the power in the tuned circuit, it will absorb some of that power and then dissipate it in the form of light in the indicator. If the stage you are checking has a plate milliammeter, you can observe the effect of the wavemeter on the tuned circuit to which it is coupled. As the wavemeter is resonated, the plate-meter reading will increase slightly as the wavemeter loads the circuit and takes power from it to light the indicator lamp.

This little gadget cannot be expected to be without its limitations. There are some things that it cannot tell you. For example, its calibration is not accurate enough to permit its use as a frequency meter for close-tolerance reading. It will tell you, however, whether your output is in the 3.5-Mc. range, in the 7-Mc. range (as it would be if you happened to tune up on your second harmonic), or somewhere in between (as it might be if the amplifier was unstable and oscillating by itself). It is for this reason that we call it a *band spotter*, rather than a frequency meter. In the case of a crystal-controlled transmitter, you can be reasonably certain of avoiding off-frequency notices if your crystal is actually in the band, provided that you are sure the output is in the band you think it is. This gadget enables you to be sure.

— *Richard M. Smith, W1FTX*

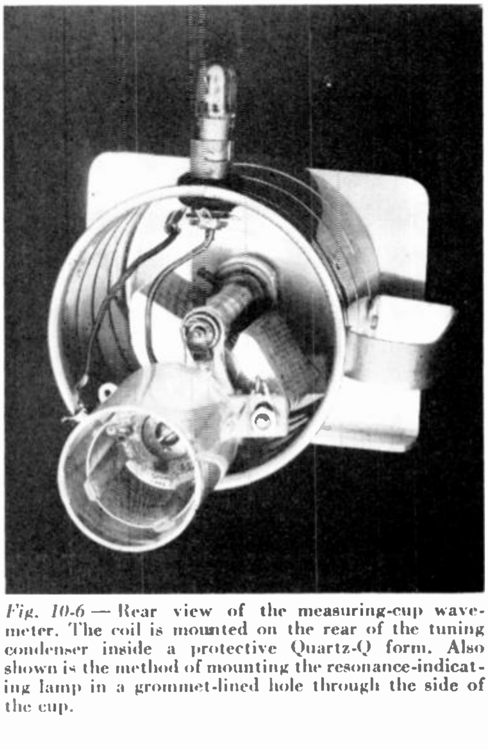


Fig. 10-6 — Rear view of the measuring-cup wavemeter. The coil is mounted on the rear of the tuning condenser inside a protective Quartz-Q form. Also shown is the method of mounting the resonance-indicating lamp in a grommet-lined hole through the side of the cup.

CHECKING CRYSTAL FREQUENCY

The method described below is a simple way to determine the approximate fundamental frequency of an unknown quartz crystal. It is especially useful in checking surplus crystals, many of which are unmarked, or at best marked only with a channel number.

Connect the crystal in series with the antenna to a receiver that tunes the proper range. A BC-453 (Q5-er) can be used to check low-frequency units, and the station communications receiver for the rest. Turn up the gain of the receiver until the background noise is heard plainly, and tune until a definite "ping" or a change in noise level is heard. This occurs at the fundamental only. The method is not accurate enough to depend on for more than a rough check, but it does eliminate the need for construction of a separate oscillator just to find the approximate frequency of the crystal.

— *Arthur C. Erdman, W8VWX*

HARMONIC GENERATOR FOR CALIBRATION WORK

It is often difficult to hear the high-order harmonics of a signal generator when doing calibration work in a frequency range that is far removed from the fundamental frequency of the oscillator. In such cases a simple harmonic generator, such as that shown in Fig. 10-7, can be

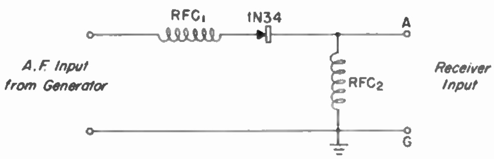


Fig. 10-7 — Simple harmonic-generator circuit using a 1N34 crystal diode to provide high-frequency harmonics from a signal generator operating in the audio range.

used to provide a stronger "signal" in the desired range. A 1N34 crystal diode is used to rectify some of the output of the signal generator. The rectification generates harmonics throughout the spectrum.

An arrangement such as this would be of great help in calibrating the 6- to 10-kc. range of the BuStan test oscillator described on page 31 of *QST* for January, 1951.

— *Russell O. Deck, jr., DL4OM, W9JVI*

CRYSTAL CALIBRATOR AND R.F. INDICATOR

Needing something in a hurry to replace a smashed neon bulb as an r.f. indicator, I connected a 1N34 crystal diode across a 0–1 milliammeter as shown at A in Fig. 10-8. With the addition of a six-inch length of wire as a probe, the gadget can be used for numerous applications. The positive side of the crystal diode must be connected to the negative terminal of the meter or the meter will read backwards. In addition, the probe wire must be connected to the negative terminal of the meter or it won't work. Keeping the probe lead short is desirable to eliminate indications from stray r.f. in the shack.

This gadget works like a charm, and is much more sensitive than the neon bulb. It was first used to indicate proper adjustment of the antenna tuner. In this application the probe wire was

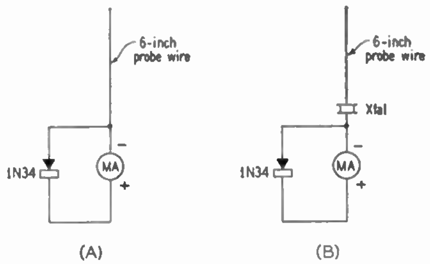


Fig. 10-8 — Simple r.f. indicator that has numerous uses in the ham shack. The arrangement at A is useful for checking for r.f. in power lines, etc., and that of B for obtaining crystal check points for VFO calibration.

placed parallel to one of the feeders and adjustments made to produce maximum deflection of the meter. It has also been found useful as a neutralizing indicator. Merely place the probe near the tank circuit of the amplifier and adjust the neutralizing condensers for minimum indication. Other uses are the detection of r.f. on power lines, in low-level speech amplifier stages, and in checking for parasitic oscillations.

By connecting a transmitting crystal as shown at B in Fig. 10-8, this gadget can be used to obtain highly-accurate spot-frequency check points for calibration of a VFO dial. Place the probe wire close to the transmitter, and tune the VFO across its range. When the VFO is tuned to the crystal frequency, the meter will show it. Used in this application, the gadget is extremely frequency-sensitive, and it is possible to set a VFO to within a few cycles of the crystal frequency. Thus, the gadget can be used in place of a more elaborate band-edge marker.

For something which can be "assembled" in a matter of minutes, this little indicator is hard to beat.

— *W. E. Bradley, W1FWH*

EMERGENCY CONTINUITY TESTER

A simple continuity tester can be constructed with a receiver and two test leads. One test lead is connected to the receiver antenna terminal and the other is connected to the antenna. With such connections, continuity can be easily detected by the increase in gain in the receiver.

— *Ronald J. Finger, WN9VCH*

BC-221 PLATE SUPPLY CAUTION

Users of BC-221 freqmeters who get the necessary 105 or 150 volts from 300-volt supplies and VR tubes will endanger BC-221 by-pass condensers rated at 200 volts if VR tubes or VR-tube connections were to fail.

— *W3VN*

USING B.C. RECEIVERS AS MAKESHIFT TEST GEAR

Not all of us are fortunate enough to own an r.f. signal generator for use in aligning and calibrating homebuilt receiving gear, but almost anyone can scare up a spare broadcast set. Described below are several methods for putting the b.c. receiver to work as a substitute.

To align the i.f. of a receiver which has a b.f.o. to 456 kc. or 465 kc., attach a couple of feet of antenna wire to the b.f.o., and run it near the broadcast receiver. Tune the b.c. set to the second harmonic of the b.f.o. (912 kc. or 930 kc.) and adjust the b.f.o. until a beat note is heard. Finding frequencies in the broadcast band is simplified by the fact that the carriers are spaced at 10-kc. intervals through the band. The frequency of your local station is usually published with the daily program schedules, and other publications are available listing all stations. For a 456-kc. i.f. try to find a station on 910 kc. The 2-kc. difference beat note can be estimated, but make sure that the b.f.o. harmonic is *higher* in frequency than the b.c. station. A slight tuning of the b.c. receiver dial will determine this. Then, without disturbing the "antenna" on the b.f.o., align the i.f. amplifier by peaking it on noise, not on a signal. This method is accurate enough for any receiver except one which uses a crystal filter. The third harmonics of 456 kc. and 465 kc. also fall within the broadcast band, and can be used, but they will not fall directly on any b.c. station frequency.

The spare b.c. set can also be used for band-edge calibration of another receiver. The h.f. oscillator in most b.c. sets can be tuned to 1000 kc. In some instances it may be necessary to add a very small amount of tuning capacity to the oscillator circuit, but in most cases this can be done merely by screwing down the padding condenser a couple of turns. Attach a couple of feet of wire to the oscillator tuning condenser in the b.c. set and place one end of it near the receiver being calibrated. Tune the b.c. set to the low-frequency end of its range so that the harmonic of its oscillator beats with WWV. Then without disturbing the b.c. receiver or the temporary antenna, the communications receiver can be tuned to pick up harmonics of the b.c. set oscillator at 1000-kc. intervals through a large part of the spectrum. It should be possible to pick up this signal at 4 Mc., 7 Mc., 14 Mc., and perhaps higher frequencies.

If the exact i.f. of the b.c. set is known, its h.f. oscillator may be used for approximate calibration of a receiver between the 1000-kc. points mentioned above. The oscillator frequency will usually be higher than the dial frequency by the i.f. Thus, if the b.c. set is tuned to a station at 700 kc. and the i.f. is 465 kc., the oscillator will be tuned to 1165 kc. Harmonics of this frequency can be used to obtain additional calibration points. It should be remembered, however, that only when the "generator" can be tuned to beat with WWV or some other frequency standard can the calibration points be considered as exact.

To determine the i.f. of a receiver which has a broadcast band, tune the receiver to a b.c. station of known frequency near the low-frequency limit of the band. With a second b.c. set, tune higher in frequency until a beat note is heard. In this area we have b.c. stations at 850 kc. and 1300 kc., just 6 kc. less than 456 kc. apart. The required 6-kc. beat note can be estimated, and a slight retuning of the second receiver will tell whether the i.f. is 6 kc. higher or lower than 450 kc. If the h.f. oscillator of the receiver being checked is *lower* in frequency than the mixer, the set being checked will have to be tuned to a station at the high-frequency end of the b.c. band while the auxiliary set will have to be tuned lower.

To determine an unknown i.f. in sets which do not have broadcast band coverage, the same principles described above are used, with the receiver being checked tuned to any station of known frequency. Tune an auxiliary receiver with a calibrated dial until the oscillator of the first receiver is heard. The difference between the frequency of the known station and the dial reading of the second receiver is the approximate i.f. of the first receiver.

— *James B. Bamberg, W8OPX*

MODULATING THE TEST OSCILLATOR

A simple way to add modulation to the r.f. test oscillator is shown in Fig. 10-9. In this circuit the primary of a small interstage audio transformer, *T*, serves as a Heising modulation choke and a feed-back winding for a simple audio oscillator. Dual triodes such as the 6SN7 are ideal for the purpose, and any type of oscillator could be

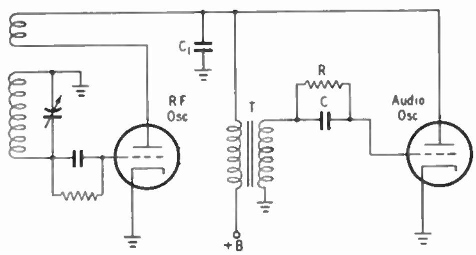


Fig. 10-9 — A simple method of applying tone modulation to the r.f. test oscillator. An old interstage audio transformer is used as combined Heising modulation choke and feed-back winding.

used instead of the series feed-back type shown in the schematic. If a Clapp or an ECO is used as the r.f. oscillator, tubes with separate cathodes must be used.

The tone may be changed by adjustment of the grid leak, *R*, and the condenser, *C*, in the audio-oscillator section of the tube. Suitable values in most instances will be 1 megohm for the resistor, and 220 $\mu\mu$fd. for the condenser. C_1 should be 0.001 μfd. or less to avoid by-passing the audio frequencies.

— *Clifford Bader, W3NNL*

SIMPLE UTILITY OSCILLATOR

Shown in Fig. 10-10 is a simple crystal oscillator that can be used in almost any ham shack for providing band-edge markers and for checking crystal activity.

The circuit is the familiar "hot-cathode" Pierce oscillator. The 100-$\mu\mu$fd. condenser, C_1, between grid and cathode was found necessary for oscillation, although its size may be altered to suit individual needs. Output is taken from the cathode

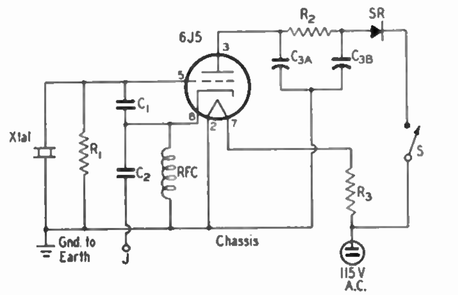


Fig. 10-10 — Schematic diagram of a simple crystal oscillator for general utility in the ham shack.
C_1 — 100-$\mu\mu$fd. mica.
C_2 — 50-$\mu\mu$fd. mica.
C_3 — Dual 40-μfd. 150-volt electrolytic.
R_1 — 47,000 ohms, 1 watt.
R_2 — 5000 ohms, 2 watts.
R_3 — Line-cord voltage-dropping resistor.
J — Pin jack.
RFC — 2.5-mh. r.f. choke.
S — S.p.s.t. toggle switch.
SR — Selenium rectifier (Federal 403D2625).
Xtal — 40-meter crystal.

through a 50-$\mu\mu$fd. condenser terminating in a small pin jack on the chassis. Sufficient output is obtained at the crystal fundamental with the little rig "as is," but a three-foot length of wire plugged into the output jack may be necessary if higher-order harmonics are to be heard. The addition of the wire causes the frequency to shift slightly, but since this was not intended to be a frequency calibrator, the difference is not objectionable.

An actual earth ground for the chassis is necessary, and if the line cord is plugged in the wrong way the rig will not operate. With the filter components specified, a T9x signal is obtained.

— *S. S. Goddard, W6FBV*

INCREASING SENSITIVITY OF NEON BULBS

In the course of tracking down parasitics in a new rig, I had need for a more sensitive indicator than the usual neon bulb. It was remembered that in some radar units a "keep-alive" voltage was used to keep the gas in the "TR" boxes ionized, and the following scheme was evolved to apply a similar voltage to a neon tube.

A half-megohm potentiometer was used to form a voltage divider by connecting the outside terminals of the potentiometer across the 115-volt a.c. line. Then a small neon bulb (NE-2, ¼-watt, resistorless) was connected between the tap on the potentiometer and one side of the line. Thus, by turning the potentiometer, the voltage across the neon bulb can be varied until it is just *below* the point at which the tube glows. In this condition, very little additional voltage is needed to cause the bulb to glow, and a very sensitive indicator results.

The neon bulb can be mounted at the end of a 4- or 5-inch length of bakelite tubing, which then serves as a probe with which to dig into out-of-the-way places inside your rig. The leads to the bulb can be run inside of the tubing.

In addition to being a simple gadget to construct, this little indicator has the advantage of being very sensitive to r.f. fields, yet it is discriminative enough to enable one to pick out the "hot" lead in a crowded chassis.

— *Midshipman Robert A. Brown, USN, W8COS*

NEON-BULB A.C.-D.C. VOLTMETER

Fig. 10-11 shows the circuit diagram for a very simple low-cost neon indicator that will measure any a.c. voltage between 100 and 900 volts, and any d.c. voltage between 100 and 1000 volts.

The voltmeter uses an NE-17 neon bulb for an indicator as this particular type has a lower starting voltage than most other types. The lid of a plastic sandwich box was used as a chassis; this makes an inexpensive mounting and affords excellent insulation. Whatever type of chassis is

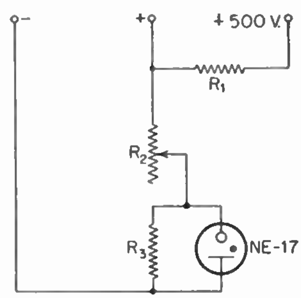


Fig. 10-11 — Circuit diagram for the neon-bulb a.c.-d.c. voltmeter.
R_1 — 0.5 megohm, 1 watt, 5 per cent tolerance (gold band).
R_2 — 0.5 megohm variable (Mallory Midgetrol U-50).
R_3 — 68,000 ohms, ½ watt.

used in constructing the voltmeter, be sure to allow a 2½-inch-square space around the shaft of R_2. This will allow enough space to accommodate the drawing of the calibrated voltmeter dial that is included in Fig. 10-12.

The base contact of the NE-17 should be wired so glow appears around the outer electrode when a positive voltage is applied to the positive terminal of the voltmeter. If the inner plate glows first when correct polarity is applied to the positive and negative terminals, the calibrated dial will read higher on all voltages checked. It should also be pointed out that if a different potentiometer than the Mallory U-50

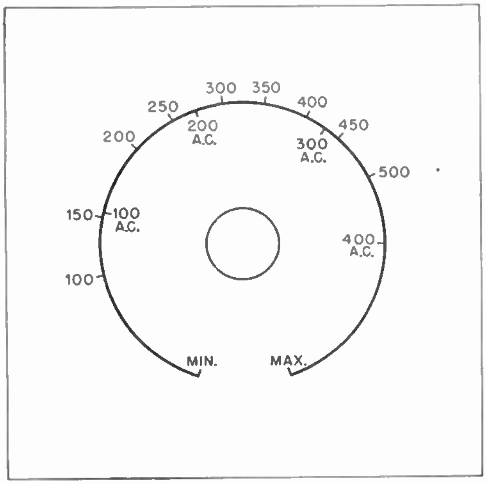


Fig. 10-12 — Drawing of a dial scale for the neon-bulb voltmeter. This scale can be traced on another piece of paper or cut out and mounted on a piece of cardboard and used in the voltmeter construction.

is used for R_2, an entirely different calibration might be necessary.

When an unknown voltage is to be checked, R_2 should be first set at maximum. *Insulated* leads are then connected to the positive and negative sides of the unknown voltage. The knob on R_2 is then very slowly turned toward minimum until the neon bulb lights. At the exact point the bulb glows, the value of the unknown voltage can be observed. *Do not* turn the knob any farther than is necessary to cause the bulb to glow because if excessive current is allowed to flow through the bulb, there is danger the neon bulb will arc over and burn out. Always start your check with the knob on R_2 turned to maximum voltage or above the voltage you intend to check.

Always use the highest voltage ranges and check down to an unknown voltage in order to protect the testing device. The "over 500 volts" terminal marked +500 v. in Fig. 10-11 should be used for checking any potentials above 500 volts. When using this terminal, add 500 volts to whatever reading appears on the dial. If the reading is 150 volts when the 500-volt tap is being used, the voltage being checked would be 650 volts.

— *Lewis G. McCoy, W1ICP*

Fig. 10-13 — Top view of the neon-bulb voltmeter. The calibrated dial was mounted on a piece of cardboard and then mounted under the shaft nut of R_2.

ANOTHER USE FOR GRID-DIP OSCILLATORS

Aside from its many uses as a variable-frequency device, the grid-dip meter also is usable as a crystal-controlled oscillator. For example, a crystal may be plugged into the coil socket of a Millen grid-dip meter to produce a form of Pierce crystal oscillator. The same can probably be done with the grid-dip meters described in recent editions of *The Radio Amateur's Handbook*. (The socket used for the plug-in coils in these units *is* a crystal socket.)

Tests made with the Millen unit with crystals from 1000 kc. to 14.3 Mc. resulted in all oscillating with ease. The tuning condenser is adjusted for best stability, and in the case of the 1000-kc. crystal, it is used to zero-beat the oscillator with WWV.

The meter serves as a tuning indicator, and will show the relative activity of several crystals of about the same frequency.

To extend the possibilities a bit more, this set-up can also be used as a low-power crystal-controlled transmitter for short-haul c.w. work.

— *Melvin H. Dunbrack, W1BHD*

IMPROVING PERFORMANCE OF GRID-DIP OSCILLATORS

After assembling a grid-dip oscillator kit, I found that in the v.h.f. range two distinct dips were present, even though the unit was not coupled to anything. After much rebuilding, it was found that the trouble was caused by the tuning condenser, which is one of the type using a "pig tail" at the rear of the rotor shaft for ground connection. Apparently the front of the rotor shaft is not grounded to the frame, merely passing through a bushing.

To clear the trouble it was simply necessary to add a second ground connection at the front of the rotor shaft. A slider from a discarded volume control was used. The spring fingers of the slider were cut to fit the rotor shaft. One end was then soldered to the condenser frame at the front. The other end made contact with the rotor shaft. This arrangement provided a 100 per cent cure, resulting in complete stability and increased output.

— *Frank Sikonski, W1KWY*

CALIBRATED DUMMY ANTENNA

An unusual but exceedingly practical dummy antenna is shown in Fig. 10-14. The device consists of an exposure meter, a 115-volt lamp bulb, and a cardboard damper, all housed in a wooden box of appropriate size. The meter fits snugly inside of a felt-lined hole at the front of the box, and the lamp mounts in a socket located on the inside rear wall of the case. The damper, located between the meter and the bulb, may be mounted on a panel-bearing assembly which has its shaft protruding through the top of the box.

Fig. 10-14 — W5TAY's dummy antenna uses an exposure meter as a means of registering power output from his transmitter.

After the assembly has been completed, the bulb should be connected to a 115-volt a.c. line and the damper adjusted to allow a ¾-scale reading on the meter. A lower-than-full-scale adjustment is recommended because this will allow the lamp to be overloaded (during testing of a transmitter) without endangering the exposure meter. Naturally, the lamp installed in the unit must have a wattage rating suitable for the power level of the transmitter with which it will be used.

When the unit is coupled to a transmitter, the meter will respond to the slightest changes in coupling or tuning. By comparing the reading obtained with the 115-volt input with that obtained from the r.f. power, it is possible to estimate closely the power output of a transmitter.

— *Harold G. Hodges, W5TAY*

INCREASING THE SENSITIVITY OF GRID-DIP METER FREQUENCY MEASUREMENTS

When obstructions such as partitions, partial shields, etc., prevent adequate coupling between a variable tuned circuit and a grid-dip meter, try the following stunt.

First, tune the dipper to the estimated frequency of the circuit to be checked. Next, tune a receiver — with the b.f.o. turned on — to the frequency of the meter. Now, swing the tuned circuit through its tuning range. If the setting for the grid-dip meter has been properly estimated, and providing that the meter is not completely shielded from the tuned circuit, the frequency of the g.d.o. will be pulled as the resonant frequency of the circuit approaches that of the meter. A change in g.d.o. frequency will be indicated by a change in receiver beat note.

The above system permits a frequency measurement to be made even with coupling conditions which prevent any noticeable dip in g.d.o. grid current. The scheme also allows r.f. signal generators and other types of variable oscillators (as long as they are not too well shielded) to assume the measuring duties of a grid-dip oscillator when the latter is not available.

— *Dave Tobias, W2JTE*

ADAPTING THE COAX S.W.R. METER FOR USE WITH 300-OHM TWIN-LEAD

The resistance-arm bridge used as a standing-wave-ratio indicator is particularly useful for coaxial lines, but normally is not used on balanced lines because of the unbalance introduced by one line being grounded at the s.w.r. meter. The coax s.w.r. meter can be adapted to measure the standing-wave ratio on 300-ohm Twin-Lead if the circuit of Fig. 10-15 is used.

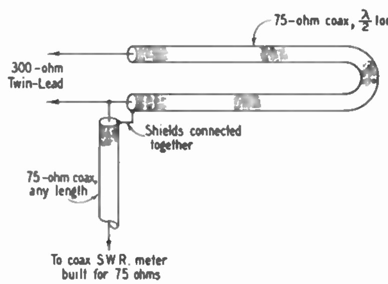


Fig. 10-15 — Method of using a 75-ohm coaxial s.w.r. meter with 300-ohm Twin-Lead. A length of 75-ohm coaxial cable is used to convert from the balanced feed line to the unbalanced input connection of the s.w.r. meter as described in the text.

The phase-inverting properties of a half wavelength of transmission line are used to give a line-balance converter and at the same time provide an impedance transformation of about four to one. This transfer of impedance comes from the fact that the same voltage appears between each conductor of the Twin-Lead and ground as exists between the center conductor of the coax and its shield. This gives a voltage step-up or step-down of four. The proper impedance match will be secured when a coax s.w.r. meter built for 75 ohms is used. It should be remembered that the physical length of the half-wave 75-ohm coaxial line is modified by the velocity factor of the line.

— *John P. German, W5HBH*

AN IMPROVED "TWIN-LAMP"

In the usual "twin-lamp," the pick-up loop is permanently connected to a short length of Twin-Lead which is then inserted in, or added to one end of, the feed line when s.w.r. checks are to be made. With the pick-up loop shown in Fig. 10-16, disturbing the feed line is not necessary, because the twin-lamp is *pinned* to the feed line

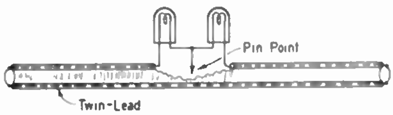


Fig. 10-16 — **Here's a simplified "twin-lamp" that requires no disturbance of your feed line, and which can be connected to the line at any point without cutting. A pin point is used at the junction of the two lamps, as shown.**

at any desired point. This is made possible by having the junction of the two lamps terminate in a sharp, stiff pin. The point of the pin is pushed through the insulation to make the required contact with one wire of the feed line. The ends of the pick-up loop may be temporarily taped to the feed line with Scotch tape. The degree of coupling between the twin-lamp and the feed line is adjusted by spacing the two slightly.

If desired, the pick-up loop can be made on a small scrap of sheet lucite or other insulating material, with the sharp point of the pin extending through the back of the sheet.

— *J. R. Fisher, VE3ALQ*

USING WWV MODULATION AS AUDIO TEST SIGNAL

Although the idea has not been tried here at W2MVR, it seems practical to suggest that transmissions from WWV be used as a source of pure sine-wave voltage for testing audio equipment. To employ the system, the receiver should be tuned to the WWV frequency coming in strongest at the time and the output taken from across the secondary of the output transformer (remove the 'speaker if possible). If a high-impedance output is required, it may be obtained by connecting the secondary of an output transformer to the secondary of the 'speaker transformer and then using the primary of the new transformer as the signal source.

The frequency of the audio signal so obtained will change from 440 to 600 cycles at regular intervals. Complete data on the WWV schedule appear in the measurements chapter of recent editions of *The Radio Amateur's Handbook.*

— *James C. Geras, W2MVR*

[Editor's Note: Selective fading — a common occurrence — causes severe distortion of the received signal and, as a result, it can not be assumed that the receiver will always deliver a pure sine wave even when tuned to WWV. W2MVR's idea should prove to be quite helpful in many instances, however.]

EASILY-BUILT AUDIO FREQUENCY METER

In recent years there has been an increasing need for accurate frequency measurement within the amateur bands. Among the reasons for this increasing need are (a) the rapidly-growing concentration of stations within certain band segments, (b) the increased use of network operation occasioned by civil defense and other traffic, and (c) the advent of s.s.b. techniques.

The circuit presented here provides in a very simple manner a sufficiently accurate comparison of frequencies for normal network and single-sideband activities. It is the function of this circuit to provide a linear indication on a calibrated meter of the heterodyne beat frequency existing at the output of any normal communications receiver. Thus, by use of this simple instrument, the procedure of manually adjusting a standard frequency meter to zero beat is replaced by a direct reading on a meter dial of frequency error compared with a preselected frequency setting. Two ranges are provided: 0 to 10 kc. and 0 to 1 kc. Thus, the frequency displacement can readily be read to within 100 cycles if the heterodyne is above 1000 cycles and to within 10 cycles if below 1000 cycles.

As shown in Fig. 10-17, the circuit includes a single 6AU6 tube connected as a square-wave limiter. The heater and plate voltages may be derived from the receiver. The square-wave audio output from this tube drives a double-diode counter circuit using two 1N38A germanium diodes that provide sufficient current to operate the 0-to-1 milliammeter. Calibration adjustment for the full-scale readings of 10,000 cycles and 1000 cycles are by means of variable shunts R_4 and R_5, which may then be replaced by fixed resistors. The adjustment holds for long periods of time and the meter calibration below the full-scale values is quite linear. Either the 500-ohm

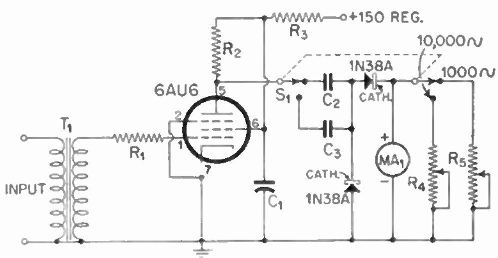


Fig. 10-17 — **Wiring diagram of the simple beat-frequency meter.**

- C_1 — 8-μfd. 250-volt electrolytic.
- C_2 — 0.01-μfd. mica.
- C_3 — 0.0011-μfd. mica.
- R_1 — 0.51 megohm.
- R_2 — 10,000 ohms.
- R_3 — 1000 ohms.
- R_4 — 10,000-ohm potentiometer.
- R_5 — 1000-ohm potentiometer.
- MA_1 — 0–1-ma. milliammeter.
- S_1 — D.p.d.t. switch.
- T_1 — Microphone, pick-up or line-to-one-grid (UTC O-1 or equivalent).

or the 8-ohm output-transformer tap on a communications receiver is satisfactory for the input signal to the circuit. The entire circuit can be housed in a small inclined-front meter cabinet.

For those unfamiliar with a "counter" circuit, a little study of Fig. 10-17 may be in order. A sine-wave signal of any frequency (and of any amplitude above the limiting threshold) appears in the output of the 6AU6 as a constant-amplitude square wave. This square-wave voltage is applied to C_2 (or C_3, depending upon the range in use). Charging current to the condenser is carried in one direction by the lower diode — in the other direction the charging current passes through the meter and upper diode. The indicated current is proportional to the frequency (*number* of cycles per second — hence the name "counter"), to the accuracy with which the capacity of the condenser, and the amplitude of the square wave, remain constant. It is only necessary to calibrate at 1 kc. and at 10 kc. to have accurate readings throughout the scale without further calibration.

When the meter is used to measure the frequency error of a network station, the receiver is first tuned to zero beat with the frequency standard (or a station known to be on the correct frequency). The off-frequency station will give an audible beat that can be measured by the meter (in the absence of other signals). Whether the off-frequency station is higher or lower must be determined, of course, by retuning the receiver to zero beat with the signal being measured.

— *J. Taylor, W2OZH, and H. Bredemeier*

REDUCED OUTPUT FROM THE BC-221-A FREQUENCY METER

Prior to a recent modification, the output of a BC-221-A was too great to permit smooth heterodyne action with the receiver tuned to a weak signal. This condition was quickly remedied by lowering the output of the oscillator. A 1-megohm resistor inserted in series with the existing screen-dropping resistor does the trick nicely. One of the 'phone jacks was rewired so that its contacts will shunt the new resistor whenever it is desirable to obtain full output from the meter. A ¼-inch bakelite rod is used to close the jack during full-output operation.

— *T. D. Koranye, W2SFW*

CAPACITANCE CHECKER FOR SMALL VALUES

Having an innate mistrust of color codes and not possessing a bridge, I built the little gadget described here especially for checking small capacitors. It covers the range 0 to 10,000 μμfd. with sufficient accuracy (10 per cent or better) for most purposes. In addition, it is small and uses very few parts. It requires no accessory equipment. A flip of the switch and it is ready to go with no heating time.

As can be seen from the circuit diagram of Fig. 10-18, it uses a built-in grid-dip meter coupled to the measuring circuit, L_1, C_1, C_2 and C_3. In use, the oscillator is adjusted by the trimmer, C_4, to the resonant frequency of the measuring circuit (C_1 at full capacitance), as indicated by a dip in grid current. Then the unknown capacitance is connected across C_3, and C_1 is backed off until the meter again shows resonance. The unknown capacitance is then read directly from the dial on C_1.

The circuit is simple and uses readily-obtainable parts. Everything fits easily in a 3 × 4 × 5-inch box. A.c. is used directly on the plate of the 3S4 oscillator tube, and the filament is heated by the reactive current through a 1-μfd. condenser connected in series with the line. Thus, power consumption is confined to just the 1 or 2 watts used directly in the oscillator itself and heating is held to a minimum. Any meter with a 1- or 2-ma. scale will serve, since all that is required is an indication of grid-current change. All parts of the oscillator circuit are insulated from the chassis for obvious reasons. C_7 was added to cure a slight hand-capacitance effect.

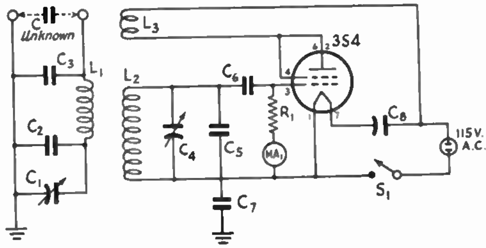


Fig. 10-18 — Circuit diagram of the simple capacitance meter.

C_1 — 100-μμfd. variable.
C_2 — 45-μμfd. ceramic.
C_3, C_5 — 100-μμfd. ceramic.
C_4 — 25-μμfd. variable.
C_6 — 15-μμfd. ceramic.
C_7 — 500-μμfd. mica.
C_8 — 1-μfd. 600-volt paper.
R_1 — 30,000 ohms, ½ watt.
L_1, L_2 — Any convenient size; see text.
MA_1 — D.c. milliammeter, 1- or 2-ma. scale.
S_1 — S.p.s.t. toggle.

Reasonable care should be used to make everything solid, particularly in the measuring circuit, so that it will hold calibration. The frequency used is not important, and any convenient coil size may be used. The only important requirement is that both circuits tune to the same frequency. This particular unit operates at about 4500 kc., which is a fair compromise between coil size and oscillator stability. Any 100-μμfd. variable can be used for C_1, but the straight-line-frequency type used here gives a better spread on the low-capacitance end of the scale. C_2 spreads the high-capacitance end of the scale. The two coils should be placed no closer than necessary to give a discernible dip on the meter.

The instrument is calibrated by connecting capacitors of known size, or combinations thereof, and marking the dial at the grid-dip point.

The meter was built primarily to measure capacitors before they are used. However, a fairly close measurement can be made on capacitors already wired into a circuit without disconnecting them. Connect a pair of test leads to the meter and connect the grounded lead to one side of the capacitor. Before connecting the other lead, rotate C_1 to the dip and read the lead capacitance. Then connect to the unknown capacitor and again rotate C_1 to the dip. Subtract the lead capacitance from the total to find that of the unknown. Do not balance out the lead capacitance by readjusting the trimmer.

— *S. A. Sullivan, W6WXU*

11. Hints and Kinks . . . for the Shack

DIRECTION-INDICATOR HINT

Most of the synchro motors available in surplus for use as direction indicators have one serious shortcoming. They lack the finished appearance that comes only after the addition of a neat compass rose to show what direction the beam is headed. This need can be filled simply by almost any ex-GI who still has the little compass supplied by Uncle Sam.

Fig. 11-1 — A neat direction-indicator scale made by photographing a compass rose.

Remove the compass rose from the compass and have it photographed by your local studio. If you know the size you want the finished article to be, enlarge it to the exact dimensions needed. A reverse print, as shown in Fig. 11-1, cemented to the indicator makes a very attractive and useful addition to any set-up. The cost is low, and extra prints for "deserving friends" can be obtained whenever needed.

— *William W. Orr, W2OWQ*

SIMPLE DIRECTION INDICATOR FOR ROTARY ANTENNAS

The homebuilt gadget illustrated in Fig. 11-2 is an inexpensive solution to the direction-indicator problem. While it lacks some refinements possible with synchro motors, its low cost and simplicity offset its minor deficiencies.

A six-inch diameter piece of half-inch plywood, a little scrap aluminum, some half-watt resistors, plus two wires and the station volt-ohmmeter are all the parts required. The circular piece of wood, after first being coated with waterproof shellac, is fitted with eight aluminum segments used as contacts in a variable-step resistor as shown in the drawing. The aluminum segments are spaced around the circumference of the wheel, and are fastened to it with small brads. The resistors are mounted on the center tabs of aluminum segments by means of solder lugs placed beneath the brads when the segments are tacked in position. The wiper arm is mounted in position on the structure that supports the beam.

The advantages of this system are numerous. It is inexpensive, and it utilizes the station volt-ohmmeter, which isn't ordinarily used for other purposes when the station is on the air. No external power supplies are required, because the

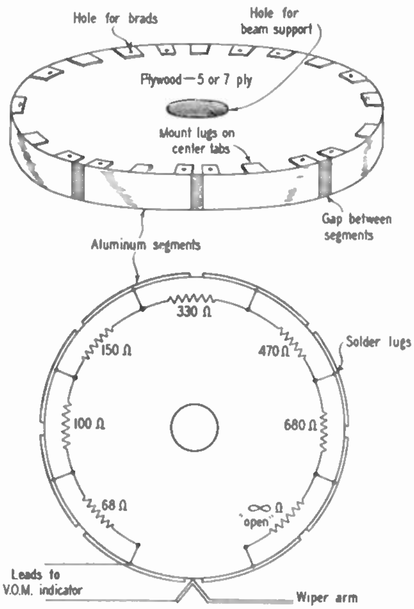


Fig. 11-2 — A direction-indicator mechanism that uses a homebuilt step-resistor and the station v.o.m.

indicator is actuated by the batteries of the volt-ohmmeter. Once the beam is pointed in the desired direction, the meter can be removed from the circuit, thus preventing unnecessary battery drain.

With eight aluminum segments, as shown, only eight directions are indicated, and the accuracy is plus or minus 22½ degrees. With a bit more work, a larger number of segments and resistors could be used to permit these figures to be improved. You can suit your own requirements. By using the resistance values shown, an approximately linear deflection of the basically nonlinear ohmmeter scale is obtained, but here again, you can suit your own requirements, using whatever resistance values you have on hand, making suitable corrections in the "calibration" on the face of the indicator. Full use of the entire scale of the meter is made possible by using "zero" and "infinite" resistors at the extreme ends of the circumference of the wheel.

— Cecil K. Johnson, WØTLY

METHOD OF POSTING QSL CARDS

What to do with the QSL cards is always a problem but it seems that the most popular method of storage is still to post them on the wall. The method shown in Fig. 11-3 does not leave

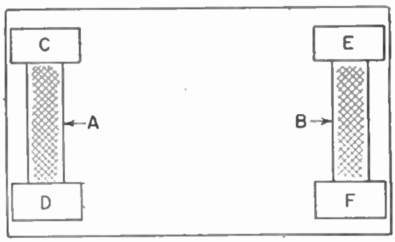


Fig. 11-3 — Here is how WN6TKA prepares a QSL card for on-the-wall posting. Strips *A* and *B* are placed on the card with the adhesive side out and strips *C* to *F* are mounted with the adhesive against the card.

marks on the wall nor does it damage the QSL card in any way.

For each card to be posted, cut six pieces of cellophane tape or, better still, the "wet-or-dry" type of masking tape, of the ½-inch-wide variety. Cut two of the strips just slightly less than the width of the card, and the other four strips about an inch in length. Place the longer strips across the width of the card (one at each end of the card) adhesive surface up, and place the shorter strips face down, one at each end of each longer strip of tape. This will firmly hold the tape to the card, adhesive side out.

Then simply place the card wherever you want it on the wall and presto — there it sticks, firmly and neatly, for as long as you want it there. It will adhere to just about every wall surface encountered, too, from wallpaper to rough stucco or plaster.

Cellophane tape, masking tape or adhesive tape will all work equally well. The masking tape, however, is the more economical and many other uses for it can be found around the shack. Electrical tapes of any kind should be avoided for this purpose, as the black adhesive usually comes off on the wall.

— Richard F. Van Wickle, WN6TKA

Earl V. Reed points out that WN6TKA's masking-tape Hint & Kink for QSL mounting (see preceding kink) is made even simpler by the use of "double-backed" tape, a variety having adhesive on both sides. X-ray supply dealers are ready sources for this type.

W4RAZ uses a new plastic liquid product, Krylon, to coat QSLs, certificates and the like with a preserving and washable finish. It is available clear or in a variety of tints.

QSL CARD DISPLAY SIMPLIFIED

Many methods of displaying QSL cards without damage to either the cards or to the surface on which they are mounted have been proposed, but almost all of the tricks have fallen short in one respect or another. About the best solution to the problem is to use Carter's rubber cement on the back corners of the cards. It will bond them firmly to almost any surface, and when it becomes necessary to remove or relocate them, they will come off easily if a thin-bladed knife is slipped behind them. The adhering cement can be easily rubbed off with the fingers, leaving both the QSL card and the mounting surface unmarred.

— Merritt F. Malvern, W2ORG

PROTECTING LOGBOOKS

Tiring of dog-eared logbooks, W6GJZ found that a paper clip arranged to engage four or five pages at each corner will keep things neat and under control. On the other hand, W2FW clips off a small segment of the top right corner of each log page as he finishes with it. The page in current use then can be instantly located without fuss and bother, wear and tear.

A "CHEAP AND DIRTY" FOOT SWITCH

The foot switch shown in Fig. 11-4 was thrown together at the last minute before the 1951 Field Day, and any comments you may have on its appearance are quite justified. But the darned thing works so well, and is so convenient to use, that it would be a shame not to pass along the idea. You can pretty it up as much as you like, so that it will fit in better with your Chippendale or Louis Quinze — this decor just happens to match our Field Day motif.

In case you are wondering "What and why is a foot switch?" it can be described briefly as "a foot-operated gadget that takes the place of the usual send-receive switch." It connects in parallel with your present send-receive switch, and if you like it well enough you can then throw away the old switch. The "why" of it is that it leaves both hands free for the 101 things required during Field Day and other contests, or traffic handling, or just plain general operating. The switch remains closed as long as your foot is on it. Other applications are possible, of course. The foot switch might be an "antiswisher" that turns on the VFO without putting a signal on the air, for example.

Incidentally, this foot switch is no untried first effort. It is the result of several redesign conferences. For example, the first model had no rest for the foot when not pressing on the switch. Certain muscle-bound members of our Field Day gang found this situation intolerable, so rests were added for both right- and left-footed operators. There were discussions concerning the proper spring-return tension and distance of travel, so these items were made adjustable. (To the best of our knowledge, no one gave a hoot about them during the contest.) But seriously, the thing is a handy gadget, and we'll wager that once you try it you will use it most or all of the time.

The switch is built around a Microswitch, available through many war-surplus channels. Just be sure you get one that is normally open and has a long lever arm. Some of the arms are plain and some have a roller on the end — either one will be fine. These switches are rated at 10 amperes for 125 v. a.c., so they will handle most control circuits.

The pedal and base of the switch were made from scraps of ½-inch plywood we had, but almost any wood scraps should do the trick. The pedal piece (ours measured 4½ by 6 inches, before and after cutting) was held to the base piece (4 by 15 inches, but it could have been wider) with a pair of hinges. The hinges were fastened with 6–32 flat-head machine screws, because there were no wood screws kicking around, and this required counterboring the wood for the nuts and cutting off the screws so they wouldn't butt out past the wood surfaces. Wood screws would have been correct, of course.

The Microswitch is mounted on an aluminum bracket, and the bracket was bent at an acute angle so that the switch arm would meet the pedal properly. The stop under the pedal was two scraps of wood that were nailed to the base, to give a positive stop for the pedal. They were located at a point where the pedal pushed down to about ⅛ inch beyond where the Microswitch had already closed. Thus, you can afford to be brutal with the pedal without injuring the Microswitch, because the switch has some allowable overtravel.

The foot rests, on either side of the pedal, were made of wood and screwed and glued to the base plate. Their height was made equal to the resting height of the pedal.

The springiness of the Microswitch lever is not used to return the pedal, since it is not enough for the job and, anyway, it would be poor design. Two brads were driven in the end of the pedal above the hinges, and two more brads were driven in the edge of the base plate, below the hinges. A rubber band was looped around each pair of brads and we were in business. Need more tension? Take up another loop. It looks corny, but it works every time.

The pedal would swing right around if it didn't have a stop on it, and this took some real engineering (Field Day style). One brad in the edge of the pedal away from the hinges and another below it in the edge of the base plate were tied together by a short piece of string. The height is adjusted by the position of the knots on the string.

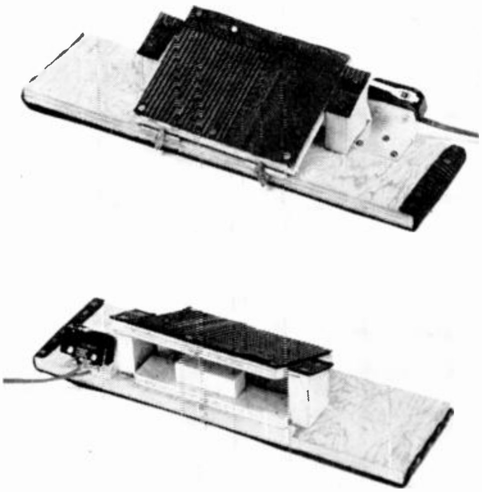


Fig. 11-4 — Two views of a simple foot-operated switch. (*Upper*) The rubber bands in front of the hinges determine the return pressure of the pedal. (*Lower*) A string between base and pedal limits the upper travel of the pedal, and a positive downstop is provided by the wood blocks nailed to the base under the pedal.

A rubber stair tread was cut up for the pedal and rests, and fastened with tacks. A piece of this rubber was also used on the bottom of the base plate, but you might want to use rubber feet instead.

As mentioned earlier, anyone with a picture-book station would want to dress up the switch a bit. About all this requires is some care with the woodworking and some paint or varnish. A box construction, with the foot rests forming the two sides of the box, would be logical with a heavy base. The rubber-band return could be eliminated in favor of compression springs under the pedal, riding on guide pins, but the string limit stop is hard to beat because it is so simple and it doesn't show from the front.

If all of your transmissions are of the 10- or 15-minute variety, a hand-operated switch is probably the best for you. But for almost all other types of operating, a foot switch is hard to beat. With one in parallel with the hand switch, you can't miss!

— *Byron Goodman, W1DX*

QTH FINDER FOR CALL BOOK USE

Take an ordinary postcard or similar piece of material and cut a slot at each end as shown in Fig. 11-5. This device displays only one QTH at a time as it is moved along a column of a call

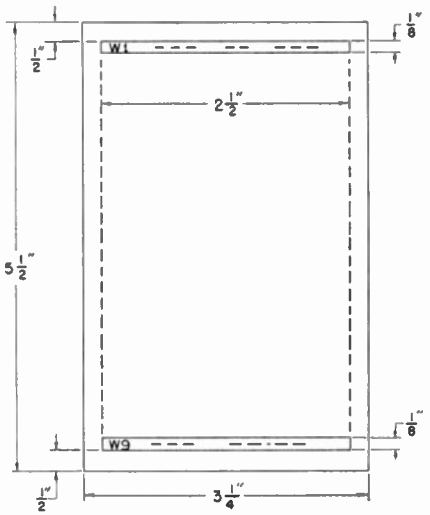


Fig. 11-5 — Drawing of W1TXY's QTH finder.

book. The card should have the slots located not more than a half inch in from the bottom and the top edges so that it will facilitate QTH hunting at the bottom as well as the top of a column.

— *Ralph S. Noyes, W1TXY*

IS YOUR STATION UNDERWRITERS' LAB APPROVED?

The National Electrical Safety Code, Pamphlet 70, Standard of the National Board of Fire Underwriters, deals with electric wiring and apparatus. The Code was set up to protect persons and buildings from the electrical hazards arising from the use of electricity, radio, etc. Article 810 is entitled "Radio Equipment." The scope of this article, Section 8101, says, "The article applies to radio and television receiving equipment and to amateur radio transmitting equipment, but not to the equipment used in carrier-current operation." Without reading further, most amateur stations comply with these safety rules, not because they are required to do so, but because of the inherent nature of the ham to provide great safety factors in most of his equipment. It is to the one in a hundred, where the safety factor is doubtful, that these articles will be helpful. It will be seen later that not only do these articles satisfy the Underwriters' Code but, when fulfilled, some are measures that one would take to TVI-proof his rig. So it's a matter of killing two birds with one stone.

The Board of Fire Underwriters sets up the code as a minimum standard for good practice. Most cities adopt the code, or parts of it, either entirely or with certain amendments which may apply to that particular city. It is up to the city to enforce these rules. When a violation is reported, periodic checks are made by an inspector until a correction is made and to insure against future recurrence.

Antenna Systems Sections 8111–8115

"Antenna-counter-poise and lead-in conductors shall be of hard copper, bronze, aluminum alloy, copper-clad steel, or other high-strength, corrosion-resistant material. Soft-drawn or medium-drawn copper may be used for lead-in conductors where the maximum span between points of support is less than 35 feet. Outdoor antenna, counter-poise and lead-in shall not be attached to poles or similar structures carrying electric light or power wires or trolley wires of more than 250 volts. Insulators shall have sufficient mechanical strength to safely support the conductors.

"Outdoor antenna, counter-poise and lead-in shall not cross over electric light or power circuits and shall be kept away from all such circuits so as to avoid the possibility of accidental contact.

"Where the proximity to electric light and power service conductors of less than 250 volts cannot be avoided, the installation shall be such as to provide a clearance of at least two feet. It is recommended that antenna and counter-poise conductors be so installed as not to pass under electric-light or power conductors.

"Splices and joints in antenna and counter-poise spans shall be made with approved splicing devices or by other means as will not appreciably weaken the conductors. Soldering may ordinarily be expected to weaken the conductor; therefore, soldering should be independent of the mechanical support.

"Metal structures supporting antennas shall be permanently and effectively grounded."

Antenna Systems — Receiving Stations Sections 8121–8124

"Outdoor antenna and counter-poise conductors for receiving stations shall be of a size not less than in the following table:

	Minimum Size of Conductor When Maximum Span is . . .		
Material	*Less than 35 feet*	*35–150 feet*	*Over 150 feet*
Aluminum alloy, hard-drawn copper	19	14	12
Copper-clad steel, bronze or other high-strength material	20	17	14

"Lead-in conductors from outside antenna . . . shall be of such size as to have a tensile strength at least as great as that of the antenna conductors (as in the table).

"Lead-in conductors attached to buildings shall be so installed that they cannot swing closer than two feet to the conductors of circuits of over 250 volts, or less; or ten feet to the conductors of circuits of more than 250 volts. . . .

"If an electric supply circuit is used in lieu of an antenna, the device by which the radio receiving set is connected to the supply circuit shall be specially approved for the purpose."

Antenna Systems — Transmitting Stations Section 8131–8135

"Antenna and counter-poise conductors for transmitting stations shall be of a size not less than given in the following table:

Material	Maximum Size of Conductors When Maximum Open Span is . . . Less than 150 feet	Over 150 feet
Hard-drawn copper.	14	10
Copper-clad steel, bronze or other high-strength material	14	12

Lead-in conductors shall be of a size as specified in the table, for maximum span lengths.

"Antenna and counter-poise conductors for transmitting stations attached to buildings shall be firmly mounted at least three inches clear of the surface of the building on non-absorptive insulating supports such as treated pins or brackets, equipped with insulators having not less than three-inch creepage and air gap distances. . . .

"Entrance to buildings . . . except where protected with a continuous metallic shield which is permanently and effectively grounded, lead-in conductors for transmitting stations shall enter buildings by one of the following methods:

"a. Through a rigid, non-combustible, non-absorptive tube or bushing.

"b. Through an opening provided for the purpose in which the entrance conductors are firmly secured so as to provide a clearance of at least two inches.

"c. Through a drilled windowpane."

Transmitting Stations Section 8192

"Transmitters shall comply with the following:

"a. Enclosing. The transmitter shall be enclosed in a metal frame or grille, or separated from the operating space by a barrier or other equivalent means, all metallic parts of which are effectively connected to ground.

"b. All external metallic handles and controls accessible to the operating personnel shall be effectually grounded. No circuit in excess of 150 volts should have any parts exposed to direct contact. A complete dead-front type of switchboard is preferred.

"c. Interlocks on doors. All access doors shall be provided with interlocks which will disconnect all voltages in excess of 350 volts when any access door is opened.

"d. Audio amplifiers. Audio amplifiers which are located outside the transmitter housing shall be suitably housed and shall be so located as to be readily accessible and adequately ventilated."

How many hams have transmitters unenclosed or without interlocks or both?

The author has purposely visited over a dozen ham shacks and there are some who do not comply with various provisions. Of course, no particular station will be shut down because the antenna lead-in is No. 16 instead of No. 14, or because the speech amplifier is not totally enclosed. The National Electric Code is only a minimum standard, and compliance with its rules will assure less operating failures and hazards, and greater safety.

A copy of the pamphlet is available by writing the National Board of Fire Underwriters in your city, or at 85 John Street, New York 38, New York. Ask for pamphlet No. 70.

Other parts of the Underwriters' Code deal with power wiring and, in addition to the requirement of the use of U.L. approved materials and fittings, have the following to say of direct interest to amateurs:

"All switches shall indicate clearly whether they are open or closed.

"All (switch) handles throughout a system . . . shall have uniform open and closed positions.

". . . supply circuits shall not be designed to use the grounds normally as the sole conductor for *any part* of the circuit."

The latter means that wire conductor should be used for all parts of the power circuit. Dependence should not be placed on water pipes, etc., as one side of a circuit.

— I. F. Wolk, W6HPV

ILLUMINATED CALL LIGHT

Certain substances possess a high degree of internal refraction for light, thus transmitting light from edge to edge without illuminating the major surface. However, wherever there is a surface discontinuity, light is allowed to leak out or become visible. Thus, by deliberately scratching or engraving the surface, it is possible to develop a unique *soft* illumination.

Fig. 11-6 shows a call sign that employs the light refraction property of lucite. Engraving of the call plate is accomplished most easily by placing the plastic sheet over the lettering desired (letters cut from a magazine serve the purpose) and then carefully etching with a Vibro-tool or similar gadget. An electric drill may also be used as a router, but is more difficult to control.

To illuminate the sign, it is only necessary to mount a pair of pilot lamps, *F* and *G* of Fig. 11-6, in holes drilled at the bottom of the lucite sheet. The lamps should be held in place with either glue or tape, and require a suitable dropping

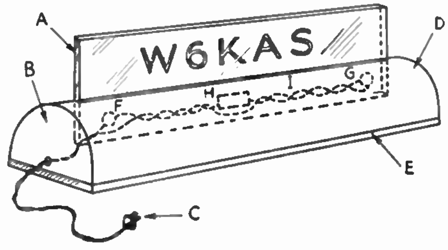


Fig. 11-6 — Drawing of the illuminated call sign. Members marked *A*, *B*, *C*, *D* and *E* are the lucite sheet, wooden end (2 required), line cord, metal shield and wooden base, respectively. *F* and *G* are the lamps. *H* is the dropping resistor, and *I* is internal wiring.

resistor if they are to be connected directly to the a.c. power line. Naturally, it would be possible to substitute a small filament transformer, mounted within the assembly, as a means of lighting the lamps.

Colored lighting may be obtained by tinting either the lamps or the edges of the engraving. Nail polish, dial-light coloring or dyes are suitable for this purpose. The etching will appear more brilliant if the edges of the sign are treated with aluminum paint to prevent spill light around the edges of the lucite.

— *John W. Sherman, W6KAS*

PLANNING THE STATION FOR CONVENIENCE AND APPEARANCE

If space limitations make it necessary to locate the shack in the living or dining room, the station design shown in Fig. 11-7 will make an instant hit with the XYL — from the appearance standpoint, at least!

Desk Construction

The operating desk is built for a twofold purpose. It can be used for letter writing, using either pen or portable typewriter, or radio operating. A row of pigeonholes is built into the upper section of the cabinet for the storage of letters, stamps, pens, etc. Five neat drawers are provided in the lower section for small tools and completely unusable prizes won at hamfests.

The main radio operating section is disclosed when the hinged front is lowered to normal horizontal position. This compartment contains the receiver with its S-meter and 'speaker, and other equipment including a VFO, a modulation-monitor oscilloscope, and the clipper-filter audio preamplifier with microphone. The microphone is on a desk stand; during operating periods it is taken from its hiding place behind the audio preamplifier and placed on the outstretched hinged front.

The lower storage space is provided with one shelf, to hold a portable typewriter and spare tubes, while the lower sections will accommodate a BC-221 frequency meter, with room left over. The left side of the lower door is hinged at the top, bottom and center, while the folding front is hinged at four places with small brass hinges. These are recessed into the wood about the depth of the thickness of the hinge's pivot to hide it as much as possible and to provide smoother operation. The knobs and handles shown are made of solid brass and lacquered to prevent oxidation. The folding front panel has no knob; it is easily brought down to operating position with the fingers, for it protrudes about ½ inch on each side. A small cabinet catch is provided in the left-hand top corner to hold it in place when the desk is not being used. Brass elbows measuring a total of 20½ inches in length hold the hinged front horizontal when the desk is in use. These are made from ½- by 1/16-inch brass stock and lacquered.

With a few exceptions, all main sections of the desk are made from ¾-inch plywood. The lower-section door is made from ½-inch plywood, as is the shelf in this compartment. The partitions for the pigeonholes are of the same material. The drawers have masonite bottoms, and ½-inch plywood is used for the front, sides, and back.

Nails of proper sizes are used throughout the desk. This was found to be easier than applying screws and just as strong, provided a large number of nails was used.

The masonite back of the desk is recessed 1½ inches to allow the desk to stand tightly against the wall and still let the avalanche of wires and cables flow from behind and to the floor, unseen. These control and audio cables pass through a 3-inch-square hole, cut into the baseboard, travel underneath the floor and arrive at the back of the transmitter cabinet through a similar entrance in the baseboard. The RG-8/U cables from the 10- and 75-meter antennas in the back yard come in to do their work through the same opening, and thus no unsightly wires are visible.

The desk is mounted on rubber-tired casters for easy access into the back of the desk and the rear of the components in the main section. Several holes are cut into the masonite to admit wires and cables to the desk equipment.

Sanding and finishing of the desk will be described fully at the end of the section concerning the transmitter cabinet.

Transmitter Cabinet

The transmitter framework (Fig. 11-10) is made of well-seasoned thoroughly-dry pine. The front supporting section is composed of 2 by 4s held together by toe-nailing and sheets of "tin." The end pieces are reinforced by 2 by 2s which also strengthen the sides of the cabinet when they are nailed on later. The bottom is made from 2 by 2s with a short 2 by 4 in the center. This center piece must be wide because it supports the ends of two of the heaviest chassis of the completed

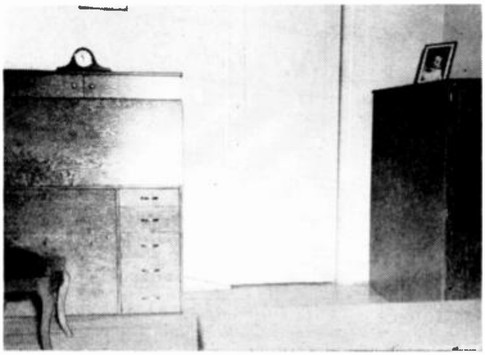
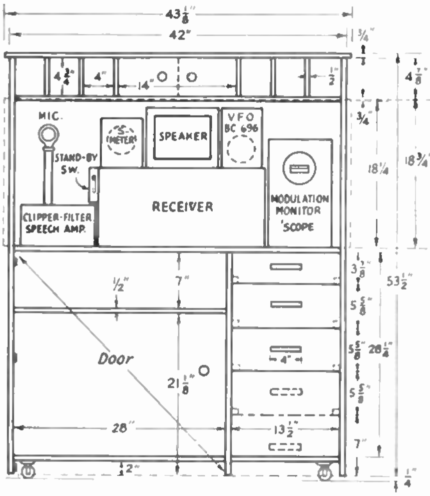


Fig. 11-7 — The shack at W4DMX, proving that a rig doesn't have to be obvious when not in use.



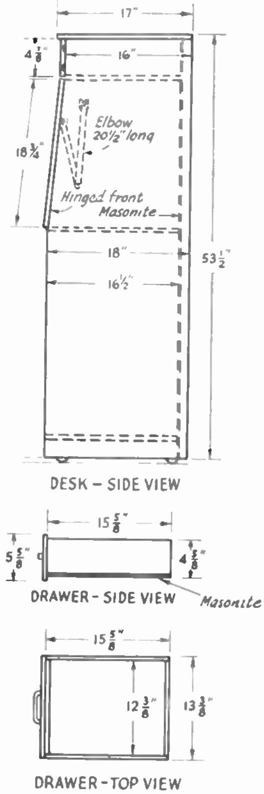


Fig. 11-8 — Details and dimensions of the operating desk.

transmitter, the high-voltage supply and the modulator. Five rubber-tired casters are securely mounted beneath this bottom frame, the fifth caster being placed in the front center to do its share of the weight lifting. A sixth one in the center back section was not considered necessary and, too, it would have gotten in the way of the many cables and wires which come through the baseboard and travel underneath the base framework into the transmitter. A small hole for these cables was cut into the bronze shielding screen wire tacked to the bottom of the base frame.

Twelve 10 × 12-inch steel shelf brackets were fastened as shown in Fig. 11-10 to support the three tiers of two chassis each. The highest one on the left has no radio equipment mounted on it, at present. It was designed into the transmitter as a future expansion item.

The two sides were nailed on, using finishing-type nails. These sides are made from 3/8-inch plywood and covered with bronze screen wire for shielding. The front doors are cut from 5/8-inch fir plywood and hinged in three places as shown. Two "ball and socket" catches are mounted into the edges of the doors where they meet so that they will remain aligned when closed. A 1/4-inch brass rod protrudes 1/2 inch out of the top edge of the left door and this fits neatly into a hole cut to receive it in the folding top of the transmitter cabinet. This eliminates the need for knobs or handles and produces a clean, smooth outside appearance when the cabinet is not in use. The doors swing open when the top is raised slightly. If you are plagued by the patter of small feet and all the youthful inquisitiveness that goes with them, then it is a godsend to be able to say: "Look, Ma, no handles!"

When the doors are closed, there is a space of 1 1/2 inches for protruding dials, knobs and meters that are mounted on the front panel. This panel is made of masonite, painted medium gray. Before this panel is nailed along its edges to the front 2 by 4 framework, a bronze sheet of screen wire is stretched tightly across the framework and tacked into place. The proper holes are cut out for shafts, meters and main switch after marking. The four windows which are cut in the panel are *not* cut out of the screen.

After three coats of medium-gray enamel paint were sprayed on, and one coat of satin finish varnish brushed on, the small nail heads around the edges of the panel were covered with corner aluminum stripping on the top and both sides. The top strip was held tightly against a wooden piece of plywood, three inches wide and 1/4 inch

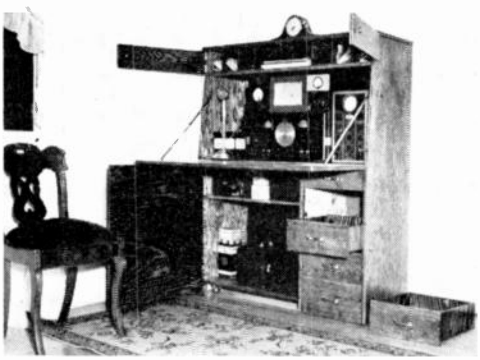


Fig. 11-9 — The operating position at W4DMX, with the drawers and doors opened out to show the construction. All wires run down the back and under the floor to the transmitter.

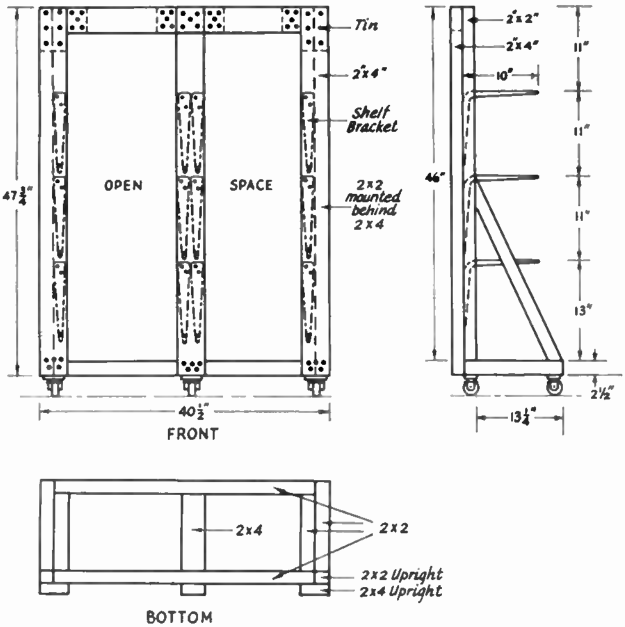


Fig. 11-10 — The transmitter frame is made of wood with metal shelf brackets for the transmitter and power-supply units.

thick, that is mounted flat across the top of the panel. This completes the "built in" appearance of the front panel and also allows something for the top to rest upon, when in the down position. There are four windows in the panel, which allows plenty of cooling air for the rectifier tubes and transformers and other components that tend to run hot. These openings are covered with the bronze wire previously mentioned and painted with one coat of silver paint. Care should be taken when painting with the brush to blow firmly with the mouth close to the freshly-painted screen, thus removing any clogs that tend to be set up. The finished job will seem to be a satin silver plate and very neat in appearance. Each window is rung with aluminum molding, made especially for masonite. The corners are mitered for better looks. One short piece must be cut in the center to allow this last strip to slip into place; however, this cut is hardly noticeable.

The folding top is covered with screen also and hinged at its back edge in four places to a 1 by 2 running the length of the transmitter and holding the back top corners of the cabinet. The top is held in the up position at an angle of approximately 70 degrees by a single short elbow of the locking type. Folding of the top permits the operator to gain easy access to the two top chassis and to make adjustments there.

The back of the transmitter is made of a framework of ¾ × 1¾-inch pine, covered with bronze screen. This completely shields the transmitter when the top is dropped down after the front doors are opened. The 115-volt input is by-passed to ground to prevent radiation through the power system of the house.

Along the edge of the 2 by 2s running vertically along the right side of the transmitter framework, as viewed from the back, is a line of 115-volt bakelite receptacles into which the different units plug. Appropriate switches are provided to control these. A relay system is interconnected with this to allow complete break-in facilities, controlled from the operating desk. A toggle switch mounted on the VFO at the desk selects two of these relays, which provide voltage for the oscillator, but does not allow any other high voltage to come on. This enables quick and accurate QSY and/or zero-beat adjustments when getting ready to call another station on his frequency. This arrangement does not QRM anyone during adjustment, for the carrier is not on the air.

Preparation for Finishing

The following material was used in finishing the cabinets:

- 6 sheets of No. 1 flint paper
- 4 sheets of No. 180-C Carborundum waterproof paper
- 1 very small paint brush
- 2 two-inch paint brushes
- 1 ½-pint can paste wood filler, transparent
- 1 small can of wood putty
- 1 pint golden oak stain
- 1 quart of clear varnish
- 1 pint of satin-finish varnish

All edges of the different sections were thoroughly sanded down using No. 1 sandpaper.

When all sections were nailed together, using finishing nails, a punch was used to drive the small heads below the surface of the plywood. About two tablespoons of wood putty was mixed at a time and all nail holes and small cracks were filled in carefully. After 24 hours allowed for drying, the cabinet and desk were sanded thoroughly all over, using fine Carborundum paper. It was found best to wrap the sandpaper around a small flat piece of plywood; with this a very flat sanded surface was obtained over the softer places produced by the filler. A lintless soft cloth, moistened in water, was used to wipe all surfaces clean.

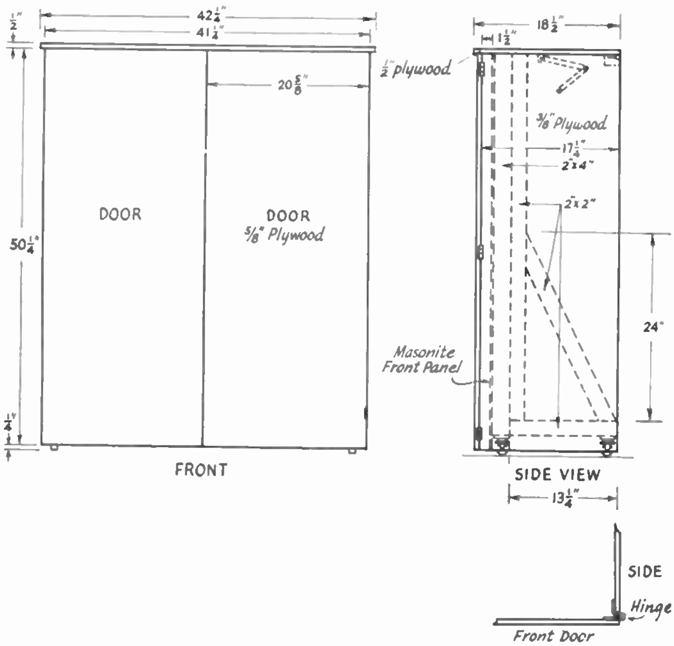


Fig. 11-11 — **Dimensions of the transmitter cabinet. This covers the transmitter frame (shown in position in the side view) but permits ready access to all tuning controls by opening the doors.**

The wood filler was stirred well and thinned with turpentine until a consistency of thick cream was obtained. Using the very small brush, a small drop was placed on each place where wood putty had been applied. The edge of one of the larger brushes was used to apply filler to all edges of the plywood sections. A soft cloth was used to wipe away excess filler immediately, before it became dry. A whole day was allowed between this operation and the staining.

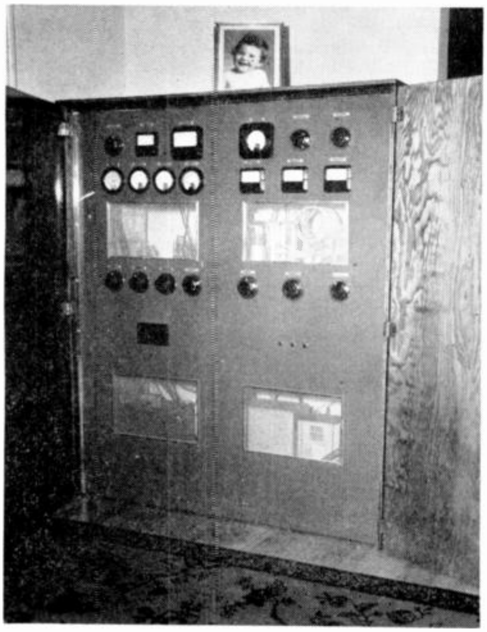


Fig. 11-12 — **Opening the doors of the transmitter cabinet reveals this neat rig. Wire screen surrounds the transmitter and helps in the reduction of TVI.**

The final cycle of the finishing began with one coat of golden oak stain being brushed on with a clean two-inch brush, being careful not to allow the stain to run. This is best done by using a brush stroke from bottom to top and wiping with a lintless dry cloth immediately. Another 24 hours was required for drying. The first coat of clear varnish came next, covering every portion that would be visible to the eye, inside compartments, drawers, etc. Before the second coat of varnish was applied, fine Carborundum paper was again used all over the outside surfaces, then a moist cloth removed all foreign matter. When the second varnish layer was completely dry the final coat was carefully applied. This was the finishing satin varnish, which took away the high gloss and gave the surface a soft hand-rubbed look.

It is a rather pleasing experience to have visiting hams drop in, look around a bit, and ask, "Where's the rig . . . in the attic?" It is then with paternal pride that this writer unfolds the doors and displays the product of his months of labor.

— *Herbert G. Eidson, jr., W4DMX*

SPACE-CONSERVING HINT

Most commercially-built receivers are supplied with rather large 'speaker cabinets which take up a lot of space on the operating table. At the possible sacrifice of a little audio "quality," the excess space can be used to advantage as housing for one or more of the small gadgets that usually clutter the operating position. Keying monitors, clippers, and small power supplies are just a few of the units that might be tucked away inside the 'speaker cabinet.

— *S. G. McDonald, W8ZSA/3*

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Foreword

THE SUCCESSFUL RADIO AMATEUR is, by nature, an ingenious fellow. Without a high order of resourcefulness and an ability to improvise he could never overcome the ever-present problem of inadequate workshop equipment and the equally common handicaps of insufficient apparatus and money. Evidence of this inherent ingenuity is to be seen on all sides. One cannot visit any good amateur station without finding clever improvisations, either in the construction of individual components or in the manner in which the whole station is assembled. It may be just a different way to mount a coil, or a scheme for getting a broken antenna halyard back upon the mast, or a fabulous remote-control system. Whatever the idea, it is invariably of value to the rest of us.

With the object of putting the best of these "brain storms" into circulation there has appeared in *QST*, these many years, a department devoted to the general subject of "Hints and Kinks." This department has enjoyed great popularity. The ideas contributed to it by ingenious amateurs have helped us all in our search for ways and means to improve our equipment. Unfortunately this garnered gold of amateur experimentation often has been lost to sight, shadowed by some big article or forgotten in the excitement of some major development. Then, too, there has been the annoying business of vaguely remembering a squib bearing on the problem at hand but being unable to locate it when it is most needed.

These factors led us, in 1933, to publish a collection of the best ideas, schemes and methods offered by *QST* contributors during the three years prior to that date. The first edition of *Hints and Kinks* was well received and established definitely the value of a single grouping of selected "experimental expedients," carefully classified and arranged. In 1937 a second volume of *Hints and Kinks* was published, containing a larger and more comprehensive collection of new ideas. The success of this second edition motivated the publishing of equally popular third, fourth and fifth volumes in 1945, 1949 and 1954, respectively.

Since the war — and especially because of the advent of television — much development of newer tubes, circuits and constructional practices has occurred. In addition, amateurs have found wide application in their stations for the large variety of war-surplus equipment which has made its appearance. These trends, of course, have been faithfully recorded in the pages of *QST*. Accordingly, this sixth volume of *Hints and Kinks* has been assembled to correlate in easy-reference form the best of these ideas. The material should suggest many intriguing possibilities for putting back to work older apparatus now gathering dust in cellars and attics. Above all, it should enable each of us, in one way or another, to increase the efficiency of our present-day stations.

We express our thanks to those amateurs whose willingness to offer the result of their efforts to the fraternity as a whole has made this publication possible.

A. L. BUDLONG
General Manager, A.R.R.L.

West Hartford, Conn.

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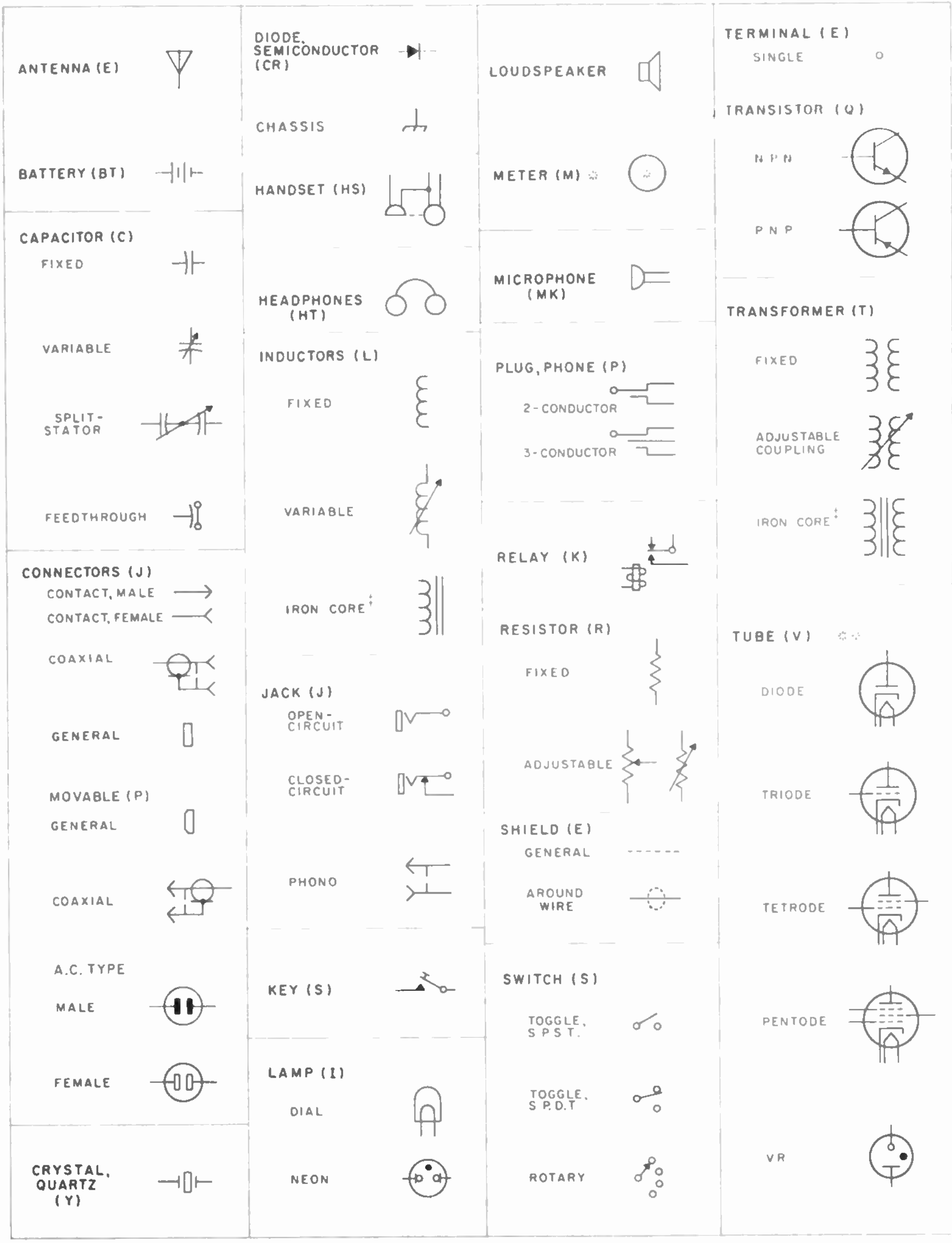
SCHEMATIC SYMBOLS USED IN CIRCUIT DIAGRAMS



Where it is necessary or desirable to identify the electrodes or capacitors, the curved element represents the *outside* electrode (marked "outside foil," "ground," etc.) in fixed paper- and ceramic-dielectric capacitors, and the *negative* electrode in electrolytic capacitors.

In the modern symbol, the curved line indicates the moving element (rotor plates) in variable and adjustable air- or mica-dielectric capacitors.

In the case of switches, jacks, etc., only the basic combinations are shown. Any combination of these symbols may be assembled as required, following the elementary forms shown.

1. Hints and Kinks . . .

for the Workshop

NEW LIFE FOR WORN SOLDERING-IRON TIPS

SOLDERING-IRON tips that have been subjected to prolonged service usually become poor conductors of heat. This condition may be remedied by cleaning away the oxide that has formed between the tip and the heating compartment of the iron. However several such treatments ordinarily reduce the diameter of the tip excessively and render it completely useless.

One method of extending the life of a tip that has been cleaned and recleaned to a state of apparent uselessness is to wrap it in a strip of flashing copper. The tip should be thoroughly cleaned before the wrapping is applied, and the fit between tip, copper and the heating barrel should be as tight as possible.

— *George Grammer, W1DF*

A TIP FOR A SOLDERING TIP

TO make a soldering tip that can be used in those small out-of-the-way spots that cannot be reached with standard tips, saw off the end of a standard size tip. Drill a hole large enough to take No. 9 wire down through the center of the remaining tip. Drill another hole in the side and tap for a 6–32 set screw. Insert a piece of No. 9 wire in the center, tighten the set screw and there is your new tip.

It takes a little longer to heat up the new tip and it doesn't have the heat capacity of the old one, but for hard-to-get-at spots it does the job.

— *Ralph Arsenault, VE1AK*

SOLDERING IRON CLEANER

SOLDERING iron tips can be cleaned easily without sandpaper, files or wire brushes simply by using a Sal-Ammoniac brick. The brick can usually be purchased from hardware or plumbing supply houses. Place the hot soldering iron tip against the Sal-Ammoniac brick and the oxide coating will be removed quickly.

— *Alex Toke, K2YVQ*

HOMEMADE "HEAVY-DUTY" SOLDERING LUGS

WHEN heavy-duty soldering lugs just don't seem to be available for mobile or antenna installation work, try the following idea.

Find a piece of copper tubing having an inside diameter that will accommodate the wire to be used. Decide how many lugs you need and then cut that number of pieces — each approximately 1¼ inches long — from the tubing. Using a vise, mash flat each piece of tubing for about one half its length. After mounting holes are drilled in the flattened sections, you'll have lugs that are sturdy and easily soldered to.

— *James W. Carter, W4JAU*

SOLDERING TO ALUMINUM

CONTRARY to popular belief, it is possible to solder to aluminum. The procedure for using ordinary solder is as follows:

1) Heat the aluminum enough to melt 50–50 solder. A blowtorch or a gas range is the best source of heat for large objects. Electric irons rated as high as 200 or 300 watts will not work unless the object to be soldered to is extremely small.

2) Melt a little solder on the part to be tinned.

3) Remove the piece from the flame and scratch the solder into the aluminum with a wire brush; reheat if necessary to keep solder molten.

4) Allow complete cooling before the actual soldering operation is started.

Aluminum is ordinarily hard to solder to because it oxidizes rapidly. However, by brushing molten solder into hot aluminum, the oxide is actually removed and the solder is brought into direct contact with the metal, thus assuring a good electrical and mechanical bond. Once the aluminum is tinned it is very easy to solder.

Obviously, this process cannot be used on delicate parts or hard-to-get-at places. But it is certain that anyone who does much work with aluminum will find the idea useful.

— *Ray Orloski, W9SED*

ABOUT SOLDERING ALUMINUM

It is perfectly possible to solder aluminum. However, aluminum soldering is generally not advisable, particularly on parts exposed to weather, as corrosion will soon set in and the joint will be destroyed. Proof of this can readily be seen by placing an aluminum soldered joint in ordinary tap water for a few days. Corrosion will become quite apparent and in many cases the joint will fall apart. If aluminum cannot be jointed by other satisfactory methods — such as riveting or welding — and soldering must be resorted to, then the joint should be completely covered with a protective paint or lacquer. — *R. W. Woodward, W1VW*

ALUMINUM SOLDER

Anyone who has tried to solder aluminum will appreciate the new "alloy" solder now made available by the L. B. Allen Co., Inc., 9329 Bernice, Schiller Park, Ill. The solder can be obtained in bars, ⅛-inch wire, or flat strips. It will readily join aluminum and common resin-core 50/50 solder will adhere to it easily.

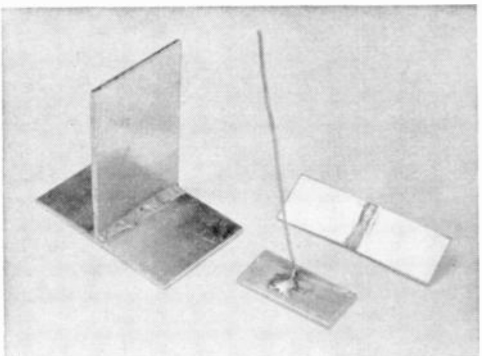


Fig. 1-1—Three typical uses for aluminum solder. The copper wire in the center was joined to the aluminum plate by first wetting the aluminum with the aluminum solder, then soldering with conventional lead solder.

The work to be soldered is first cleaned with a scratch brush or file. The solder is then applied to the aluminum surfaces which are heated by a soldering iron or small torch. When the solder melts, it should be rubbed thoroughly into the surface of the aluminum. This rubbing process tins the aluminum with a rough coat of solder. Once the tinning coat has been applied, the aluminum pieces may be joined by sweating them together.

For those interested, information on the development of this alloy solder for aluminum can be found in the May 1958 issue of *Bell Laboratories Record*. — *B. L. Hinnant, W4RJ*

SOLDERING AND SOLDERING ACCESSORIES

One of the petty annoyances in coil winding with cotton and silk covered wire is frayed insulation. A wire having frayed insulation is difficult to poke through a hole in a coil form, and loose and rumpled insulation certainly does not enhance the appearance of the finished product.

By melting solder directly over the point where the wire is to be cut, sufficient resin will be saturated into the insulation to hold it in place while the cutting, dressing, tinning and soldering operations are performed.

This trick is also very effective when it is necessary to tap a length of insulated wire. The results will not present the appearance of mice having gnawed at the covering!

— *Bill Fishback, W1IKU*

HOMEMADE ELECTRIC SOLDERING TOOL

The soldering tool illustrated in Fig. 1-2 was developed for students at the New York School for the Blind. The iron receives power from a modified broadcast receiver transformer and is controlled by a foot switch. In operation, the iron is held with one hand and manipulated as pliers are handled. Materials to be soldered may be clamped together with the tool, thus leaving one hand free for holding solder. Sections of ¼-inch copper tubing have been successfully soldered with the tool.

The iron is constructed with junk-box and other readily available components. These parts are identified by the letters *A* through *H* in Fig. 1-2. The tips (*A*) are made with carbon obtained from flashlight batteries. The arms or conductors

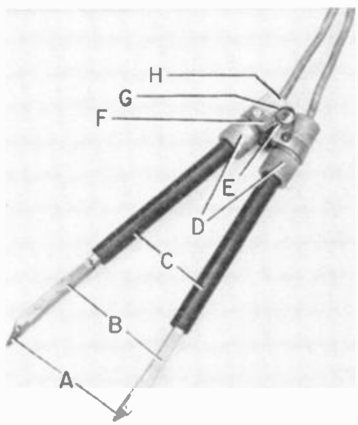


Fig. 1-2—View of the soldering tool described by W2UVF See text for details of components A through H.

(*B*) are lengths of ¼-inch-square brass or copper rod. Bakelite tubing (*C*) protects the operator's hand against burning and provides electrical insulation between the electrodes. Items *D* are copper-tubing unions. The clamps for the unions (*F*) are made from a piece of brass or copper and are joined together by a pivot assembly (*E*) such as a hinge. The spring return (*G*) spreads the arms or handles when the iron is released. The knurled pieces (*H*) at the top of the iron (as seen in Fig. 1-2) are union locking nuts that have been finished off with the aid of a lathe.

When constructing the tool, it is first necessary to drill holes in the ¼-inch rods to accommodate the carbon tips. The carbon may then be roughed to size with a hack saw and file. The shank that will be force-fitted into the rod may be conveniently turned down by rotating the carbon in an electric drill and working the material with a file.

The bakelite covering for the rods must extend straight up through the copper unions if electrical insulation is to be provided. The inside diameter of the tubing should fit snugly over the square rods so that the latter will actually be clamped in position when the unions are tightened around the bakelite. Leads made with No. 8 flexible wire should be attached to the top end of each rod. The leads should be long enough to reach down to a foot-operated control switch. Electric-range cable is one good source of flexible lead wire.

The transformer used here at the school is an old b.c. receiver transformer having all of the original secondary windings replaced with a single winding that delivers slightly over 3 volts under load. Because the new winding must carry considerable current, it is made with a conductor consisting of three lengths of ½-inch shield braid connected in parallel. Actual specifications for the secondary will depend on the type of transformer undergoing modification and must be determined experimentally.

The foot control should be a high-current push-type switch, mounted on a slightly elevated board. A 3-inch "T" hinge, arranged to swing over the switch push button, can be used as a convenient foot pedal.

Heat should not be applied to the iron until the units requiring solder have been clamped between the electrodes. Of course, excessive pressure on the electrodes will break the carbon tips. After the solder has been applied, the tool may be used as a clamp while the solder sets.

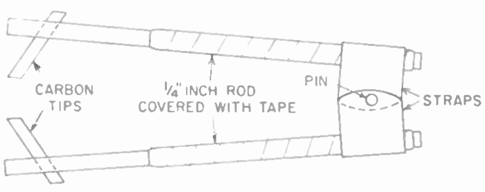


Fig. 1-3—A simplified version of the electric soldering tool

A simpler version of the iron can be readily visualized. One extremely simple model would use ordinary tape for insulation, and a strap-and-pin assembly as shown in Fig. 1-3.

— *Harold C. Dressel, W2UVF*

SOLDERING TAPS ON SMALL SPACE-WOUND INDUCTORS

It is always a nerve-racking chore to solder taps on small space-wound inductors without soldering adjacent turns together. Since commercial air-wound coils are widely used, the following hint may be of value to many.

The idea is to isolate the selected turn on which the tap is to be attached. This can be done quite effectively by inserting ½-inch wide strips of Reynolds Aluminum Wrap on either side of the tap point. The aluminum foil keeps the solder where you want it, protects the supporting bars by rapid dissipation of heat, and prevents that *messy* appearance that usually goes hand in hand with the operation. The strips can be removed with ease after the solder has hardened.

— *Ray Naab, K2YCL*

SOLDERING TO SHIELDED WIRE

While soldering TVI-suppression capacitors to the metallic braid of shielded wire, I burned the d.c. insulating coating so badly that it later failed. In replacing the wire, the following step-by-step procedure was employed as a preventive measure against renewed breakdown.

1) Cut the wire to size.

2) Slide the shielding out over one end of the wire for an inch or so.

3) Cut off the protruding shielding.

4) Slide the shielding out an additional ½ inch.

5) Insert a rusted nail or spike (diameter depends on the i.d. of the shielding) into the protruding shielding.

6) Wrap capacitor lead tightly around this end of the shielding, and solder.

7) Slide the shielding back on to the wire and repeat Steps 4, 5 and 6 at the opposite end.

8) Center the shielding, strip d.c. insulation from ends of inner conductor, and solder capacitor leads to wire.

This neat and safe way of soldering to shielded wire may be modified slightly to take care of connections to be terminated at grounded soldering lugs.

— *Francis J. Maier, K2BSZ*

REVERSING THE HEAT-CONTROL SWITCH OF WELLER SOLDERING GUNS

The newer Weller soldering guns (Type D-550) with dual-heat range have a switch action that is very light. The manufacturer, quite reasonably, points out that high heat should be used only intermittently. Unfortunately, the weight of the gun *vs.* the switch action combines to make it just a little difficult to refrain from pulling the trigger into the second (high-heat) position.

It is relatively simple to remove the case and rewire the switch. There are two terminals on the upper half of the switch and one on the lower part. Reversal of the upper connections will provide high heat on the first position and low heat with the trigger full on.

The change allows the gun to be firmly grasped and the trigger firmly pulled all the way on as the work is begun. Momentary release (partial) of the trigger raises the heat quickly and easily.

— *William H. Fishback, W1IKU*

MISCELLANEOUS SOLDERING HINTS

The problem: Field repair of a broken receiving antenna without having access to 115 volts a.c. for a soldering iron.

Solution: After cleaning the ends of the wires and looping them together, the joint was wrapped with solder that had been flattened with a hammer. The solder was then melted with a small torch, in this case an ordinary match!

Not the most highly recommended method of making an electrical joint, but certainly one worth remembering when an emergency arises.

— *Robert Carpenter*

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One simple method of preventing damage to a polystyrene coil form during soldering is to insert the form in an inexpensive wafer socket before applying heat from the iron. The socket does carry off some of the heat that would otherwise reach the prongs, but it makes up for this by maintaining the prongs in perfect alignment.

Here at WØSGG, we mount the socket in a sheet of material that can be clamped in the bench vise, thus taking care of the problem of holding the coil form while working on it.

— *Otto Woolley, WØSGG*

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Here is another method of protecting polystyrene coil forms against heat.

When ready to solder, stand the form on its end with the prongs sticking up. Wrap a piece of half-inch masking tape around the form with its uppermost edge protruding up over the prong end by approximately 3/16 inch. Using a teaspoon, fill the walled-in area around the prongs with water.

You can now apply heat and solder to the prongs without too much danger of the form melting and the prongs becoming misaligned.

— *Alexander McGlashan, K2GIX*

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A tinned copper wire extension added to the regular tip of a gun type iron will facilitate soldering in some seemingly inaccessible places.

Clean and tin the wire extension and then bend

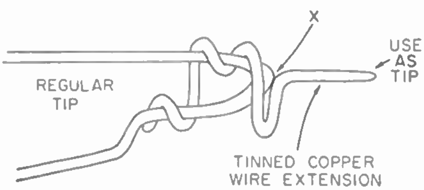

Fig. 1-4—Sketch showing how W5CYF extends the usefulness of a soldering gun by extending the length of the tip.

it tightly around the main tip as shown in Fig. 1-4. Make very sure that the tips are clean and in good contact at point marked X, and add a little solder at this junction to assure maximum transfer of heat.

The extension may now be bent into a shape best suited for the job. Of course, the wire will not transfer enough heat for heavy soldering operations, but it does permit doing many light jobs located in hard-to-get-at spots.

— *Edwin B. Robertson, W5CYF*

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A handy *unsoldering* accessory is a tool made from an old hacksaw blade. The surplus scavenger will find it practically indispensable and, if he has a power grinder available, it can be made in a few minutes.

The shape of the *unsoldering aid* is shown in Fig. 1-5. Remove the teeth from the blade while the grinder is turning over and, of course, make the tool long enough to permit a good grip. Adhesive tape of one type or another may be

Fig. 1-5—An illustration of the unsoldering aid suggested by W7JJP. The tool is made from a hacksaw blade.

used to cover the handle part, but do not cover up the hole at the grip end. Just remember to use that hole to good advantage — slip it over a nail driven high in the wall — if you have any junior ops that can creep into the workshop!

— *Rudy Erickson, W7JJP*

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When removing the base from a plug-in coil, tube, or multiwire connector, it is always helpful if the prongs involved can all be unsoldered at the same time. Use of a homemade ring tip such as illustrated in Fig. 1-6 will allow all prongs to be heated simultaneously.

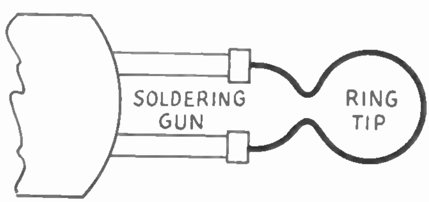

Fig. 1-6—Illustration of the ring tip used by W1MWO for simultaneously unsoldering a number of base prongs.

The ring tip is made with tinned No.12 or 14 copper wire. The loop should be just large enough in diameter to encircle the ring of prongs that require heat, and the leads to the soldering gun should be as short as possible.

This method can also be used to unsolder canned components by forming the tip properly.

— *Harry Star, W1MWO*

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The accompanying photograph, Fig. 1-7, is an open-for-inspection view of a soldering aid that has seen factory use for the past four years. The aid has so speeded soldering operations that we simply *litter* the bench with them so that whenever we reach for solder — it's there.

The aid consists of small diameter solder wound on the film spool of a 35-mm. film cassette. Up to

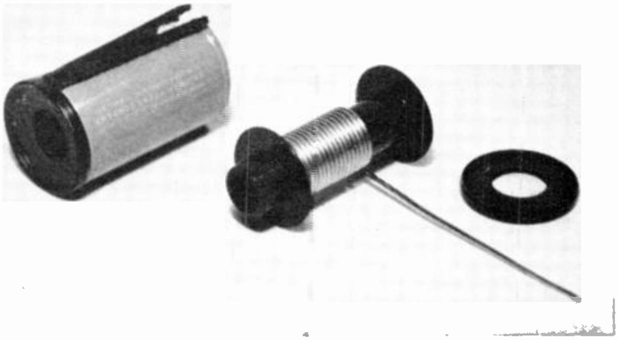

Fig. 1-7—An open-for-inspection view of the soldering aid made from a 35-mm. film cassette. WØOJS gives construction details in the text.

four layers of solder may be wound if a 36-exposure cassette is used. When reassembling the unit, make certain that the solder feeds through the velvet lined slot properly by aligning the slot with the solder lead. Otherwise the solder will not release easily. A small hole is drilled in the spool to hold the starting end for ease of winding.

Cassettes may be obtained from some film processing companies at no cost because they are not normally reused after the film is developed.

Incidentally, Kester Company puts out an excellent booklet on the subject of soldering. A copy makes good reading for anyone interested in the proper application of solder.

— James R. Grace, WØOJS

CUTTING COIL STOCK

THE USE of a small saw to cut Miniductor or Air-Dux is not very satisfactory because a considerable length of the coil is damaged. A hot razor blade may be used to cut even the smallest coils with no damage to adjacent turns. A single-edged blade is clamped in a bench vise. Paper or tape should be used to reduce heat loss to the vise. The tip of a soldering gun or iron is applied to the side of the razor blade while one of the plastic rods of the coil is pressed gently against the cutting edge. After cutting all of the support bars, the two parts of the coil can be separated far enough to cut the wire with diagonal pliers.

— E. P. Smith, W8JYY

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THE difficult task of cutting fine pitch Miniductors can be easily accomplished by breaking a discarded razor blade in half and fastening

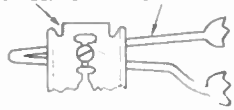

Fig. 1-8

one half of the blade to the tip of a soldering gun as shown in Fig. 1-8. Slip the blade between the turns to be cut and switch on the soldering gun. As the blade warms up it will cut through the plastic. Don't allow the tip to remain hot too long as this will melt the plastic and loosen adjacent coil turns. Incidentally, for safety's sake, hold the razor blade in a vise and break it with pliers.

— E. A. Sahm, W5FFE

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CLOSE-SPACED commercial coil stock can be cut without damaging adjacent turns by simply using a length of fine wire, a soldering iron, and a pair of long-nose pliers.

The wire used should be smaller in diameter than the spacing between turns. Loop it around a support bar as shown in Fig. 1-9 and then twist

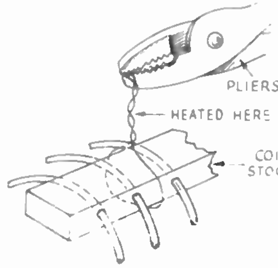

Fig. 1-9—Sketch of W7WFC's "hot wire" method of cutting coil stock. Heat from a soldering iron is applied to the pigtail as indicated.

the ends into a pigtail. Grasp the free end with a pair of long-nose pliers and apply heat from a soldering gun at the point indicated. Pull the heated wire through the melted support bar, and then repeat the operation on the other three supports. Clip the two sections apart with a pair of cutters and the job is finished without strain.

— Dale E. Miller, W7WFC

TAPPING HOMEMADE COILS

ONE neat and simple method of providing taps on hand-wound coils is to form, wherever a tap is necessary, a small tightly coupled loop in the wire. After the loop has been cleaned and tinned, the winding may be continued.

— Harold Morris, W4VUO

TAPPING CLOSE-WOUND COILS

Putting a tap on a Miniductor coil whose turns are spaced rather closely together can pose somewhat of a problem. For example, a No. 20 wire will not pass between the turns of a coil of No. 24 wire wound 32 turns per inch. A solution is to flatten the end of the wire used for making the tap. This can be done by putting the wire on a hard flat surface and pounding it flat with a hammer. The wire can easily be flattened to a thickness of a few thousandths of an inch so that it can be wrapped around a coil without shorting adjacent turns. The wire can be annealed to its original pliability by momentarily heating it red hot over a flame and allowing it to cool slowly. After cleaning the wire with steel wool it can be soldered in place easily; small strips of aluminum foil alongside the tap will keep the solder from running to adjacent turns.

— *Leo B. Weiner, W3LOS*

MOUNTING AND TAPPING B & W MINIDUCTORS

Nearly all users of B & W Miniductors mount these small ready-wound coils out in the open without regard to mechanical protection. In cases where the latter is desirable, it is suggested that the inductors be slipped inside of regular coil forms. The Amphenol types 24-4P, -5P and -6P will accommodate the 1-inch diameter coils and several manufacturers make forms that will enclose the ½- through ¾-inch diameter units. In most cases, it is necessary to round off the outside surfaces of the coil support bars (use fine sandpaper) before the Miniductor can be slipped into the form.

Another method of mounting Miniductor is shown in Fig. 1-10. The protective covering for the coil is a transparent case used originally by a

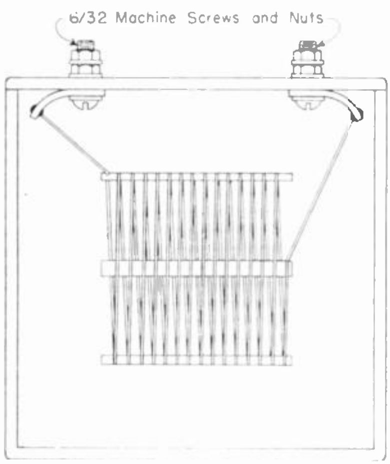

Fig. 1-10—B & W Miniductor mounted in a transparent parts container.

manufacturer (Walsco) as a container for hardware and small radio parts. This method of support is especially effective and convenient because it permits chassis or panel mounting, provides good mechanical protection and prevents the accumulation of dust around the turns, support bars, etc.

Taps easily can be soldered to Miniductor by using small wire — No. 36 does very well — and

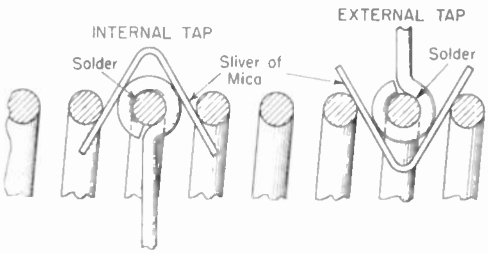

Fig. 1-11—CP1BK suggests the use of small wire and a mica sliver when soldering taps to B & W Miniductor.

a sliver of mica. Fig. 1-11 shows how the mica can be used to protect the winding during the soldering operation and to prevent shorts between the tapped and adjacent turns.

— *CP1BK*

COIL SHIELDING HINTS

The aluminum containers used for packing 20- and 36-exposure 35-mm. film make excellent shields for miniature plug-in coils. The hump in the screw cap can be pressed flat with any blunt instrument. Attach this cap to the chassis along with the coil socket. The aluminum cover may then be screwed in place over the coil making a solid installation, both electrically and mechanically. The appearance of the assembly leaves nothing to be desired.

If you are not lucky enough to have a spare packing can or two on hand, you may be able to secure a small supply from a local film concern.

— *Stanley P. Guth, W7KGF*

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Some of the more expensive cigars come in aluminum humidors which, when cut down to size, make fine shields for small slug-tuned inductors. The removable cap for the case is drilled or punched at the center so that it may be fastened to the chassis along with the coil. A hole should be placed in the top of the shield so that the coil may be tuned after the shield is mounted in place.

— *Ernest A. Coons, W1JLN*

HANDY COIL WINDER

The inner cardboard tube from bathroom tissue rolls makes a snug fit over the top of a 45 r.p.m. record player spindle and thus makes a handy method for winding coils. The speed is a convenient one and will make short job of the winding.

Multilayer or scramble-wound coils with a large number of turns may be counted approximately by using the second hand of a watch after calculating the number of turns per second. If the wire is large enough in diameter to stand the strain, tension pay be put on the wire to slow down the motor for slower and tighter winding.

— *L. E. Copleston*

MAKING SLUG-TUNED COILS FROM COAX

TUNABLE coil forms for v.h.f. and u.h.f. converters or transmitters can be made from scrap pieces of coax cable, such as RG8/U or RG87/AU. The outside shield and inner conductor are removed and the end product is a polyethylene or teflon tube with an o.d. of 0.3 inches and an i.d. just large enough for a 6-32 tap. The plastic tube can be cut with a tube cutter or a small hack saw to any convenient length. The 6-32 thread is tapped clear through; this allows you to fasten one end to the chassis with a short screw and a star washer to prevent turning. The brass screw changes the inductance enough to shift the frequency a few megacycles. The wall thickness is about 0.1 inches which allows a small hole to be drilled between the outside wall and the center. Choose a drill to obtain a snug fit for the wire being used.

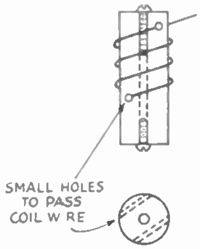


Fig. 1-12—Sketch showing the slug tuned coil made from a piece of coax.

— *James Theodore, W7LJA*

MAKING FARADAY SHIELDS

THE construction of Faraday shields can be simplified by using materials included in etched-circuit kits. The desired shield is drawn on a piece of copperclad phenolic using the special etch-resistant ink. Etching solution is then used to remove the unprotected copper, leaving the shield ready for easy mounting.

Incidentally, most mail-order houses list the kits under the *printed circuit* heading of their catalogues.

— *E. Laird Campbell, W1CUT*

COIL WINDING HINT

THE spacing between turns of homemade solenoid-type inductors can frequently be controlled by using ordinary sewing thread as a spacer. Naturally, the diameter of the thread should be equal to the desired spacing between turns. Usually, thread suitable for the purpose can be found either in the XYL's sewing cabinet or at the local dime store.

When employing this old construction hint, first coat the coil form with a thin layer of coil dope. Allow the dope to dry until "tacky" and then wind the required turns of wire. Space the turns with a winding of thread. Carefully remove the layer of thread after the dope is completely dry.

The inductor may then be covered with a light coating of dope. Avoid using an excessive amount of dope because a heavy, slow-drying application may cause the turns of wire to slip out of position.

— *J. Herm Rickerman II, K2HXP*

VOLTAGE CHANGE NOMOGRAPH FOR ELECTROMAGNET COILS

THOSE who like to rewind d.c. relays, solenoids, transformers, motors, or generators to operate on a new voltage and current will find the nomograph in Fig. 1-13 a time saver.

The first three columns are for dividing the present operating voltage by the desired voltage. The right-hand three columns are for multiplying the cross-sectional area of the present wire by the voltage ratio to give cross-sectional area of the desired wire. By choice, the scales on the wire columns are given in AWG gauge and inches diameter rather than in cross-sectional area.

Example:

On hand —

24-volt relay wound with No. 26 wire.

Problem —

To find wire size to rewind relay for 12 volts.

Procedure —

1) Under present volts, mark 24 volts.
2) Under desired volts, mark 12 volts.
3) Draw line through 24 and 12 volts to ratio column.
4) Under present wire, mark No. 26 wire.
5) Draw line through ratio and No. 26 wire to desired wire column. Read No. 23 AWG gauge, or .023-inch diameter wire.

With this change in wire and voltage we get: one half the voltage, twice the current, one fourth the resistance, two times the cross-section area of wire and one half the turns (assuming same winding space filled).

— *Guy Buckner, W5VGK*

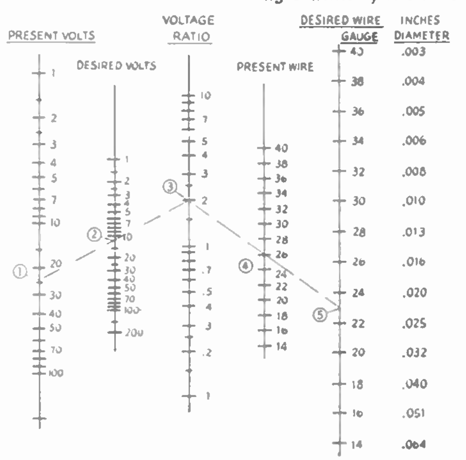


Fig. 1-13—Voltage Change nomograph for electromagnetic coils.

ALUMINUM FOIL TEMPLATES

Chokes, transformers, etc. — especially surplus brands — are frequently housed in complicated castings with mounting holes at the bottom that seem to have been laid out any-old-how. This type of construction usually presents a problem when the time comes for laying out the chassis.

One solution is to take a sheet of aluminum foil such as Reynolds Wrap and lay it flat over the mounting surface of the component. Gentle rubbing with a fingertip will then bring out the position of the mounting holes as well as the outline of the casting. The template may then be trimmed down to size with a razor blade, transferred to the chassis, and the mounting hole locations spotted with a scribe or center punch.

Credit for this technique goes to the small boy observed "making money" by rubbing a tinfoil wrapper placed on a fifty-cent piece.

— *John Paddon, VE3VC*

ANOTHER USE FOR ALUMINUM FOIL

Here is an idea which I found in the September, 1955, issue of the *P. F. Reporter.*

When doing touch-up painting or some similar small job, press some aluminum foil (such as Reynolds Wrap) into a cup or container and paint from this. When finished, the excess paint can be poured back, and the foil thrown away, leaving a clean container and much less mess. It also works when cleaning brushes.

— *R. L. Ellis, W5YVQ*

USING "SARAN WRAP" IN THE SHACK

A simple, inexpensive and effective protective cover for ARRL certificates, FCC licenses, QSL cards, etc., can be made with Saran Wrap. Cut a section of this transparent plastic food wrapper to a size slightly larger than the area to be covered or protected. Then take a piece of cardboard and cut it exactly the same size as the certificate, license, card or what have you. Now, sandwich the item to be protected in between the Saran Wrap and the cardboard backing. Fold the transparent wrapper over at the edges and then use Scotch Tape to bind the loose ends to the cardboard backing.

— *Charlie Tiemeyer, W3RMD*

REMOVING PAINT FROM PANELS

Acetone is useful in removing paint from a panel and chassis when a tight metal-to-metal r.f. seal is needed. Use only enough acetone to remove the paint in the desired area. Several applications of small "doses" on the selected area seem to work better than a single soaking on the entire panel.

Acetone is flammable so safety precautions should be observed during the entire cleaning process. Also, avoid breathing the fumes from the acetone and do the cleaning in a well-ventilated area.

— *Nelson Bigelow, jr., W5HQL*

ALUMINUM WORKING HINT

Rubber feet for chair legs, which can be purchased cheaply at any variety store, are very handy in working aluminum.

When fitted over a hammer head, as illustrated in Fig. 1-14, the foot enables aluminum to be bent and shaped without scarring or ruining the

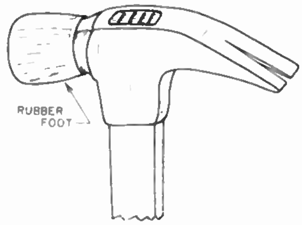


Fig. 1-14—W5YVQ slips a "rubber foot" over the head of the hammer when the tool is used for forming aluminum.

finish. The small initial cost will be repaid many times over in neater work.

These rubber feet also make a handy hot tube puller, and they are flexible enough to be used for several sizes of tubes.

— *R. L. Ellis, W5YVQ*

CLEAR PLASTIC REFINISHING

Restoration of transparency and lustre to scratched or fogged clear plastics is easily done by going over the surface of the plastic with fine grade steel wool. Use fast light strokes until the entire surface is matted. Don't concentrate on individual scratches; bring the entire surface down to the level of the deepest scratch. After the surface is leveled and evenly matted, apply ordinary household silver polish cream and rub lightly with the finger tips or with a piece of fine chamois. A few minutes of light rubbing will make the plastic as clear as glass.

— *John B. Ferguson, jr., W3AEV*

GRAPHITE AS A LUBRICANT

Powdered graphite, obtainable in tube form from most auto stores, makes an ideal lubricant for panel bearings, rolling contacts of rotary inductors, and other control mechanisms that become squeaky or binding after a period of use. Graphite is also a good conductor and therefore will not adversely affect the operation of a circuit if, during application of the lubricant, it is allowed to make direct contact with capacitors, coils, etc.

— *Wm. C. Martin, W6PLK*

LUCITE REPLACEMENT FOR WINDOW GLASS

A sheet of 1/8-inch lucite, cut to size and used as the replacement for a cellar windowpane, provides an easily worked surface for mounting feed-line feed-through insulators, etc. Mount the lucite in place with regular glazier's tacks and putty. Save the window glass for the day when it becomes desirable to return it to the frame.

— *E. M. Fry, K2CW*

UTILIZING BURNT-OUT METAL TUBES AS CABLE PLUGS

EXCELLENT cable connectors can be made from tubes such as the 6H6, 6C5, etc. First, pry the metal shell loose from the base of the tube. Then remove the glass and metal components from the shell and unsolder the leads which connect to the base prongs. Drill a hole for a rubber grommet at the end of the shell and slip the grommet in place. After the cable has been passed through the grommet and the ends soldered to the base prongs, place the shell back on the base and crimp it securely in place with pliers or other suitable tool.

— Peter Baghdasarian, W1YHU

COLOR-CODE REMINDER

MANY of the sentences used for remembering the resistor color code are not exactly printable. However, *Radio ZS* for March, 1954, carried one that is worthy of being repeated for the benefit of anyone who finds only occasional use for the color code. The sentence, "Better Be Right Or Your Great Big Venture Goes West," supplies in correct order the necessary reminders for Black = 0, Brown = 1, Red = 2, etc.

— Perry F. Williams, W1UED

USING RUBBER GROMMETS AS RUBBER FEET

AN easily installed substitute for bumper feet is a set of rubber grommets mounted in the usual manner where the feet are desired. This idea works well on metal cabinets, chassis bottom covers, etc. Frequently, the grommets will give more "slip-proofing" than standard rubber feet!

— Merritt F. Malvern, W2ORG

ANOTHER USE FOR THE MOTHBALL

THE silver-plated contacts of components — switches, relays, etc. — headed for a rest in the junk box may be protected against tarnish by dropping one little mothball into the storage compartment. You will appreciate how well this stunt works when you next solder to the terminals of a component so protected.

— Neil Johnson, W2OLU

EASIER REMOVAL OF BATTERIES FROM HOLDERS

PENLIGHT cells in test instruments or transistor devices are sometimes difficult to remove from the battery holder for replacement. The designer's success in tucking the batteries into a recess, or out-of-the-way corner, is least appreciated at that moment.

Before slipping a replacement battery into place, wrap a strip of plastic electrical tape around it near one end (to clear the clip in the holder). Bring the ends of the tape together to form a projecting tab about a half-inch long. This tab is easily grasped with pliers or fingers, the next time the battery needs removal.

— Edmund B. Thompson, KØLLJ

PLASTIC STORAGE BINS

THE small plastic boxes such as the ones in which General Cement Company packages small hardware and parts sometimes become a problem when scattered around the workbench. These can be cemented together side by side in units of six and then they become handy permanent storage units. Use a plastic solvent such as ethylene dichloride for cementing. If the boxes are narrower at the bottom than at the top a thin plastic skin can be cemented along the bottom edge.

Ethylene dichloride is an excellent solvent for cementing all types of plastic, even where acetone will not work.

— Don Maxwell, W8FQS

STORAGE RACK FOR SPOOL-WOUND WIRE

THE round slender type of curtain rod that is available from most dime stores and hardware concerns makes an ideal rack for spools of wire. One or more of the rods may be easily mounted on the workshop wall, under a table or bench, or on the inside of a closet door.

— Thomas Skopal, W3WJN

WIRING ASSIST

WHEN doing construction work, make a sketch of the original schematic diagram and run a red pencil over the lines of the circuit as each part and wire is put in place. This will help to prevent wiring mistakes and will simplify the wiring of a complicated circuit. Furthermore, it tells at a glance what wiring has been done and what wiring has yet to be done.

— R. L. Ellis, W5YVQ

MODIFYING UNDERSIZE SURPLUS PHONE JACKS

UNFORTUNATELY, many of the inexpensive surplus phone jacks have too small a bore to accommodate a standard size phone plug. An easy way to convert these cheap but undersize jacks into useful equipment is to mount them firmly in an old chassis and then redrill the bore with a ¼-inch drill. After this simple operation, behold, a standard jack!

— Rev. Michael Windolph, W9NEL

PREVENTING WEAR ON PANEL FINISHES

AFTER several months of operating some new equipment, I noticed a shiny circle appearing on the panel behind a frequently-used control. Unwittingly, I had allowed my finger to drag on the panel as I operated the control and had worn the paint surrounding the knob.

My remedy was to drill a hole in a thin piece of clear plastic and slip it onto the panel behind the control. The plastic protects the paint but allows the lettering around the knob to be seen. It's a good idea to apply this scheme to all controls and switches that are used repeatedly.

— Ronald Phoenix, W9HFN

GROUNDING SHIELDED LEADS

A NEAT and effective method of anchoring and grounding shielded leads at through-chassis points is shown in Fig. 1-15. Section A of the drawing shows how a shakeproof washer is drilled or reamed to fit around the shield braid. The braid is fitted with a small collar as indicated in B, and is then slipped into the lug and soldered as shown in C. The wire is then pushed through a chassis hole of appropriate size, and the lug is bolted down with a machine screw and nut as illustrated in section D of the sketch.

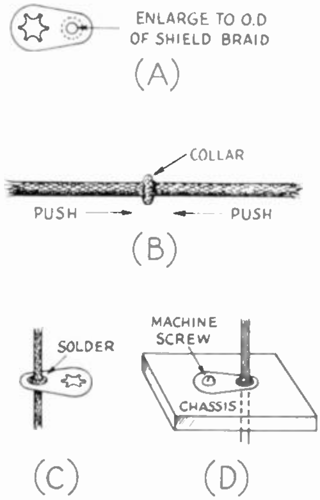


Fig. 1-15—Illustration of the method of grounding shielded wire at through-chassis points.

If the wire is to be unshielded after it enters the chassis, simply clip the braid at the point of entry and solder it to the top side of the lug.

— *Herbert Wade*

FLEXIBLE SHIELDING FOR CABLES AND JOINTS

CUSTOMARY methods of shielding fall short of the requirement when a shielded cable or lead has to be tapped. The following idea permits a tap or joint to be effectively shielded even when it is desirable to maintain flexibility of the conductor.

First, cover the area where the wire is exposed with thin electrical tape such as Scotch Tape No. 33. Next, cut some paper thin brass or copper sheet into ½-inch strips of convenient length. Now, "tape" the joint with the metal strip, overlapping the regular shield braid ¼ inch or so at each end of the wrap. Lightly and quickly solder the metal wrapping to the braid at each end and you have a flexible shielded joint.

— *George F. Reynolds, VE4AG*

PREVENTING R.F. LEAKS WITH ALUMINUM FOIL

ORDINARY aluminum foil — the kind that the XYL uses around the kitchen — can be used to seal up cracks or holes that must be covered in the interest of good shielding. Merely cut the foil into ½-inch strips of proper length and seal it over the openings with 1-inch masking tape. It works!

— *George E. Forant, W1FOX*

CHEAP AND EASY SHIELDING OF POWER CABLES

PLATE, filament, power mains and relay control leads are expensive and difficult to shield by conventional methods. However, such shielding can often result in a substantial reduction of TVI. The idea is to slice an 18-inch roll of heavy duty aluminum foil into 2-inch-wide rolls with a single-edge razor blade. Then spiral wrap the power cables with a 1-inch overlap to provide good contact. The ends can be fastened tightly with metal cable clamps to which the grounding system is connected. This method easily accommodates wires fanned out of the cable. Lacing or spot tieing of the cable before shielding helps to make it a neat job.

It should be noted that it is essential to use heavy duty aluminum wrap because the lighter foil tears easily.

— *Jack Blindbury, W6VIO*

USING REYNOLDS "DO-IT-YOURSELF" ALUMINUM FOR SHIELDING

THE Reynolds do-it-yourself aluminum products are now available from many hardware stores. Most of the items are relatively inexpensive and some of them are ideally suited to ham-type shielding projects. Nice thing about shopping for the metal is that it is stored in "open-for-inspection" display racks — right where you can examine each piece or shape for its adaptability to a particular job. Here are three suggestions on how to use the material for shielding transmitters.

— *Ed.*

ONE form of extruded aluminum comes in five- and six-foot lengths. It is designed for those hardy souls who wish to construct their own storm sash. The strips have a groove nearly ¼-inch deep which is intended for holding glass in place. Strips of this metal can be used for holding flat shielding plates at such places as the rear of a cabinet, the top of a box, etc.

This type of strip may be fastened to three sides of an opening. A sheet of aluminum large enough to cover the opening is then inserted, slide-door fashion, into the grooves. METEX TVI-20-S electronic weatherstripping (see page 89, *QST*, September, 1953) can be sewed on the inside of the door (the side facing in toward the cabinet) at the unclamped end to prevent r.f. leakage. If the aluminum sheet is too thin to fit snugly inside the grooves, it is advisable to weatherstrip along all four sides of the door. Handles can be bolted in place to facilitate easy removal, and holes may be punched wherever ventilation is necessary.

— *H. L. Kreh, W8TCH*

THE ¾-inch aluminum angle manufactured by Reynolds may be used as corner posts for shielded chassis enclosures. But what must throw many fellows is the problem of making neat corners without special tools and with all surfaces flush.

A solution to this problem is shown in Fig. 1-16. It is believed to be the simplest possible. Note

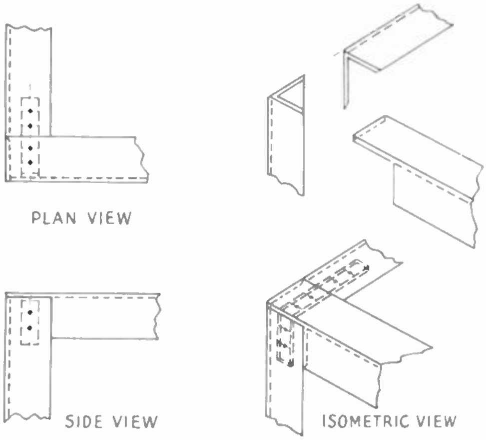


Fig. 1-16—Sketches of the corner post described by W2HCP.

that only one cut is necessary other than a square end and that is just to cut away ¾ inch of the vertical flange of the front-to-back member. A simple right angle strap underneath and suitable machine- or self-tapping screws complete the three-way joint.

— *F. Landsperger and Wendell P. Munro, W2HCP*

REYNOLDS also offers an assortment of 36 × 36-inch sheets to work with. Plain, patterned and perforated aluminum is available in this size. Although the material is quite thin, it is rugged enough for use as the flat surface of many shielded enclosures. The perforated stock is the most expensive, selling at a local hardware store for $2.98 per sheet. Plain aluminum sheets are $2.49 at the same store. — *Ed.*

CHASSIS-LAYOUT AID

THE construction practices chapter of recent editions of *The Radio Amateur's Handbook* makes the excellent suggestion that one commence construction by covering the chassis with a sheet of paper. The location of components, mounting holes, etc., is then marked on the paper so that the latter may be used as a drilling template for components to be mounted above deck. After drilling, the parts which require mounting underneath may be located and the mounting holes drilled, making sure by trial that no interference exists with parts mounted on top.

An easy way to *ensure* a good alignment of components below with those above the chassis is to place a sheet of *translucent* paper (onionskin) on top of the chassis, and mark on its top surface the position of topside parts. Then place the same sheet against the underside of the chassis, unmarked side exposed, and locate the parts to be mounted inside the chassis. Since the paper is translucent, these may be easily placed so as not to interfere with components on top of the chassis.

— *David Weinfeld*

PROTECTING CHASSIS FINISH DURING CONSTRUCTION

AN application of wax to a new chassis, especially plated ones, will prevent finger marks during construction. After the work is finished, pencil or crayon marks used during layout can be removed by applying more wax. Paraffin or candle wax, rubbed into a cloth moistened with benzine, naphtha or lacquer thinner provides a good protective coating and dries almost immediately.

— *Joseph J. Kosina, W2LGK*

[EDITOR'S NOTE: A coating of clear plastic spray may also be used to protect the finish of a chassis during construction. The protective layer peels off most easily after marking, drilling, etc., have been completed.]

REMOVING PILOT LAMPS

AN ordinary wedge-type pencil eraser, obtainable from most any 5- and 10-cent store, makes an ideal tool for removing pilot lamps which are located in hard-to-get-at places. Use the wedge end of the eraser as the handle, slip the open end (the end which normally fits over the pencil) over the lamp, and twist. It almost seems as though the eraser was designed for the bulb-removing assignment. — *Dane Terrill, W8MQS*

REPAIRING CERAMIC OR ISOLANTITE COMPONENTS

A BROKEN ceramic or isolantite component (insulator, capacitor support bar, etc.) can be quickly and effectively repaired by using Plastic Tile Cement to secure the break. The cement is sold by many hardware stores for approximately 35 cents per can. This manner of repair is not recommended for parts that will be subjected to great stress. — *Sy Greenberg, W2IHE*

STARTING HARD-TO-GET-AT MACHINE SCREWS AND NUTS

WHEN the needle-nosed pliers are too cumbersome, and the fingers are too clumsy, try starting a machine nut as follows:

Press the eraser of an ordinary pencil momentarily against the barrel of a hot soldering iron. Stick the nut to the melted eraser and then use the pencil to poke the nut in place; a screwdriver will do the rest. — *Frank Joseph, W9AOI*

— • • • —

WHENEVER difficulty is encountered in getting screws, washers and nuts into tight corners, it is possible to solve the problem by wrapping a couple of turns of masking tape, sticky side out, around the end of a pencil. Any small piece of hardware will stick to the tape long enough to allow completing the job on hand.

— *Joseph J. Kosina, W2LGK*

RESTORING BLACK CRACKLE FINISHES

Black crackle finishes can be restored to their original factory appearance by first washing with a mild soap and warm water. Apply a light coating of liquid furniture polish; let dry for a few minutes and then wipe off with a clean, soft cloth. The old panel will look as good as new. The same cleaning process works well on bakelite meter cases and knobs.

— *Sol Davis, W3WPN*

READING FADED TUBE TYPE NUMBERS

This is far from being a new idea but is presented for the benefit of the newcomers. The number stamped on the glass of old tubes is sometimes almost impossible to read. Wipe the tube clean with a soft cloth, then breathe on it as you would to clean a pair of glasses. The condensation of the moisture from the breath on the cold glass of the tube should make the number stand out plainly.

— *John McMullen, WØVJS*

ILLUMINATING METERS

A simple and effective method of providing illumination for most of the standard panel meters is to cut a small slot in the top of the meter case, as shown in Fig. 1-17, and mount a pilot lamp directly above the slot. The meter scale will have to be bent back slightly and the slot covered with transparent cellophane or plastic material to keep dust out of the instrument.

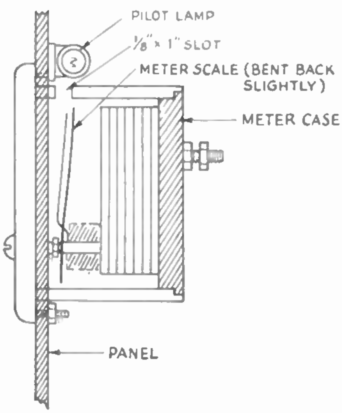


Fig. 1-17—Cross section of the meter showing special illumination slot.

— *William Vandermay, W7DET*

REMOVING STATIC ELECTRICITY FROM PLASTIC METER COVERS

A static charge, as noted on plastic meter covers of various test instruments and meters, can in most cases be greatly reduced or eliminated by cleaning the plastic meter face with a liquid detergent. Use the detergent full strength, wipe it on and off the face of the meter with a clean soft cloth — *Stuart Leland*

HANDY MOUNTING FOR THE NEON BULB

A small neon bulb may be protected against breakage by mounting it inside a plastic dental floss container (Johnson and Johnson "New Era," pocket size) as shown in Fig. 1-18.

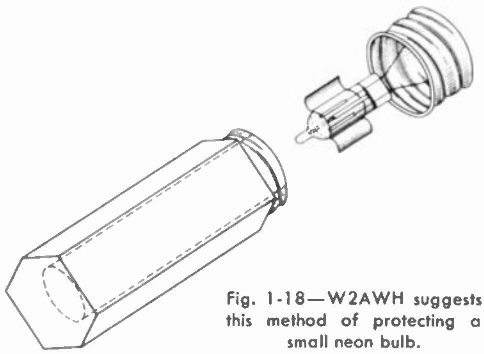


Fig. 1-18—W2AWH suggests this method of protecting a small neon bulb.

The hexagonal cross section of the case reduces the possibility of the assembly rolling off a table or bench and the length of the insulated container makes it safer to probe high-voltage circuits.

Three or four radial fins of Scotch Tape, fastened to the neon bulb, are used to center the bulb in the container. The pigtail leads for the bulb should be soldered to the inside of the metal cap of the case. The bulb, with its fins attached, is forced into the container, and the cap is screwed on. — *Yardley Beers, W2AWH*

A HANDY CONTROL-TERMINAL PANEL

The panel shown in Fig. 1-19 may be used for mounting control switches, antenna feed-line terminals, coaxial receptacles and other items. Terminals and jacks located at hard-to-get-at spots at the rear of a receiver or other pieces of equipment may be piped out to the new panel so that the connecting and disconnecting of leads and cables can be done with a minimum of effort.

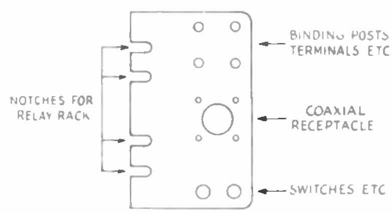


Fig. 1-19—The auxiliary panel used by W3GKP for mounting feed-line terminals, jacks, control switches, speaker terminals, etc.

The panel may be made with aluminum, bakelite, Presdwood, etc. It should be notched as shown if it is to be mounted on a relay rack or a rack-type receiver panel. The size, layout and drilling should accommodate individual requirements. Provision for extra jacks and terminals may come in handy at a later date.

— *William L. Smith, W3GKP*

CONTROL SHAFT FOR SURPLUS-TYPE APC CAPACITORS

Most of the surplus APC type variable capacitors have short shafts intended for screwdriver adjustment. Fig. 1-20 shows how a small homemade aluminum bracket and a panel-

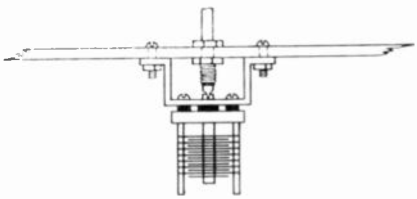


Fig. 1-20—Drawing of the bracket-bearing assembly that permits knob control of short-shaft variable capacitors.

bearing assembly can be combined to permit using a knob with these capacitors.

The panel-bearing assembly may be a standard manufactured component or it may be a makeshift affair obtained by salvaging parts from an old potentiometer or rheostat. The section of the shaft that protrudes from the rear of the panel bushing must be filed flat to mate with the slot in the shaft of the capacitor.

— *Herman W. Gross, W9ITT*

KNOBS FOR APC TYPE CAPACITORS

For years I have been looking for a method of adding knobs to the small APC variable capacitors that normally require screwdriver adjustment. A method was finally found. I cut off a ¾-inch piece of ¼-inch o.d. copper tubing and slipped it over the screwdriver adjustment shaft. After it was soldered in place, a knob could be added.

— *Stanley O. Andrews, W4AHW*

CUSTOM-MADE NAME PLATES

All you need to make attractive custom-designed name plates for the new rig are a package of transmitter decals (Tekni-Labels, Burbank, Calif.), narrow strips of aluminum, clear finger polish and a piece of crocus cloth or polishing paper.

The strips are cut to the desired width and length, a mounting hole drilled at each end, polished with the crocus cloth or paper, cleaned of abrasive dust and given a quick even coating of nail polish. After the polish dries, the decal may be affixed and allowed to dry thoroughly. Then one or two more coats of polish should be applied, each coat being given sufficient time to dry completely.

The result is an inexpensive indicator or name plate that is commercial looking in appearance. As the drying of the nail polish is tricky, since it dries so rapidly, it is best to experiment first before going into production. The instructions supplied with the Tekni-Labels should be followed closely.

— *Rev. Joseph F. O'Reilly, W9UFL*

ANOTHER METHOD OF STARTING MACHINE NUTS

I ran across an item the other day which should prove of interest to those who build or service their own gear. It is merely another method of starting machine nuts in inaccessible places, but it seems to work as good or better than any other well-known way.

To apply the idea, a piece of solder is laid across the nut and given a slight tap with a hammer. This drives the solder into the hole and against the threads holding the nut securely. The screw is then started in from the opposite side of the nut. After the screw has *started*, the solder may be released by giving it a slight pull.

This method has been used with various sizes of nuts up to and including the 1-inch type. It worked equally well in all cases.

— *Robert B. Walker, W8MIH*

ANOTHER "STARTING NUTS" KINK

When space limitations make it impossible to use either your hands or a regular tool to hold a nut while the screw is being started, try binding the nut in position with surgical adhesive tape. Punch a hole in the tape to permit the screw to pass through, and then work the tape and nut into position with the aid of a slim tool. Press the tape onto the surrounding surface, and if the screw is one that you may want to remove in the future, leave the tape in place for the next cycle.

More difficult cases can be handled by cementing the nut to a strip of cardboard. Model airplane cement or any other quick-drying binder will hold the nut firmly until the screw is started.

— *George W. Tappan, W1WOA*

A NOVEL FEED-THROUGH INSULATOR

An inexpensive feed-through insulator can be quickly made by using parts from the junk box. A polystyrene rod or the center portion of a piece of coax is drilled and tapped to take a 6-32 threaded rod. A rubber grommet of the proper size is placed over the rod as shown in Fig. 1-21.

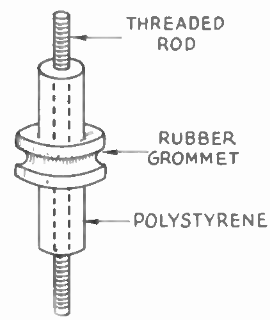


Fig. 1-21

The threaded rod may be a 6-32 machine screw with its head removed.

— *J. R. Pivnichny, KN3EOV*

DON'T CLEAN CERAMIC MATERIAL!

Keeping equipment clean plays an important role in routine equipment maintenance. However, care should be exercised when using solvents such as alcohol, carbon tet, or other wax dissolving substances around ceramic material such as steatite, isolantite, etc.

Most ceramic material used in switches, tube-sockets and the like are impregnated at the factory with a waxy substance. This prevents moisture from collecting in the small pores of the material. When this substance is removed by the cleaning solvent, the voltage breakdown point of the material is decreased, leakage may develop, and general insulating quality, especially at high frequencies, will suffer.

A COAXIAL STRAIGHT ADAPTER

The connection of two or more lengths of RG-8/U (52-ohm) coax requires the use of a PL-275 straight adapter, which is often hard to procure. On the other hand, chassis-type receptacles, SO-239, are plentiful on chassis of surplus equipment.

A very practical straight adapter can be made by removing the flanges from two chassis receptacles, either in a lathe or by means of a hacksaw, and filing flush with the diameter of the connector. The normal protruding connections are then soldered together as shown in Fig. 1-22, keeping both pieces on center line as much as possible. Next, wrap a piece of sheet metal completely around and over the gap, overlapping the start of the sheet slightly. This continues the shielded portion. Finally, solder along all the edges.

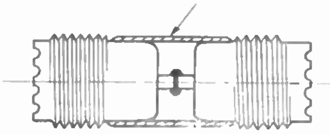


Fig. 1-22—W8HXB's coaxial straight adapter.

To facilitate soldering, the sheet can be held snugly against the connectors by winding a couple of turns of wire around the outside. The wire can be removed after the solder freezes.

— *H. W. Peterka, W8HXB*

TUNING WITH DIELECTRICS

When the plates of a neutralizing capacitor or similar tuning device approach each other, danger of a voltage breakdown increases. The introduction of a strip of dielectric material between the fixed plates increases the capacitance without necessity for moving the plates closer together.

For example, two 1-inch square plates ¼ inch apart have a capacity in air of about 0.9 μμf. Introducing a polystyrene strip in the gap changes the capacitance to almost 2.5 μμf. A piece of plate glass shoots the capacitance up to almost 6.3 μμf. The dielectric may be made adjustable or may be fixed permanently once the desired capacitance is reached. Remember, however, to choose a material that has low loss at the operating frequency.

— *Frank Cronin, W4WOB*

DRILLING HINT

When modification of a unit includes drilling holes in its steel chassis, the following trick can often save trouble that might follow after the modification is made. Insert a small magnet under the area to be drilled and, if possible, inside the chassis. The magnet will catch the steel shavings which might otherwise collect in spots and endanger the original circuitry.

— *J. Wimmer, W6RPX*

REMOVING HOT TUBES

There is nothing new about this idea but even so it bears repeating. A simple method for removing hot tubes from "hard to get at" places is to wind a rubber band around each of the jaws of an ordinary pair of pliers. This makes an excellent tool for gripping and removing the tubes.

— *Lewis G. McCoy, W1ICP*

SPARE TUBE STORAGE

To prevent those embarrassing hours of silence because of tube failures, almost every ham, at one time or another, makes some attempt to keep spare tubes on hand; some even striving to have on hand, at all times, a tested spare for each socket. These attempts usually run afoul of storage and inventory problems, so that a tube failure still results in a mad scramble for a spare.

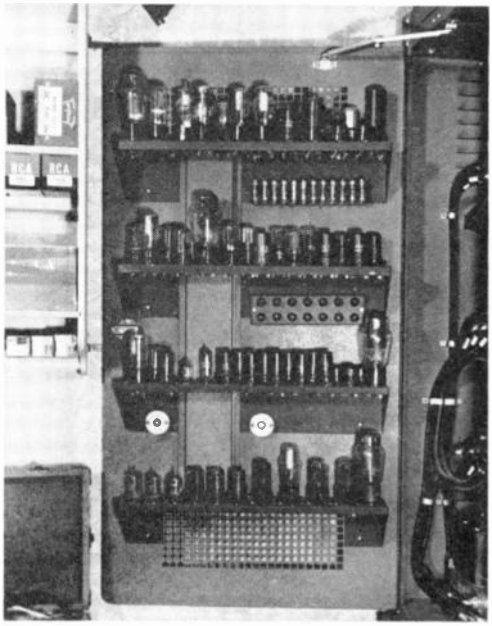


Fig. 1-23—Racks for spare tubes, spare fuses, and indicator lights mounted on rear door of rack cabinet. Two tube pin straighteners are also permanently mounted here to insure availability.

One happy solution to this problem is to store the tested spare tubes in racks, mounted on the back door of the rack cabinet, as shown in Fig. 1-23. The racks are cut from chassis bases 17 inches long and 3 inches deep, drilled for the requisite sockets, and then painted with crackle enamel to match the rack cabinet.

After sockets are inserted in the proper holes, the racks are mounted on the rack cabinet door at the approximate level of the chassis for which they hold the spare tubes, and the tubes are inserted. Small racks for spare indicator lamps and fuses are also mounted on the cabinet door, as are straighteners for tube pins, so that they are always available when needed.

By marking each socket with the designation of the tube which it should hold, inventory is a matter of seconds, as removal of a tube immediately exposes the number of the tube to put on the want list.

— *Ronald L. Ives*

USING THE COAXIAL FEED LINE AS AN A.C. EXTENSION CORD

A HEAVY-DUTY 115-volt extension cord that will reach to the top of a tower or out to the mobile rig is not always readily available when the electric drill, grid-dipper or soldering iron must be used at the outside location. If your next beam or mobile project necessitates outside use of electric tools or instruments, and if you do not have one of the relatively expensive a.c. extension lines on hand, consider using the coaxial feed line for carrying 115 volts to the desired location.

The homemade adapters that permit running 115 volts a.c. through the coax are shown in Fig. 1-24. A standard dual a.c. outlet is equipped

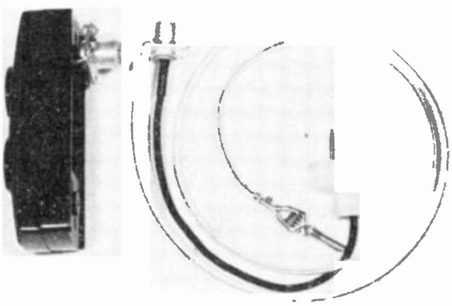


Fig. 1-24—The assembly at the left is used at the outside end of the coaxial feed line when the latter is used as a 115-volt extension cord. The unit at the right is used to connect the "shack" end of the coax to a 115-volt a.c. outlet.

with a female coaxial chassis receptacle (type SO-239) as shown at the left side of the photograph. This assembly permits connection to a tool or instrument at the "work" end of the line. The unit to the right side of the illustration mates with the "shack" end of the feed line and consists of a type SO-239 receptacle, a pair of leads, a test clip and an a.c. plug. The a.c. plug shown has one of the prongs removed, but this modification is not actually necessary. Notice that the test-clip lead is connected to the outside shell of the coax receptacle. The lead connected to the center terminal of the SO-239 is terminated at one prong in the a.c. plug.

When preparing the feed line for 115-volt use *always make certain* that it is first disconnected from both the antenna and the transmitter (or antenna coupler). This will prevent the inadvertent application of power to the antenna and will thus prevent shock hazard and blown fuses. Next, connect the dual-outlet block to the outside end of the line. Now connect the test-clip lead to a *known* ground inside the shack, and then insert the one-prong a.c. plug into a 115-volt outlet. Power will now be available at the far end of the coaxial line providing the active prong of the a.c. plug has made contact with the "hot" side of the a.c. line. If power is not available at the outside end of the coax, it indicates that the a.c. plug is in contact with the "cold" side of the power line and, of course, it is necessary to reverse the plug.

If you can't talk the XYL into lending a hand inside the shack while you test for power at the far end of the line, it is a simple matter to make a one-man job out of the entire operation. Merely hang a test lamp at the output end of the line (place it where it may be seen from the shack) and then watch the lamp as you insert the plug. Color code or otherwise identify the correct plug-outlet combination so that future use of the system will necessitate no trial-and-error runs. — *Ken Glanzer, K7GCO*

SHOCK MOUNT FOR RELAYS

A SIMPLE and inexpensive method of reducing relay noise is shown in Fig. 1-25. The system shown has been used in the construction of a.c.-d.c. receivers (to mount variable capacitors) for years and, when used to support relays, reduces the sounding-board effect normally caused by the chassis or other mounting surface.

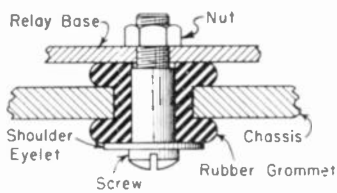


Fig. 1-25—Drawing of the rubber-grommet shock mount used by W3WPN.

Fig. 1-25 is almost completely self-explanatory. However, one precaution should be observed. Make certain the shoulder eyelet is shorter than the grommet thickness so that the grommet will be under compression when the nut is tightened. Otherwise, the cushioning action of the mounting will be impaired. Naturally, this system may be used to shock-mount tube sockets and other components. — *Sol Davis, W3WPN*

MAKING LARGE ROUND CHASSIS HOLES WITHOUT A PUNCH

There is no need of holding up work on an aluminum chassis just because punches for cutting large holes are not immediately available. Fig. 1-26 illustrates a set of four operations used here at W6GJZ whenever a large hole for a meter, tube socket, etc., is required. The steps involved in employing the system are as follows:

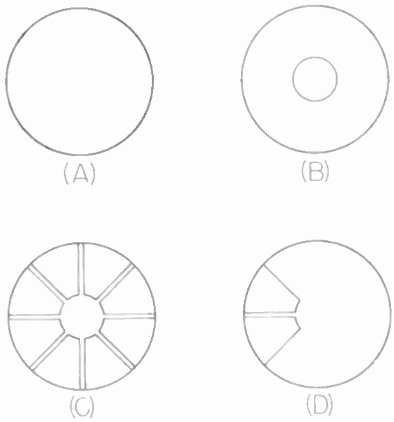


Fig. 1-26—Method of making large chassis holes recommended by W6GJZ. Operations (a) through (d) are listed in the text under the same headings.

a) Use a pair of small sharp-pointed tinsmith's calipers to scribe the chassis as shown in Fig. 1-26. Make several *round trips* so as to score the metal deeply.

b) Drill a hole at the center of the circle. The hole must be large enough to accept a hack-saw blade. A pistol-grip saw is recommended for the operation ahead.

c) Make radial cuts — the more the better — from the center hole to the scored line marking the perimeter.

d) Bend each individual tab back and forth until it breaks free. After all of the tabs are removed, finish the job with a half-round file.

An alternative, if a pair of tinsmith's calipers is not available, would be to use an ordinary pencil caliper or a circular template for marking the hole. The saw cuts could then be made to the pencil line and the tabs removed with a small sharp chisel. The metal should be placed on a solid surface as the tabs are removed and the cuts should be made well inside the pencil line. This method worked out satisfactorily on 18-gauge aluminum and required about ten minutes' work per hole. — *Dr. Russell R. Crane, W6GJZ*

DEBURRING TOOLS

Jagged burrs around screw, ventilation, bezel and socket holes are not only unsightly indicators of poor workmanship but also constitute a considerable hazard, as the burrs have and retain razor-sharp edges.

Deburring is an irritating and time-consuming job under most conditions because of lack of suitable tools. With soft metals, a knife blade is partially satisfactory, but may slip out of the hole being deburred, cutting a deep gouge in the panel, or a gash in the hand. Small hand grinders are somewhat more satisfactory, at a cost of about $25.00 each, plus about one cent per hole for wheel replacement. Metal countersinks have been used, but these, having a 55- or 60-degree included angle, ream the hole almost as fast as they remove the burr.

Quite satisfactory deburring can be done with a carpenter's wood countersink having an included angle of approximately 90 degrees. These, which come in all sizes up to about ¾ inch in diameter, are supplied with a square shank. To convert a carpenter's wood countersink into a deburring tool, grind off the corners of the shank and drive the shank into a plastic screwdriver handle from which the blade has been pulled.

Performance will be most satisfactory if the axes of the handle and of the countersink coincide. Length of the finished tool should be approximately six inches, with a tolerance of about plus or minus one inch to suit the materials available and the user's personal taste.

Larger holes are easily deburred by use of an automotive valve-seat reamer. These come with four, five, and six blades and cost from $2.00 up. No changes are needed in this tool, and those with a larger number of blades, such as six, are preferable to the four-bladed type. When only steel is to be used, an abrasive valve seater, which is merely a conical grindstone with a large included angle, such as 105 degrees, is very effective. This cannot be used with soft metals, such as aluminum, as the abrasive will plug up after deburring only a few holes.

— *Ronald L. Ives*

HANDY ADJUSTMENT TOOL

Those who have transmitters built in a one-piece cabinet know that internal adjustments sometimes can be made only by pulling the transmitter completely out of the cabinet. My Johnson Valiant transmitter has a control on the time-sequence circuit and in order to adjust this control the transmitter must be removed from its cabinet.

To overcome the above problem, I use a length of wire bent into a small right angle as shown in Fig. 1-27. The wire is small enough to go through

Fig. 1-27—K4AVU's tool for adjusting hard to get-at slotted controls.

the perforated holes in the cabinet and fits into the slot on the end of the control. The wire is used to adjust the control to the desired position. One caution: be sure the high voltage is turned off whenever the adjustment is being made!

— *Paul G. Marsha, K4AVU*

HOMEMADE WIRE STRIPPER

An old hacksaw blade, two washers, a machine screw and a nut are the only parts needed for making the simple wire stripper shown in Fig. 1-28.

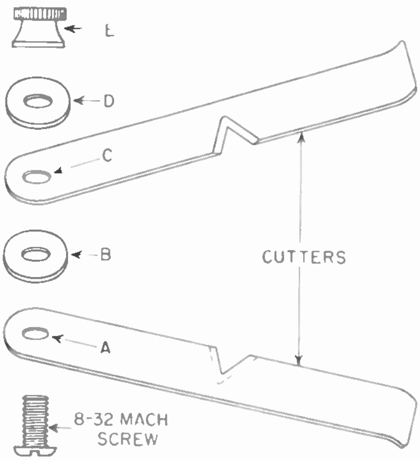


Fig. 1-28—Sketch of the homemade wire stripper. The cutters are made from an old hacksaw blade. B and D are No. 8 flat washers. A, C and E are referred to in the text.

Length of the stripper cutters may suit individual taste — anything from half the length of a hacksaw blade down to one inch or so. A miniature model with 1-inch cutters is a handy tool to carry in one's pocket.

The exploded sketch of the stripper shows the various components arranged in the order of assembly. The machine screw passes through A, B, C and D and is locked in place by E. The nut illustrated is a knurled terminal removed from a dead dry cell. In the final assembly the lead end of the machine screw is soldered to the top side of the locking nut.

The cutter members are prepared with the aid of a vise, a grinding wheel and a half-round file. The blade may be cut into sections of the desired length merely by clamping it in the vise and then bending. One edge of the file is used to cut the V-shaped cutting notches. The grinding wheel is used to remove the teeth, bevel the outside edges of the cutting slots and smooth off the open ends of the cutters. The holes at the ends of the cutters are the ones already found in the hacksaw blade. Any attempt to drill new holes with an ordinary drill will be most unsuccessful.

It is not necessary to round the ends of the cutters outward as shown. However, this finishing touch may be added by applying heat and then bending with the aid of the vise.

— *Billy E. Allen*

ANOTHER INEXPENSIVE WIRE STRIPPER

In the field of inexpensive ready-made wire strippers, the Mueller No. 27 test clip just about takes the cake. This clip — the 3-sided mesh teeth job rated at 20 amperes — sells for 11 cents (mail-order house price) and does a swell job of removing insulation from hookup wire.

— *Jack Nelson, W2FW*

DEMAGNETIZING TOOLS

Screwdrivers and other small tools which have accidentally become magnetized may be made to lose this undesirable property with the aid of soldering gun. After the trigger of the gun has been pulled to the "on" position, pass the tool to be demagnetized through the "hairpin"-shaped tip. One or two passes through the strong magnetic field that surrounds the tip will usually free the tool of bad habits such as clinging to iron filings, picking up steel wool, screws, etc.

— *Leslie E. Downs, W9YSZ*

USING TAP WRENCHES AS HOLDER FOR COPING SAW BLADES

As most constructors sooner or later find out, many chassis and panel holes are difficult to cut unless a set of fairly expensive punches is on hand. Cuts that can be made with a hacksaw or a regular coping saw assembly are usually confined to the outer edges of a large chassis or panel because of the travel limitation imposed by the frame of the saw.

One dodge around this problem is the use of a coping saw blade clamped between a pair of dime store tap wrenches as shown in Fig. 1-29. The *distance in* that can be reached with this tool is limited only by the length of one's arms. It does take a bit of practice to learn to keep the blade taut while the cut is being made, but once mastered it is possible to make the most complicated cuts.

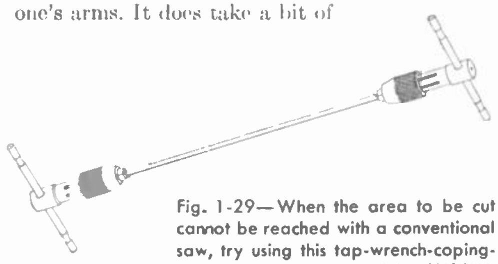


Fig. 1-29—When the area to be cut cannot be reached with a conventional saw, try using this tap-wrench-coping-saw assembly suggested by W3SUJ.

— *Dick Knoth, W3SUJ*

MEDICAL TOOLS FOR THE WORKBENCH

The act of holding the wire leads of a diode or transistor in place to absorb heat while soldering, holding a soldering iron in the other hand, and then reaching for solder with the third hand is quite a problem!

One solution is to use any of the large assortment of surgical clamps known by a variety of names: hemostats, snaps, mosquito forceps, kelly clamps. These instruments all have an automatic locking device yet have the same grasping action of pliers. They can be quite expensive if purchased new but probably can be obtained reasonably second hand or as discards from hospitals. — *Dr. Ernest S. Pentland, VE3DWP*

BASIC TOOL KIT FOR THE BEGINNER

When a newcomer starts out in amateur radio, he soon finds that one of the "must" items around the ham shack is a good set of tools. Whether he is building gear or maintaining his present equipment, there will be special tools, particularly suited to radio work, that he'll be needing in his tool box. He may get by for a while using a pair of scissors for wire cutters, or the family carving knife for wire-stripping, but sooner or later he'll find these makeshift substitutes are inadequate for the job. When that time comes, he is confronted with the problem of exactly what kind of tools he should buy.

The first item on the list should be a soldering iron. The iron to use for general radio work is a 60- or 100-watt job with a 3/8- or 1/4-inch tip (such as the Drake model 400 used in the ARRL laboratory). If you buy an iron with a larger tip, you'll find there will be many places around a chassis you won't be able to reach. Larger-sized irons and tips *are* needed when doing sheet-metal work or when it is necessary to transfer a great amount of heat to the work.

When wrapping wires around terminals or when making connections to points that are difficult to reach, long-nose pliers are a radioman's "must." Long-nose pliers are available with or without wire cutters at the base of the jaws. The cutters are of little help in cutting wires close to sockets or the chassis, but often wires will be easy to reach, and having the cutters on the long-nose pliers will save time. The cost difference between pliers with and without cutters is so slight that it is worth while to purchase those with the cutters.

When wrapping wire around terminals and then soldering, many times there are short lengths of wire protruding that must be snipped off. This is done with a pair of diagonal-cutters. With these it is possible to reach into very cramped spaces and cut wires. The three tools listed, a soldering iron, long-nose and side-cutting pliers, together with a screwdriver, are probably the most important that the amateur uses.

TABLE I-1
Beginner's Tool Kit

Electric soldering iron, 60 to 100 watts
Solder (rosin-core)
Long-nose pliers, 6-inch
Diagonal cutting pliers, 6-inch
Soldering aid (Hytron)
Screwdriver, 6- to 7-inch, 1/4-inch blade
Screwdriver, 4- to 5-inch, 1/8-inch blade
Hand drill, 1/4-inch chuck or larger
Drills, 1/8- and 1/4-inch, and Nos. 18, 28 and 33
Pliers (combination)
Pocketknife
Two large coarse files, one flat, one rat-tail
Two small files, one flat, one round
Keyhole saw (metal-working)
Hammer
Center punch
1 1/8-inch socket punch
Small paintbrush
Reamer
Carpenter's brace

A cheap paintbrush makes an excellent clean-up tool for removing bits of loose matter from a chassis or for brushing out dirt.

Small holes in metal and some insulating materials are drilled with twist drills and a hand drill. Most hand drills will only take drills up to 1/4-inch diameter and one has to look for other methods if larger holes are involved. For holes up to 1/2-inch, a common method is to start the hole with a small twist drill and the hand drill, and then finish with the large drill held in a carpenter's brace. Another, and perhaps preferable, method, is to use a reamer held in the carpenter's brace. For still larger holes, such as the 5/8- and 3/4-inch holes for miniature sockets and the 1 1/8- and 1 1/4-inch holes for bakelite and ceramic octal sockets, radio chassis punches are recommended. These punch out a clean hole as a bolt is tightened, and they work beautifully in the materials normally used for chassis material.

A hack saw, large coarse flat file, and rat-tail

Fig. 1-30—Representative group of the tools needed in a beginner's tool box. They include hand drill, twist drills, knife scale, screwdrivers, soldering iron, solder, soldering aid, files, hammer, pliers, center punch and brush.

file also are helpful for cutting and enlarging holes on a chassis.

In addition to the tools outlined earlier, Table I-1 gives the contents of a basic tool kit for the ham. An electric hand drill is a luxury unless one is doing considerable work in iron and steel, as in building an antenna tower, where it becomes a "must." However, the tools described will prove to be adequate for most jobs the newcomer encounters.

— *Lewis G. McCoy, W1ICP*

TOOLS & TRICKS — OLD AND NEW

While the abuse of tools is not a practice to be universally recommended, there are many small jobs that most hams have learned to make easier by using some tools that weren't necessarily designed for the purpose. For instance, if you have to do all your chassis work with a hand drill that won't take a drill larger than ¼ inch, enlarging holes to ½ inch can be a tedious process. But if you have a dime-store carpenter's brace, you can clamp a rat-tail file (minus the handle) in the brace and do the job easily. Simply turn the brace in a counterclockwise direction and the file will walk through a chassis as though it were cheese. You can get these files up to ½-inch diameter or more. Don't rotate it in the opposite direction, because the file will lock up in the hole and snap off.

If you have a lot of holes to tap in sheet metal, you can speed up the job of threading by using the tap in the hand-drill chuck. You will have to use a little care to avoid snapping off the tap, but if you put a drop of oil on the tap every hole or two, hold the drill steady and back it up whenever it sticks, you shouldn't have any trouble. A two-speed drill at low speed is ideal for this sort of work.

If you are making a metal box, or putting a bottom plate on a chassis, it is seldom that all of the holes in the pieces to be joined will line up accurately, making it difficult to get the screws in place. After the first screw has been started, you can line up the others by jabbing an ice pick through the two holes and prying them into line. If they won't stay in line long enough to get the screw started, use the ice pick in an adjacent hole, prying in the direction that will bring the desired holes into line. The ice pick, as well as a machinist's scriber, is also an aid in steering a nut onto the end of a screw in a place where you can't reach it with your hand. If the scriber is of the type that has one end bent at right angles, you can use the bent end to rescue the nut if it falls off. As simple an item as a pair of tweezers can save a lot of wear and tear on the nerves.

In most dime and hardware stores you can buy very cheaply a cast-iron handle that holds tapered keyhole saw blades. The teeth of the blades are fine enough so that they will cut aluminum quite readily and can be used for cutting out large holes in panels or chassis. If you want to hold the chassis in a vise while you're working on it, place a block of wood a little thicker than the depth of the chassis underneath. The jaws of most vises won't clear the chassis otherwise.

Several manufacturers have recognized the need for special tools of the gadget class in radio-assembly and repairing work. Most hams are familiar with the screw-type socket punches made by Greenlee and also by Pioneer. But perhaps you haven't noticed that they have four marks around the "cup" part that make it possible to center the punch when the pilot hole is much larger than the screw. Just scribe lines at right angles through the center of the hole and match up the centering marks on the punch with the lines on the chassis. This makes it easy to increase the hole diameter to take a five-prong socket, for instance, where an octal socket originally was mounted. The easy way to use these punches is to clamp the head of the screw in a vise and cut the hole by turning the chassis or panel instead of the screw.

Most hams working with tools know about the automatic center punch that eliminates the need for a hammer when making hole centers in metal. Simply press down in the handle and an internal spring gives the punch a kick that will go through thin aluminum if you aren't careful. The tension is adjustable.

Hytron "Soldering Aids" are fast becoming well known as indispensable tools in radio work. In case you haven't seen one, it's a harmless-looking gadget with a metal insert at either end of a wood handle. One end is forked so that it can be slipped over the end of a wire that is to be unsoldered. By guiding the fork up close to the connection you're working on, you can wiggle the wire to loosen it up without burning your fingers. It is especially effective in removing wrap-around connections. The metal fork is coated so that it won't get gummed up with solder itself and the mass is small enough so that it doesn't conduct all the heat away from the joint as a pair of pliers often does. The other end of the tool is a tapered spike that can be used to remove old solder from terminal holes. The "Aid" will be found to have many other uses — in restringing dial cords, for instance.

Most radio-parts catalogs carry a small angle-mounted mirror with a long handle that can be used dentist-fashion to get a peek at some hidden part. Some of these are illuminated with small batteries.

Most of these tools are inexpensive items and are of the sort that can take the cussing out of otherwise awkward jobs. They are well worth adding to the ham's workshop equipment.

— *Donald H. Mix, W1TS*

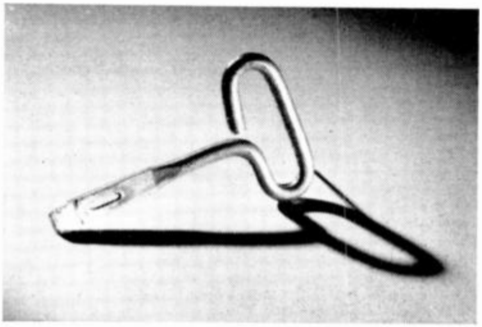
HOLE-DRILLING AID

Sometimes, while constructing or revising equipment, it is necessary to drill a hole in the chassis from the bottom since parts already mounted on the top side are in the way of the drill. I have found that a sharp hand awl or ice pick, when pressed down and rotated from the top of the chassis, will easily pierce the aluminum so that the hole can be positioned and drilled from the opposite side. This method is especially useful when a drill press is used and such components as i.f. transformers and tube sockets have already been mounted.

— *Mel Hart, WØIBZ*

CAN-OPENER SCREWDRIVER

Are you constantly hunting for a small screwdriver? Try making one: Take an opening key that comes with sardine or coffee cans, file or pound it flat to the desired thickness and width



to fit the screw head. The result, shown in the photograph, is a miniature screwdriver.

— *Stuart M. Mulne, KN8LEA*

BOLT ASSEMBLY HINT

Here's a convenient way to hold a nut in position to thread it on an out-of-reach bolt. Wrap the end of a length of lead solder around the nut. Using the free end of the solder as a handle, place the nut over the bolt and start the threading. The job can be finished by tightening up from the opposite side with a screwdriver. This method allows positioning of the nut while the thread is started, but will not grip the nut so tight that the solder can't be removed for the final tightening. — *Charles J. Boutell, W5YSC*

CARPENTER'S TRICK

Fig. 1-31 shows a carpenter's trick that is applicable when trying to line up elements of a beam. Stretch a piece of fish line or string taut along the side of the elements from the end of one to the end of the other. Place a block of wood approximately ¾ inch square under the string at

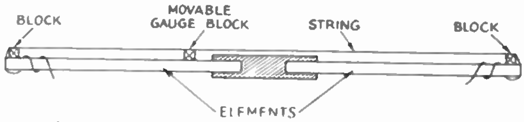


Fig. 1-31—A method of lining up beam elements.

either end. Take a third block of wood of the same thickness and using it as a gauge, move elements from side to side until the gauge blocks shows the string to be equidistant from elements at all points. Secure the elements in place.

— *Edward P. Foster, jr., K4BZL*

TIPS ON USING SHIELDED WIRE

Shown in Fig. 1-32 is a method of preparing the ends of shielded wires which produces a neat and simple termination It is in general use in commercial practice, but apparently has been overlooked by hams.

The sketches tell the story. First, bend the wire, as at A. Next, slide the shield over the bend (B) using either a blunt instrument or your fingernail to separate the strands. Pull the short end out of the shield, as in C, and then pull the shield taut as in D. The end of the shield may then be cut to desired length and tinned for soldering. The result is neat and strong, with no frayed ends to short-circuit the high voltage.

This method can also be used to tie into the middle of a shielded run, as is necessary when wiring the heaters of several tubes in parallel. The type of connection is shown in sketch E.

— *Paul A. Quinn, W1QXU*

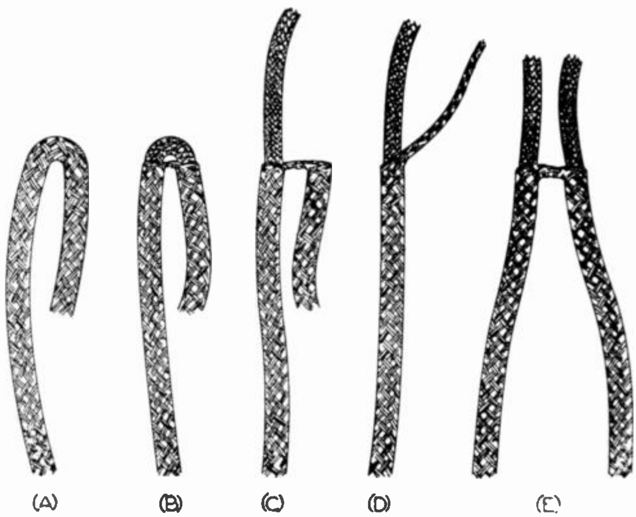


Fig. 1-32—Here's a simple way to make neat connections with shielded wire. Widely used in commercial practice, it should find equal favor among hams.

2. Hints and Kinks . . .

for the Receiver

USING 1N34s TO PREVENT RECEIVER OVERLOAD

After installing a kilowatt final amplifier, I was troubled by very slow recovery of the receiver in going from transmit to receive after the send-receive switch was thrown. It took as long as three seconds for the receiver to return to normal, especially when using sharp crystal selectivity. Putting a neon bulb across the antenna terminals did protect the antenna coil on the receiver, but had no effect on receiver overloading. Attempts to time the relays weren't too successful, since getting the relays to open in the proper sequence would result in the wrong closure sequence.

Installation of two germanium diodes (1N34 crystals) across the antenna terminals of the receiver completely eliminated the slow recovery and effectively prevented receiver overload regardless of relay timing. Apparently, the crystals begin conduction at a fraction of a volt, and bypass anything above this level so that it does not enter the receiver. No effect on the strength of received signals was noted, and there was no TVI as might be possible from the use of nonlinear elements in the antenna circuit.

The crystals were installed directly across the antenna terminals of the HRO-5, with the polarities of the crystals such that one was opposite in polarity to the other. The same system was tried on a BC-779 receiver with equally gratifying results.

The author hopes that this novel idea may be of help to someone who is bothered by slow receiver recovery caused by transmitter energy feeding back through the antenna relay to the receiver.

— *Sidney L. Gerber, W0TAI*

EARPHONE PADS

Gerrard Industries, Jackson Heights, N. Y., are manufacturing telephone ear pads that work well with regular amateur-type headphones. The pads sell for 25 cents each and are distributed through some of the 5- and 10-cent stores. They are soft, washable, and carry an adhesive which really holds them in place against the phones. Because the material is easily cut, it is possible to trim the pads for almost any size phones.

— *John Messler, W8MUL*

TRANSISTOR CONVERTER

Shown in Fig. 2-1 is a circuit diagram of a 40-meter transistorized crystal-controlled converter. It is a simple circuit, yet works surprisingly well considering the small number of parts it uses. The circuit is basically a Pierce oscillator with an untuned collector. The transistor used is one of the less expensive types and the crystals can be surplus. Basically, the circuit oscillates as a crystal-controlled oscillator while the input signal is injected into the base. After mixing, the desired signal is picked out by a tunable receiver. I use a 3 to 6 Mc. ARC/5 receiver with my converter. Resistor R_1 may have a value from 100,000 ohms to 1 megohm. However, I found 390,000 ohms worked best in my circuit.

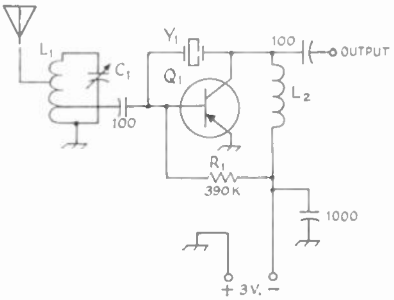


Fig. 2-1—Transistor crystal-controlled converter. All capacitors are in μμf., resistance are ohms, resistors are ½ watt.

C_1—100 μμf. variable capacitor.
L_1—30 turns No. 22 enam. wire, close wound on 5/16 inch dia. tube. Transistor tap at 3 turns from cold end, antenna tap 12 turns from cold end.
L_2—1- to 2.5-mh. r.f. choke.
Q_1—2N247, 2N170.
Y_1—3700 kc. to receive 7000 to 7300 kc. when tuning receiver 3300 to 3600 kc.

With 3 volts on the collector, the unit draws about 100 μa. When the crystal is removed, the collector current will jump to 500 to 1000 μa. This is a good indicator to show when the circuit is not oscillating. The converter can be used to cover other bands by choosing the proper crystal and changing the input circuit to tune to the new frequency.

— *Milton K. Foxworthy, W9BNW*

TRANSISTOR B.F.O.

Fig. 2-2 shows a transistor b.f.o. that can be with any receiver having a 455-kc. i.f. It is basically a Colpitts oscillator and uses a 2N190 transistor. I built the unit in a b.f.o. can discarded

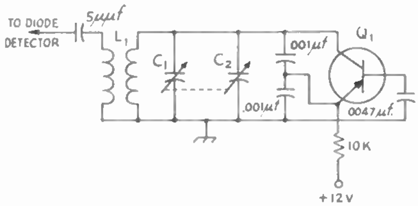


Fig. 2-2—Transistor b.f.o. The tuned circuit L_1 C_1, C_2, is the b.f.o. assembly from a 1.5 to 3 Mc. ARC/5 receiver. Q_1—2N190, CK768, 2N107

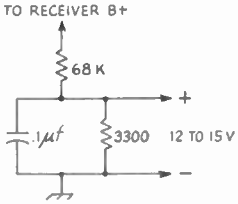


Fig. 2-3—The voltage divider connects to a 250 to 300-volt source. Resistors are ½ watt.

from a 1.5 to 3 Mc. ARC/5 receiver. The oscillator tank $L_1C_1C_2$ is the b.f.o. coil assembly from the 1.5 to 3 Mc. ARC/5 receiver. The oscillator is coupled to the receiver detector through the 5-μμf. capacitor. Since the unit requires only 12 volts at 60 μa., it makes a convenient b.f.o. for mobile operation. It can also be incorporated into the home receiver by using the voltage divider shown in Fig. 2-3. The divider is connected to the receiver B-plus line.

— *Charles Hartley, K6GQL*

VARIABLE BANDWIDTH FOR THE HEATHKIT Q MULTIPLIER

After reading "Variable Band Width *Q* Multiplier," *QST*, April, 1957, I converted my Heathkit *Q* Multiplier for variable bandwidth in less than 15 minutes. All that was needed was a 2-inch piece of wire, and the entire job consisted of cutting and reconnecting one wire and ungrounding one terminal.

Results were excellent in that adequate bandwidth for phone reception was obtained. Also, the ability to change bandwidth to meeting varying conditions made some signals readable where otherwise they would have been lost.

Basically, the modification allows the NULL control to operate on both PEAK and NULL and connects the PEAK pot across the series resistor in the *broad* position of the switch. The *broad* position then becomes variable, with the PEAK pot acting as the variation control while the NULL pot acts as the regeneration control for both the NULL and PEAK condition.

A complete description — Heathkit style — of the modification follows:

1) The wire running from the switch (Terminal 7) to the PEAK adjustment control is cut at a point about ¾ inch from the switch.

2) The ¾-inch piece of wire (from Terminal 7) is then soldered to Terminal 6 of the switch.

3) The 1-inch piece of wire (from the PEAK control) is now soldered to Terminal 9 of the switch.

4) Next, connect a 2-inch piece of wire between the outside terminal of the PEAK control (this terminal previously unused) and Terminal 11 of the switch.

5) Remove the lead between the outside terminal of the PEAK control and ground.

Incidentally, the reason why the connection from switch Terminal 9 is not made to the previously grounded end of the potentiometer is that the span to the other end is much shorter.

— *Cal Enix, W8ZVC*

ACCURATE ZERO BEATING

Because the audio frequency response of most receivers drops rapidly below a few hundred cycles per second, it is not possible to zero beat two signals exactly by listening to their audio beat note on a receiver's speaker or earphones. A more accurate indication of zero beat can be obtained by measuring either the receiver's a.v.c. voltage or its second detector output voltage with a vacuum tube voltmeter. When the difference in frequency between the two signals is only a few cycles per second, the voltmeter needle will fluctuate with the beat signal. The fluctuations become slower as the frequency difference becomes smaller and a large dip is obtained when the frequencies are exactly equal. However, this dip is extremely sharp and it sometimes requires a steady hand to zero beat the two signals exactly.

— *D. F. Zawada, K8EMS*

SOURCE OF HUM IN OLD RECEIVERS

My six-year-old receiver, after traveling all over the country without benefit of normal servicing, finally required a complete overhaul. One of the most obvious defects was the strong a.c. hum that appeared consistently in the output of the set.

Although all new capacitors — both paper and electrolytic — were installed in the receiver during the overhauling process, the hum was found to be just as bad as ever when the set was turned on. After much checking, the trouble was traced to defective ground connections.

This particular receiver is one of the type that utilizes the metal mounting rings for the tube sockets as ground tie-points. These rings are in turn fastened to the chassis by means of rivets. During the years of use, the rivets had worked loose, thus allowing a coating of oxidization to form between the rings and the chassis. Naturally, a set of very poor ground contacts was the result. A little solder between the rings and the chassis did the trick as indicated by complete elimination of the hum.

— *Lee Dilno, W8DAP*

21-MC. CALIBRATION FOR THE HQ-129-X

THE following is a simple and convenient method of providing 21-Mc. calibration for the HQ-129-X receiver.

Using a crystal-controlled frequency standard, and by adjustment of the two tuning dials, set number 2 of the calibrated bandspread scale (the uppermost ring of numbers — 0 to 200 — on the dial) as the position for 21-Mc. reception. With this setting of the controls, it works out that each higher number on the bandspread scale — after multiplication by 4 — equals the approximate number of kc. above 21 Mc. Therefore, by multiplying by 4 and then adding 21,000, the approximate frequency is readily determined.

For example, 25 on the scale corresponds to 21.1 Mc. (25 × 4 + 21,000 = 21,100 kc.). With the scale set at 100, the approximate frequency is 21.4 Mc. (100 × 4 + 21,000 = 21,400 kc.). The mental process of multiplication and addition may slow you up a bit at first, but soon becomes a routine matter.

The main tuning dial of my receiver is set at approximately 21.85 Mc. for 15-meter operation. The exact setting of the dial for each particular receiver should be determined by means of a frequency standard. Band-edge operation should also be checked against a standard.

— John Abbott, W6ZOL

SERVICE HINT FOR COLLINS SERIES 75A RECEIVERS

THE COLLINS 75A series receivers are famous for their frequency stability and calibration accuracy, but the rigors of time, humidity, and wear may cause the variable-frequency oscillator to shift and throw the dial calibration off to the point where it can no longer be corrected with the zero set. If the calibration error is the same on all bands, the variable oscillator is at fault. If only one band is off calibration, the first oscillator for that particular band should be suspected.

The 75A-3 at W4CEN, when new, was calibrated perfectly at the high-frequency end of all bands, but at the low-frequency ends it was necessary to move the zero set pointer three kc. to the left to correct the calibration. This pointer can only be moved four kc. either side of zero center. After a year's use, the calibration drifted off two more kc., so it was no longer possible to correct the calibration with the zero set. The oscillator unit is completely sealed and there is no provision for adjustment of the oscillator frequency. The Collins instruction books says to remove the oscillator unit and return it to the factory when this condition occurs. If the calibration error is very great, these instructions should be followed.

In my case, such drastic action hardly seemed necessary, and I cast about for some easy method to correct the calibration. A very small reduction in the capacitance across the oscillator coil was necessary to do this. The tube tables in the *Handbook* list the input capacitance of the 6BA6 tube used in the oscillator (V_{14} in the circuit diagram) as 5.5 $\mu\mu f$. The tables list a number of other miniature pentodes with a lower input capacitance, among them the 6AK5, with an input capacitance of 4.3 $\mu\mu f$. The base connections are different, but the difference is in the manner in which the cathode and suppressor grid connections are made to Pins 2 and 6. Since both these pins are grounded in the receiver, the 6BA6 and the 6AK5 may be interchanged. A 6AK5 was then substituted for the 6BA6 in the oscillator socket, and presto, the zero set moved back to only one kc. to left of zero at the low-frequency end of the dial.

Incidentally, there may be considerable difference in the input capacitances of the same type tubes produced by different manufacturers. I discovered that a Tungsol 6BA6 had an input capacitance sufficiently lower than an RCA 6BA6 to move the calibration two kilocycles.

In cases where it is necessary to move the zero set to the right to correct the calibration, an increase in capacitance is indicated. This may be obtained by the simple expedient of taking a short piece of No. 22 solid hook-up wire, remove the insulation from about one-quarter inch at one end, form a small loop and crimp it around the No. 1 or grid pin of the 6BA6 oscillator tube, wrap the wire around the other pins to form a semicircle, and plug the tube back in its socket. The length of the wire may be adjusted until the calibration is correct.

— Tom Brandon, W4CEN

FEEDBACK CURE

IF YOU are plagued by feedback — acoustical or r.f. — here is one way to get rid of it for good without fiddling around with ground leads or microphone cords.

The circuit is shown in Fig. 2-4. The only parts needed are a 115-volt a.c. s.p.d.t. relay and a

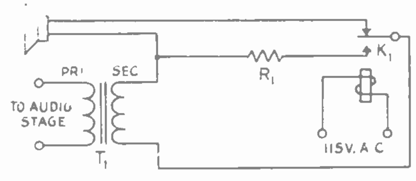


Fig. 2-4—W5AXI/MM uses this simple circuit for curing feedback.

2-watt resistor, R_1. The resistance of R_1 should be approximately equal to output impedance of the audio transformer and the relay may be actuated by the same power source used for the antenna relay.

When the transmitter is on, and the relay closed, the speaker is disconnected from the receiver and the resistor, R_1, is connected across the secondary of the receiver output transformer, T_1. The relay disconnects the resistor and restores the speaker to operation whenever the transmitter is turned off.

— Arthur E. Hutchins, W5AXI

Q MULTIPLIER FOR BC-312 OR BC-342

Here is a hint for users of the BC-312 or BC-342 who wish to use these receivers with the Heathkit Model QF-1 *Q* Multiplier. The QF-1 will not tune to the BC-312 i.f. of 470 kc. To make the conversion refer to the QF-1 schematic and you will see a 3300-$\mu\mu$f. silver-mica capacitor in the tank circuit. Replace this capacitor with one with a value between 2800 and 3000 $\mu\mu$f., and retune the inductor to 470 kc. by adjusting the tuning slug.

Using a 2800-$\mu\mu$f. ceramic capacitor, the circuit came to resonance with the slug almost all the way in; so, if normal tolerances will not permit tuning to resonance at 470 kc., try a capacitor of 3000 $\mu\mu$f. Although I used an available ceramic capacitor which works very well, it is possible that the recommended silver-mica unit would improve the selectivity and *Q*. As it is, with the BC-312 series having such broad selectivity, the *Q* multiplier is a welcome addition when the going gets rough. — *Harry K. Long, W7CQK*

NOTE ON SURPLUS TYPE BC-348 RECEIVERS

The dial calibration on BC-348 receivers can be greatly improved by adjusting the inductance of the oscillator coils. To provide this adjustment (except in J, N, & Q series) proceed as follows:

1) Make certain that the i.f. is correctly aligned at 915 kc.

2) Note whether the dial spread is greater or less than the actual frequency band covered.

3) If the dial spread is greater, the inductance is too small.

4) If the dial spread is less, the inductance is too large.

5) Remove the top and bottom covers from the oscillator compartment and drill and tap a 6–32 hole over the center of each coil which requires correction. The covers are thin and best results will be obtained if the holes are punched through with a tapering punch to give more material for threading.

6) In the holes over low inductance coils, insert a small powdered iron slug with 6–32 screw attached.

7) In the holes for the high inductance coils, insert a 1-inch 6–32 brass screw, with the head inside the coil.

8) By alternately adjusting the trimmer capacitor (near the high end of the dial) and the slug (near the low end of the dial) bring the receiver as nearly as possible into calibration. Lock the slug adjustments with a 6–32 nut and cut off any excess screw length to prevent catching on case.

If care is used, the calibration over most of the dial should be off not more than the thickness of one of the heavy calibration marks on the dial.

—•••—

Single-sideband reception with the BC-348 type receiver can be improved by adding a small variable capacitor to permit fine adjustment of the b.f.o. frequency.

A double-spaced unit having a maximum capacitance of approximately 2 $\mu\mu$f. is recommended for the job. If a made-to-order APC type is not available, a larger size can be modified by removing plates.

The capacitor may be centered above the "Volume" and "Beat Freq." controls by using a suitable bracket to avoid wires in the vicinity. The rotor should be grounded and the stator connected to Pin 5 of the 6F7 (VT-70).

Another installation places the vernier capacitor on the panel directly above the "C.W. Osc." switch. The rotor of the new vernier capacitor should be grounded, and the stator terminal connected to terminal "C" at the top of the c.w. oscillator inductor. Terminal "C" is already wired to Pin 6 of the 6F7 tube (VT-70). — *George S. Carson, W0JV*

USING THE GONSET SUPER-SIX AHEAD OF A COMMAND RECEIVER

An excellent, low-cost communications receiver can be assembled by adapting the BC-453 Command receiver (190-550 kc.) for use with the Gonset Super-Six converter. This combination has been used at this station for s.s.b., c.w. and a.m., and has outperformed several amateur receivers costing many times more.

The simple modification necessary to the Command receiver is accomplished by removing approximately 180 turns from one end of L_1, L_3 and L_5, the antenna, r.f. and oscillator coils, respectively, in addition to the removal of the powdered-iron slugs. The tap on L_1 is unimportant in this instance and may be neglected if desired by connecting the grid coupling capacitor directly to the hot end of the coil. The trimmers can be adjusted for optimum gain at 1430 kc., the output frequency of the converter, by using a broadcast signal as a source. Modification of the coils does not prevent the use of the BC-453 for other purposes at a later date since the coils come as a plug-in set and can be easily replaced with the original type.

If desired, the usual Command receiver modifications for phone jack, r.f. gain control, b.f.o. and a.v.c. switch, noise limiter, etc., can be made at the same time. The construction of a small 200-250 volt a.c. power supply with a separate inexpensive 26-volt filament transformer (Stancor P-6469) completes the unit. Voltages for the converter are obtained from the same power supply, of course, and B-plus should be dropped to 130–180 volts through a suitable resistor for optimum operation.

No special precautions need be observed in connecting the converter to the BC-453. In the interests of safety, however, it should be pointed out that at least one variety of commercially available "plug-in" power supply for Command receivers should be used with extreme care since if the line cord is plugged in backwards the receiver cabinet will become hot to ground. Severe shock or death might result if a grounded lead and the receiver cabinet is touched at the same time! — *Ronald E. Delp, W6DAW*

BANDSPREADING THE BC-455

THIS modification to the popular 6–9.1 Mc. Command receiver should appeal to both old hands with surplus equipment and those newcomers who are using this receiver as a mainstay of their stations. The end result of about an hour's work on the BC-455 will double its bandspread so that the 40-meter band covers about 2½ inches of dial circumference compared with the original one inch it occupied.

First, take off the outer dust cover of the receiver and remove the cover over the tuning capacitor. In order to do this it will be necessary to remove two of the i.f. cans and several tubes unless a right angle screwdriver is available. This provides access to the two bolts on the cover of the plate that supports the 12K8 grid cap lead. Now remove all rotor plates from the capacitor except the right-hand three in each section (looking at the capacitor from the rear of the receiver). Replace the dust covers. The dial will now have to be recalibrated. First paint it completely with black enamel. Locate the 40-meter band with a transmitter, signal generator, or the 7.335-Mc. Canadian Observatory signal. The rest of the calibration is best done with a 100-kc. crystal calibrator that has been checked against WWV. The dial can be calibrated by scratching it at 100-kc. intervals. Commercial decal numbers will dress it up and give it a professional appearance.

— *Hovey M. Cowles, W3JWZ*

A PANADAPTER CONNECTION FOR THE 75A-4

I FOUND an easy way to connect a BC-1031C panadapter to my 75A-4 without the need for much more than lifting the cabinet lid. Connect the hot wire from the panadapter cable to the tube shield of the 6BA7 second mixer and ground the outer shield of the cable to the receiver chassis. When replacing the tube shield, push it down to within 1/32 of an inch from the tube base shield, but don't let it touch! This forms a concentric capacitor around the tube and provides sufficient coupling between the receiver and panadapter.

— *Robert W. Westcott, W8DNY*

HEADPHONE ADAPTOR FOR CONTEST OPERATING

HERE's a gimmick that is useful during contest operating, especially on Field Day. The circuit is shown in Fig. 2-5. It allows two sets of headphones to be operated from one receiver; each channel has its own volume control.

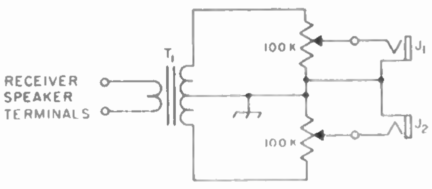


Fig. 2-5—Diagram of the adaptor. The transformer, T_1, is a universal output transformer. J_1, J_2, are phone jacks.

The transformer can be a universal output transformer. The voice coil winding is connected to the low-impedance output terminals of the receiver and the phones are on the push-pull winding side. The potentiometers allow for level adjustment to suit the operator/logger. Value of the pots is not critical; the ones shown just happened to be in our junk box!

The unit can be wired into a small minibox for easy transportation to the Field-Day site.

— *Jack Cox, WØKMV*

OUTBOARD B.F.O.

THE circuit shown in Fig. 2-6 is a simple 455-kc. b.f.o. which is easy to build and adjust. Most of the parts can be found in the junk box but if components do have to be purchased they can be obtained with no great damage to the billfold.

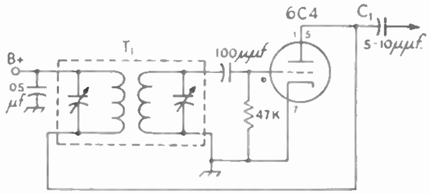


Fig. 2-6—Circuit of the b.f.o. Transformer T_1 is a 455 kc. i.f. transformer.

The circuit is a basic one and almost any triode may be used. The two coils and their capacitors are the two sections of a common 455-kc. i.f. transformer. If the b.f.o. is mounted near the receiver detector circuit no additional coupling may be required. However, the diagram shows a coupling capacitor C_1 which may be connected to the detector diode plate if additional coupling is required.

— *James Lewis, K4SAM*

NEW SHIELDING TRICK

RECENTLY we were bothered by a case of hum in a newly built receiver. It was suspected that more shielding would turn the trick, but we did not wish to remove half the components to make the necessary corrections. With an assist from the XYL the problem was quickly solved.

A piece of aluminum foil (the type used in cooking) was trimmed to the approximate size required and a length left attached for grounding. Then a piece of "Mystik" tape, a cloth-backed tape with excellent adhesive power, was attached to the foil and trimmed to size. A similar piece of tape, slightly larger, was attached to the other side of the foil and bent around the edges.

This shield could then be wrapped tightly around the components and leads in question and revealed in a few moments the source of the trouble. In fact, it worked so well that it was permanently attached. The tape has a tendency to "set" with time and makes an excellent shield.

— *George P. Carpenter, W1TGV*

AUDIO MUTING FOR THE COLLINS 75A-4

When the Collins 75A-4 receiver became available, many hams — particularly s.s.b. enthusiasts — were happy to find a provision for audio muting built into the receiver. The receiver has, in fact, provisions for two separate methods of receiver silencing. The first entails an "open the circuit while transmitting" means of biasing the r.f. amplifiers past cutoff. This method is quite satisfactory and requires no change in the average send-receive control circuit. However, the arrangement requires the application of positive 20 volts or more to the receiver's audio-muting circuit. Some hams have found existing sources of d.c. in their shacks for this purpose. The only charge necessary, then, was to change the contacts on the station's transmit-receive relay from "open" to "close" while transmitting. This is necessary because the 20 volts has to be applied to the receiver during transmitting periods. Others were forced either to build a suitable power supply or drag out a number of dry cells. Both of these alternatives, unfortunately, leave something to be desired.

In looking for another suitable arrangement, I found that the 75A-4 could provide the 20 volts d.c. needed for the audio-muting circuit and, also, retain the "open the circuit while transmitting" feature. At first, I simply opened the cathode-to-ground connection on the audio-output tube. However, to keep the pops caused by switching to a minimum, it was necessary to connect a filter capacitor across this circuit. This, in turn, brought up another problem. When the receiver's audio gain was turned up past the midpoint, modulation peaks blasted through with a monkey-talk quality (probably caused by leakage in the filter capacitor).

In any event, the voltage appearing across the capacitor while the silencing circuit was in the transmit position measured 21 volts. It was necessary only to run a jumper between this source and the regular audio-muting circuit and the problem was solved.

In case anyone should like to use this simple built-in power supply to silence their own 75A-4's audio, here is a step-by-step description of the modification.

1) For purposes of orientation, place the receiver, upside down, with the front panel toward you. Locate R_{98} and disconnect the wire that comes from the panel wiring harness and connects to the left (ungrounded) side of that resistor. Run a bare wire jumper between the terminal you just removed the wire from (the left terminal) and the ground terminal on the same strip (third terminal from the left). This disconnects the r.f. gain silencing circuit and leaves it in the "on" position.

2) Now locate the socket for the audio output tube, V_{22}, right below the terminal strip, and disconnect the bare wire running from Pins 2 and 3 to the ground lug on the terminal strip. Run a new wire between Pin 3 of the tube socket and ground. Then connect the free wire you originally disconnected from R_{98} to Pin 2 of the tube socket. Solder all these new connections.

3) Locate the "muting" terminal strip on the rear of the receiver. Connect a 10-μf. 150-volt capacitor between Terminals 2 and G, the positive end of the capacitor on Terminal 2. Now connect a jumper wire between Terminals 2 and M for the final step in the modification.

The receiver will now mute completely when no connection exists between Terminals 1 and 2 of the muting strip. Thus the normal "open while transmitting" breed of control circuit will perform nicely. Just connect this circuit to Terminals 1 and 2, and you are in business. (Note: If one side of your control circuit happens to be grounded, be sure to connect that side to Terminal 1).

One more thing. In the more recent 75A-4 receivers, a small subchassis has been added near the socket for V_{22}. This chassis mounts the potentiometers for S-meter zero and scale adjustment. In order to get at the terminal strip and audio output tube socket, it is necessary to remove the two chassis mounting screws and flop the chassis out of the way. Have no fears about moving the chassis, but be sure to remount it when the modification is completed.

Finally, operate the receiver with the combination power switch in the "standby" position. Otherwise, the silencing circuit will be bypassed and the receiver will remain on all the time. — *Lawrance H. Mitchell, W7BAS*

REMEDY FOR NOISY VOLUME CONTROLS

The following scheme has been used for several years to advantage, for quieting noisy volume controls. First make up a cleaning solution using a small dab of plain unmedicated Vaseline and a small amount of lighter fluid, naphtha, or any noncorrosive solvent that is quite volatile under normal conditions. Dissolve the Vaseline in the solvent in a warm place. Make up a batch of it and keep it in a stoppered bottle.

To cure the noisy volume control, remove the volume control knob, dip a pipe cleaner into the cleaning solution, and apply to the control shaft while turning the shaft back and forth with your fingers. A few applications for about one minute should be enough to return the control to normal again. Remember, if you use an inflammable solvent, keep fire and sparks away from it. If used on a plugged in receiver or other equipment connected to the a.c. line, pull the plug out first. The cleaning solution is both a cleaner and a lubricant and is not messy. It will penetrate small spaces, the solvent will evaporate and the lubricant will remain.

— *G. Roger Gladding, W1AOS*

USING THE NC-300 ON MARS FREQUENCIES

The 80-meter range of the NC-300 may be lowered to receive some of the MARS frequencies by connecting a "two-bit" capacitor in parallel with the high-frequency oscillator section (front end of the gang) of the ganged variable

The capacitor is made with a length of bare solid hookup wire, a coin and a layer of Scotch tape. Solder the wire to the free lug on the oscillator tuning capacitor, and then bend as shown in Fig. 2-7. The coin must make good contact

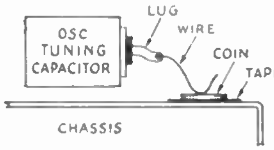


Fig. 2-7—Sketch showing the "two-bit" capacitor connected in parallel with the oscillator tuning of a type NC-300 receiver.

with the wire *spring*, and must be completely insulated from the chassis by the tape. A 25-cent piece will lower the receiver tuning range to include the MARS frequency at 3250 kc.

— *Capt. J. R. Hagen, K4JMA*

If you want to include a MARS frequency — say, 4025 kc. — in the 80-meter tuning range of a National NC-300 try the following:

Using a pair of tin snips or good quality side cutters, cut about one sixteenth of an inch from the dial stop on the ganged tuning capacitor. Then, with the aid of long-nose pliers, bend the tab until it breaks off. Now, you have extended the tuning range of the receiver without harming its resale value.

Just be sure not to cut too much off the dial stop. Otherwise, you may run the dial pointer off scale and down the side of the receiver!

— *Leonard M. Norman, W5CIN*

IMPEDANCE MATCH FOR THE SIMPLE SHUNT CLIPPER

Although a single-tube circuit can be used for noise clipping during c.w. reception, it is not usually an especially effective arrangement unless the receiver output circuit is designed for a high-impedance load. In other words, the average one-tube clipper does not work too well when

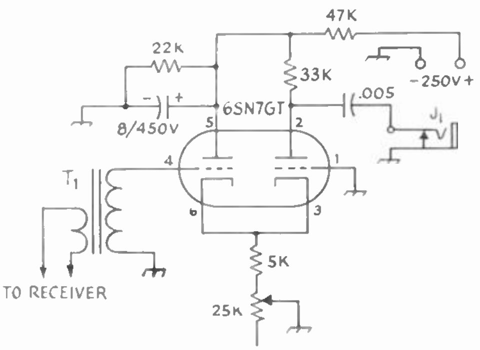


Fig. 2-8—Circuit diagram of the one-tube clipper. T_1 is an inexpensive b.c. receiver output transformer used for impedance matching.

plugged into the output jack of a receiver designed for low-impedance phones.

This problem can be easily overcome without expense by using a cheap or salvaged broadcast-receiver output transformer at the input of the clipper. The transformer, reverse connected as shown in Fig. 2-8, will provide a better impedance match for the grid of the clipper tube, thereby increasing the input signal and the clipping action. Use of a variable cathode resistor as shown permits adjustment of the audio volume and the clipping level. The rest of the circuit is quite similar to the clipper arrangement described in chapter five of *The Radio Amateur's Handbook.*

— *Otto Woolley, WØSGG*

SIMPLE HIGH-PASS FILTER FOR 28-MC. CONVERTERS

The simple high-pass filter circuit shown in Fig. 2-9 has a cut-off frequency of approximately 10 Mc. It is used to suppress b.c. signal feedthrough that frequently occurs when a

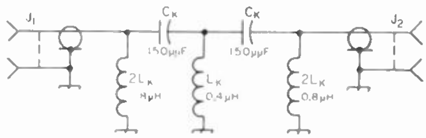


Fig. 2-9—Circuit diagram of the high-pass filter suggested by W1DBM.

LK—0.4 µh.: 6 turns No. 20 enam. wire, 3/8-inch diam., 3/16 inch long.

2LK—0.8 µh.: 11 turns No. 20 enam. wire, 3/8-inch diam., 3/8 inch long.

Note: Coils are self-supporting.

28-Mc. converter is worked into a low-frequency tunable i.f. such as a broadcast receiver. In one particular installation — e.d. layout described in *QST* for September, 1955 — the filter completely eliminates "birdies" which were encountered when using a ground-plane antenna and a long feed line. The filter was inserted between the antenna relay and the converter.

The housing for the filter may be made from either aluminum or flashing copper and should measure 2 by 2 by 4 inches. A box of this size allows inductors to be spaced apart enough to prevent coupling between coils.

Component values shown in Fig. 2-9 are for use with a 50-ohm antenna feed system. Values for a 75-ohm filter, or one having a cut-off frequency other than 10 Mc., may be quickly determined by employing the following formulas:

$$C_K = \frac{1}{4\pi fc}$$

$$L_K = \frac{1}{4\pi fcR}$$

where C_K = Capacitance in microfarads (µf.)
f = Cut-off frequency in megacycles (Mc.)
L_K — Inductance in microhenrys (µh.)
R_C = Termination resistance in ohms.

— *P. S. Rand, W1DBM*

SERVICE NOTES ON SOME HAMMARLUND RECEIVERS

When Hammarlund receivers type SP-100, SP-200, SP-400 and the surplus versions (BC-779, etc.) are operating properly, the maximum high-frequency oscillator drift is usually about 50 kc., and most of this takes place during the initial warm-up. The oscillator drift characteristics of these receivers can be materially improved by making a simple modification suggested by Jack Scheider of Hammarlund's Engineering Department.

First, obtain a 3.3-$\mu\mu$f. temperature compensating capacitor having the highest negative temperature coefficient available. Three 10-$\mu\mu$f. capacitors may be connected in series if the 3.3-$\mu\mu$f. job is not obtainable. Lift the top shield from the main tuning capacitor gang after removing the mounting screws from the top plate of the shield. Connect the 3.3.-$\mu\mu$f. capacitor between the stator terminal of the oscillator tuning capacitor (the first section away from the panel) and ground.

Realignment of the oscillator trimmers is the next operation. Turn the receiver upside down, panel facing toward you, and remove the bottom cover. Using a signal generator or the standard frequencies from WWV, adjust the trimmers for on-the-nose calibration of the test signals, The trimmer control shafts are accessible through the line of holes running from left to right across the shielded coil compartment. The line of holes directly to the rear of the panel are over the oscillator trimmers. *Do not* touch any of the other trimmers. All of the more popular receivers in the group referred to above have the high-frequency band trimmer at the left end of the line. Move on one step to the right each time the range of the receiver is decreased to the next lowest band.

Since the shunt capacitance which has been added to the circuit is only 3.3. $\mu\mu$f., it is obvious that each oscillator trimmer will require only slight adjustment. Only a fraction of a turn of each adjustment screw should be necessary.

Everyone who has made this modification to his receiver reports complete satisfaction. One report stated that the drift had been reduced to less than 200 cycles, and another claimed that the modified set was *excellent* for s.s.b. reception.

Audio-Limiter Alterations

The following is a step-by-step procedure for improving the action of the noise limiter for the aforementioned receivers. If you have the bottom plate off the receiver because of the oscillator modification, now is a good time to go to work on the limiter.

Audio-Circuit Changes

Operations 1 through 5 involve the first-audio tube socket.

1) Remove .02-μf. coupling capacitor feeding grid of first-audio tube. Replace capacitor with a jumper.

2) Remove grid-leak resistor from grid pin.

3) Remove ground connection from Pin 8.

4) Remove lead from 3-volt bias to Pin 6

5) Connect a 100-ohm ½-watt resistor between Pin 8 and ground.

Second Detector-Limiter Modifications

1) Disconnect all wiring to the second detector socket (6H6) except that terminated at Pins 1, 2 and 7.

2) Remove all components and wiring from the terminal strip adjacent to the 6H6 socket except heater leads on the last lug.

3) Remove *all* wiring from the 6N7 socket.

Note: Steps 4 through 8 to follow pertain to wiring of the 6H6 socket. Fig. 2-10 is a sketch of the socket and the new wiring.

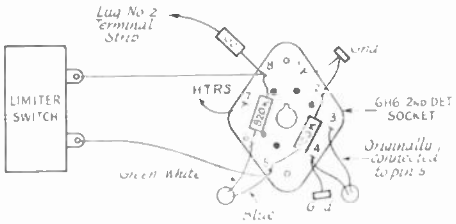


Fig. 2-10—Sketch of the layout for the second-detector socket (Hammarlund SP series receivers) after modification.

4) Connect the lead that originally went to Pin 5 to Pin 3.

5) Ground Pins 1, 2 and 4.

6) Connect the following to Pin 5: a lead to the limiter switch; a 100K ½-watt resistor to ground; the blue lead from the i.f. transformer.

7) Connect an 820K ½-watt resistor between Pins 6 and 8, and connect the green-white lead that originally went to the 6N7 grids to Pin 6.

8) Connect the .02-μf. coupling capacitor (see Step 1 of audio-circuit changes) from Pin 8 to Lug No. 2 of the terminal strip. Wire a lead between Pin 8 and the remaining terminal on the limiter switch.

9) Solder the audio input lead to Lug No. 2 on the terminal strip.

Do not attempt these modifications unless you feel that you are thoroughly capable of diving into a superheterodyne receiver. If you have any hesitancy about operating on your set, either forget the whole idea or pass the job along to someone who is familiar with what makes a superhet tick. —*Frank Lester, W2AMJ*

A TRANSISTORIZED TUNABLE CONVERTER

While it is perhaps cheaper to build a converter using tubes, it is very interesting to try the same project using transistors. The transistorized version can be used with a transistor car receiver with no power problems, and is small in size. The converter described here is designed for fifteen meters, mainly because ten meters is still hard to hit with inexpensive transistors, and the lower

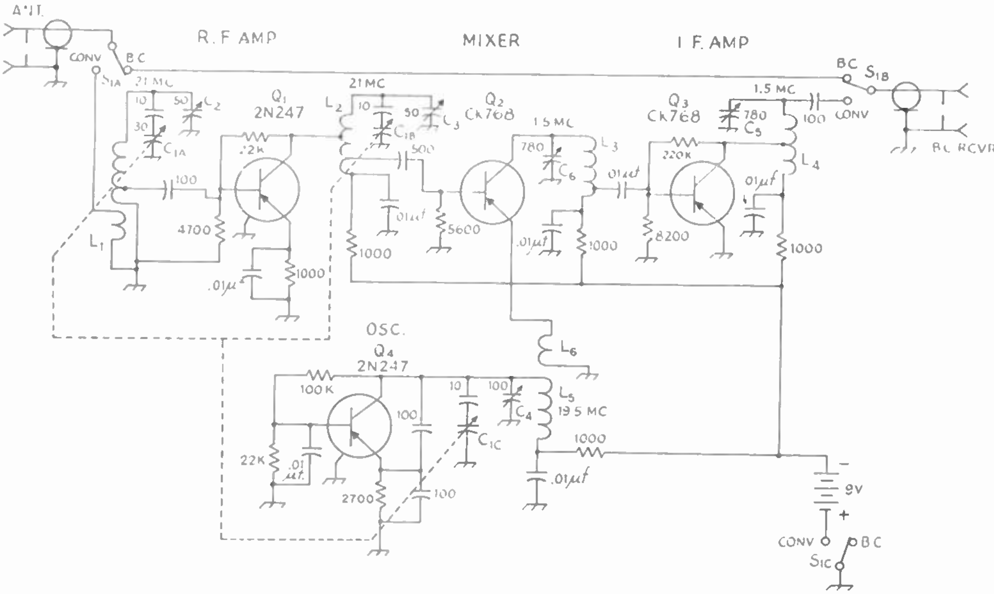


Fig. 2-11—Circuit of the transistorized tunable converter. Unless otherwise indicated, capacitances are in μμf. resistances are in ohms, resistors are ½ watt.

C_1—30μμf. 3-section variable capacitor (three-ganged Cardwell type PL-6003 trim-air midgets).

C_2, C_3—50-μμf. air trimmer.

C_4—100-μμf. air trimmer.

C_5, C_6—780-μμf. mica trimmers.

L_1—9 turns No. 22 enam., ¼ inch long, ¾-inch diam., tapped 3 turns from cold end. Link is one turn No. 22 enam. wound near cold end of above coil.

L_2—12 turns No. 22 enam., ⅜ inch long, ½-inch diam., tapped at 2nd and 7th turn from cold end.

L_3, L_4—No. 32 enam. close-wound, ½-inch diam., 1 inch long, tapped 20 turns from cold end.

L_3, L_1—No. 32 enam. close-wound, ½-inch diam., 1 inch long, tapped 20 turns from cold end.

L_5—7 turns No. 22 enam., ½-inch diam., ¼ inch long.

L_6—4 turns No. 22 enam., close-wound ¼ inch above top of K_5.

S_1—3-pole 2-position rotary switch (Centralab PA-2007).

frequency bands have quite a bit of QRM. There is no reason, of course why the converter could not be built for the other bands just by changing the coils.

The converter is of the tunable type with a fixed output frequency somewhere in the broadcast band (in this case, 1500 kc.). The ultimate performance obtainable from this type of converter is higher than from the fixed-frequency type because the front end need not be broadbanded. The converter is powered by a small 9-volt battery mounted inside the case, and since the total current drain is less than 3 ma., the battery should last for quite a while.

No particular constructional details are needed; the layout can be left up to the individual constructor.

The circuit used for the oscillator is a Colpitts. Stability was hard to come by when using a transistor at 19.5 Mc., but after many circuit modifications, the oscillator drift was cut down to about 5 kc. in a half hour from a cold start. It was found necessary to use a high-C circuit in the oscillator to get any usable stability at all, and the size of the base bias and emitter stabilizing resistors radically affected the performance of the oscillator, while changes in the base loading resistor did not have too much effect. One peculiar thing observed about the oscillator was its extreme sensitivity to temperature changes; heat from a quick touch of a soldering iron would send it drifting many kc. It was found that the oscillator could be made to drift noticeably by simply blowing on it. In the finished converter, every effort was made to keep the temperature stable.

The mixer operated best with absolutely no bias at all, which is not too surprising since that must be its most nonlinear condition. By vacuum tube standards, a lot of local oscillator injection was required. Several methods of injecting the signal were tried, but the method shown here reduced the "pulling" of the local oscillator when tuning the mixer to a minimum.

The r.f. amplifier is straightforward, with the size of the bias resistor being the most critical item. The base had to be coupled near the bottom of the coil before the base tuned circuit would have any selectivity at all. This tuned circuit was very easily loaded by the antenna, and one turn in the primary seemed to give maximum signal transfer and front-end selectivity.

The i.f. stage was thrown in as an afterthought, since an old automobile broadcast set was used. However, the converter had gain to spare, so there was probably to real need for this stage. The method of coupling this stage to the car receiver was determined purely by experimentation, and may require a little modification with other types of receivers.

—H. A. Ross-Clunis, jr., W6GRZ

PRODUCT DETECTOR FOR COMMAND RECEIVERS

A SIMPLE and inexpensive adaptation of the product detector[1] to the popular Q5-er (BC-453) is used here at W4JJX. The performance of this combination, used in conjunction with a type NC-183, is most gratifying. Fortunately, the detector circuit may be built into the Command set without necessitating any socket-hole punching or outboard construction.

The circuit of the detector and the method of connecting it to the BC-453 are shown in Fig. 2-12. The detector circuit is identical to the one described by Crosby except that type 6SN7GT tubes are used instead of the miniature type 12AU7. This modification does not require any changes in the component values used in the original detector, but it does permit taking advantage of the octal sockets already mounted

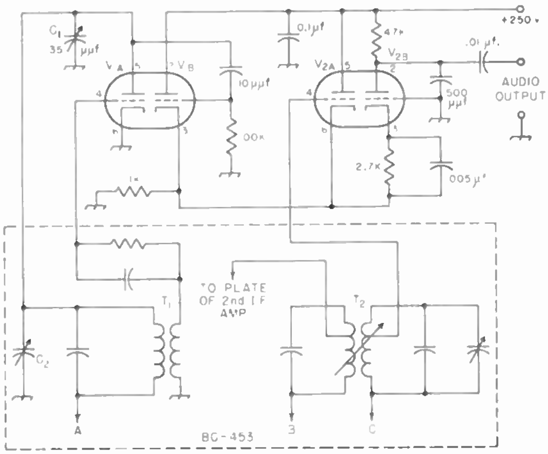


Fig. 2-12—Circuit diagram of the product detector as connected to a type BC-453 receiver. All resistors ½ watt. Components inside dotted lines are parts of the BC-453. Arrows A, B and C point to receiver wiring that need not be disturbed. T_1 and T_2 are the BC-453 b.f.o. and i.f. output transformers, respectively. C_2 is the original b.f.o. control and C_1 is a b.f.o. control mounted on the panel (see text). V_1 and V_2 are type 6SN7GTs.

in the Q5-er. In Fig. 2-12, V_{1A} is the b.f.o. tube for the BC-453 (the original tube for the b.f.o. circuit having been removed) and V_{1B} and V_2 operate in a triple-triode product detector circuit. Since the b.f.o. frequency of the Command receiver is screwdriver adjusted, the original control (C_2) was set at minimum capacitance and a new capacitor (C_1) having an external control knob was installed. This provides a convenient means of adjusting the b.f.o. to center frequency to furnish carrier for an s.s.b. signal.

Modifications which must be made to the Q5-er are the substitution of 6-volt equivalents for the r.f., i.f. and mixer tubes. Naturally, this will require rewiring of the heater circuit. The types 12A6 and 12SR7 used in the audio output and b.f.o. — second detector circuits, respectively, are not replaced with 6-volt equivalents, but the sockets for these tubes are used for the 6SN7GTs of the new b.f.o.-detector arrangement.

When clearing the wiring from these two sockets, do not clip short the leads to the b.f.o. circuit and the secondary of the output i.f. transformer as these will be reused as indicated in Fig. 2-12. Also, while working with the BC-453, adjust the b.f.o. control for minimum capacitance. If you don't care to open up the b.f.o. can so that the minimum-capacitance setting may be readily determined at this time, the adjustment can be made after the externally-controlled capacitor has been mounted and the complete receiving system has been placed in operation. In the latter case, set the new control at minimum capacitance and make a normal adjustment with the original control. Then, simultaneously increase and decrease the capacitance of C_1 and C_2, respectively, until the b.f.o. oscillator is *walked* back onto frequency.

The fiber adjustment rods for the three i.f. transformers (BC-453) should be pulled full *upward*. The i.f. passband is so narrow under this condition that intelligibility suffers when the BC-453 is used as a Q5-er for the reception of a.m. signals. It is therefore obvious that when an s.s.b. signal using either the upper or the lower sideband is tuned into the center of the BC-453 i.f. passband, and the b.f.o. is adjusted to the proper side of the signal, the operator has a *built-in* band-pass filter that is fair if not excellent.

When using this system for the reception of single-sideband transmissions, first tune the desired signal for maximum deflection of the receiver's S meter with the BC-453 *out* of the circuit. The BC-453 is then switched into the circuit and is tuned back and forth through the receiver i.f. passband until maximum audio is heard. Then the b.f.o. frequency is adjusted until the received signal sounds natural. Now the receiver a.v.c. is turned off.

After the preceding adjustments have been made, signals using the same sideband can be tuned in with the tuning control of the main receiver without the necessity of going through the above procedure.

Naturally, this setup will not compete with the upper-bracket gold-plated receivers on the market, but for the few dollars it costs, it gives surprisingly good results.

— *Charles McDowell, W4JJX*

A SIMPLE CONELRAD ALARM CIRCUIT

A SIMPLE visual-type indicator circuit for conelrad monitoring is shown in Fig. 2-13. The arrangement permits full compliance with conelrad regulations as they affect radio amateurs, and can be installed in a few minutes at a cost of less than $1.00. The indicators, ordinary pilot lamps identified in Fig. 2-13 as I_1 and I_2, flash brightly on audio peaks developed by an a.c.-d.c.

[1] Crosby, "Reception with Product Detectors," *QST* May, 1956.

receiver tuned to a modulated broadcast carrier. Inasmuch as most broadcast carriers are almost constantly modulated, the indicators glow with-

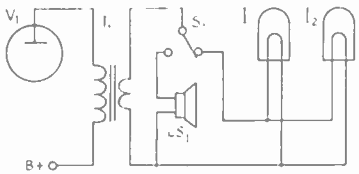


Fig. 2-13—Circuit diagram of the W3BFO conelrad monitor. The alarm components—two pilot lamps and a toggle switch—may be built into an a.c.-d.c. broadcast receiver or they may be mounted in a small box as illustrated in Fig. 2-14.

out appreciable interruption as long as the broadcast station continues normal operation. When the lamps go out, it is an indication that the station has ceased operation for one reason or another, or that either the receiver or lamps have failed.

In Fig. 2-14, LS_1, T_1 and V_1 are the loudspeaker, audio output transformer and output tube, respectively, of a small a.c.-d.c. broadcast receiver. S_1 is a s.p.d.t. toggle switch which transfers audio voltage developed across the output winding of T_1 to either the speaker or the indicator lamps, I_1 and I_2. Thus, while the receiver is being used as a conelrad monitor, the speaker may be silenced to prevent annoying background noise. I_1 and I_2 are standard 6.3-volt 150-ma. (No. 40 or 47 will do) pilot lamps. Using two or more lamps connected in parallel (I use 3 lamps here at W3BFO) reduces the possibility of a *false* alarm that could be caused by lamp burnout in a single lamp arrangement.

Unless the broadcast signal is extremely weak, the lamps will glow quite brightly after the receiver has been tuned, S_1 thrown to the monitor position and the audio gain control advanced to the full-on setting. Remember to back off on the gain control before returning S_1 to the speaker position; otherwise you'll hear a most unpleasing blast of radio.

The lamps and the switch may be mounted in a small box located in some convenient spot at the operating position. Ordinary hookup wire may be used for the leads between the indicator unit and the control receiver.

— *Harry T. Ebner, W3BFO*

Editor's Note: Shortly after W3BFO submitted his conelrad alarm circuit, Earl W. Douglas, W9BBG, forwarded his ideas on the same stunt. However, Doug uses a small Christmas tree lamp as the visual indicator and points out an additional feature of the simple alarm. The bulb or lamp *flashes* when activated by the audio peaks derived from a broadcast carrier modulated by music, voice or other forms of entertainment. However, the lamp glows brightly *without* flashing when the 1000-cycle conelrad signal is being transmitted. In other words, the simple visual indicator actually differentiates between normal broadcast programming and conelrad alert signals.

A SIMPLE HOUSING

The simple conelrad monitor by W3BFO — and his comment about a small housing for same — made us think immediately about one of the most readily available (especially if you have any junior ops in the house) and inexpensive metal boxes that we know of — the containers used to package adhesive bandages. These small boxes can be drilled or punched with ease, soldered to without difficulty, have a hinged cover, and come in at least two different sizes.

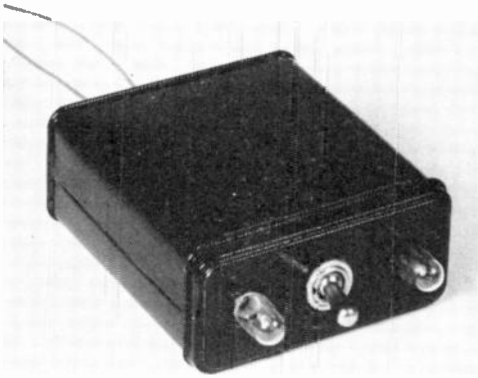


Fig. 2-14—The pilot lamps and toggle switch for a W3BFO-type conelrad monitor may be mounted on the lid of an adhesive bandage container as seen in this view.

The three alarm components, I_1, I_2 and S_1 of Fig. 2-13, can be mounted on the hinged lid of a box as shown in Fig. 2-14. Remove the enamel from the inside surface of the lid so that the lamps, after being twisted into snug-fitting mounting holes, can be tacked securely in place with a spot or two of solder. Punch or drill a hole in the bottom of the can (this surface is actually the rear of the box when the unit rests as shown in the photograph) to clear the three leads that must run to the speaker and the output transformer at the receiver end. The finished job takes on a neat appearance if the box is painted with a coat or two of enamel.

Incidentally, if you are building one of the alarms for use in a weak-signal area, it may be advisable to use the No. 48 or 49 lamps rated at 2 volts and 60 ma. It takes much less signal input to the receiver to light 60-ma. bulbs to full brilliance than it does to really brighten up the 150-ma. jobs. If there is doubt as to the best type of lamp for your own particular installation, use a v.t.v.m. to measure the audio voltage — audio gain control full on and speaker disconnected — available at the secondary terminals of the output transformer. If the maximum output is less than 3.5 volts, use the 60-ma. bulbs.

— *C. Vernon Chambers, W1JEQ*

RECEIVER INPUT IMPEDANCE MATCHING

After purchasing a new t.r. switch I realized it would be a problem to couple the switch to the receiver, since the receiver has a 300-ohm input and the switch has a low-impedance output.

Several methods of solving the problem were considered. I thought of using transmitting-type balun coils, building a matching device, or using antenna coils from an old junk-box receiver. It suddenly dawned on me that TV front-end tuners use a pair of balun coils to match a balanced 300-ohm line to a low-impedance unbalanced line. After purchasing a pair of these coils from a sur-

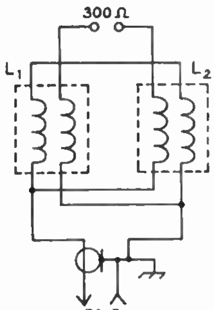


Fig. 2-15—Diagram showing connections when using TV front-end baluns for receiver impedance matching.

L_1L_2—TV front-end balun coils.

plus store I installed them between the switch and receiver and found an increase in signal strength of at least two S units over the previously mismatched condition.

These balun coils are available from most surplus stores and measure about ⅝ × 1½ inches. They are bifilar-wound, one being a dark color and the other shiny in appearance. Close examination will identify the proper leads or an ohmmeter can be used to find the correct leads. The diagram in Fig. 2-15 shows the proper connections. —*Clark A. Chamberlain, W5RSH*

[The table below shows measured impedance at the 72 ohm side with a 330-ohm resistive load connected to the 300-ohm terminals. — *Ed.*]

Frequency (Mc.)	Input Resistance (ohms)	Equivalent Shunt Capacity (μμf.)*
7	100	− 86.5
14	90	− .1
21	80	+ 10.4
28	70	+ 10.5
30	68	+ 10.4
50	50	+ 4.5
100	109	− 4.0
145	53	+ 2.5
220	160	− 1.5

* Shunt capacitance required to be added (−) or subtracted (+) to resonate the circuit at the given frequency.

VISUAL INDICATOR FOR CONELRAD MONITORING

Anyone interested in gadgets in order to comply with the conelrad rules may be interested in the simple visual alarm used here at W7UWO.

The indicator circuit, shown here as Fig. 2-16, is the familiar electron-ray indicator arrangement described in recent editions of *The Radio Amateur's Handbook* (Signal Strength and Tuning-Indicators Section). It uses a type 1629 electron-

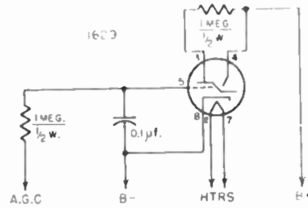


Fig. 2-16—W7UWO uses this circuit as a conelrad alarm. The visual indicator is a type 1629 removed from a surplus Command transmitter.

ray tube which, incidentally, was lifted from a Command transmitter that had been assigned to the junk box. A small five-tube a.c.-d.c. broadcast receiver provides the control voltage (a.g.c.) and the power for the plate, target and heater elements of the tube. The filament of the 1629 is connected in series with the heater line of the broadcast receiver. This results in slightly reduced heater voltage on all of the tubes, but this appears to have no adverse effect on the operation of the receiver or the indicator tube. Remember to return the B — lead of Fig. 2-16 to the *common* ground in the broadcast receiver — not to the receiver's chassis or the bracket that supports the tube. This method of installation will eliminate shock hazard.

The 1629 may be conveniently located at the operating position. The *eye* of the tube will remain closed as long as the receiver is tuned to a broadcast signal. When the eye opens, it is time to cease transmitting and then retune the receiver to one of the two conelrad frequencies — either 640 or 1240 kc.

This simple indicator works quite well in actual practice and about the only cost involved was a little time on my part.

—*Charles A. Lofgren, W7UWO*

AUDIBLE CONELRAD WARNING

The circuit shown in Fig. 2-17 provides conelrad monitoring by mixing the output of a broadcast receiver with that of a ham-band communications receiver. The "background" signal caused by the broadcast audio will provide continuous monitoring as long as both receivers — and a broadcast station — are in operation. Amplitude of the background or warning level may be controlled by the volume control for the broadcast receiver. Although the system is simpler and less expensive than most of the a.v.c. triggered arrangements, it may be used with any broadcast signal that *can be heard.* And in most cases, signals that can *just be heard* are ones having insufficient strength to operate reliably an a.v.c. controlled alarm.

LS, T_1 and V_1 in Fig. 2-17 are the loud-speaker, output transformer and audio-output tube, respectively, of a small broadcast receiver. T_2

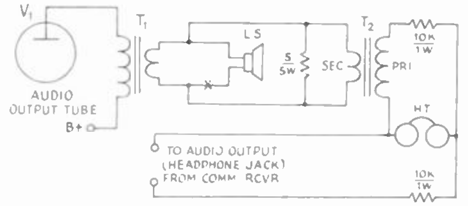


Fig. 2-17—Circuit of the audible conelrad monitoring arrangement submitted by WA2ANU.

is a transformer of either the filament or output type and must be connected with the secondary winding in parallel with the low-impedance side of T_1. The values of resistance shown in the schematic work well with headphones of 2000- to 8000-ohm impedance.

A s.p.s.t. toggle switch may be inserted at point X to disable the broadcast receiver loudspeaker if desirable.

— *David T. Geiser, WA2ANU*

USING THE GRID DIPPER AS A CONELRAD MONITOR

HERE is another conelrad idea that puts a piece of test gear to work almost "full time." I've been using my B & W grid dipper as an audible/visual conelrad monitor and find that it works quite satisfactorily when tuned to a local broadcast carrier of reasonable strength.

The only work involved in preparing the meter for conelrad operation is the winding of a broadcast-band coil. The tuning range of the meter is not wide enough to cover the complete band, but will cover better than 700 kc. with one swing of the main-tuning dial. An inductor of fair size — both in value and physical shape — is required. A form similar to the now obsolete National type XR-6, having a diameter and winding length of 1½ and 2¼ inches, respectively, is ideal for the job after all but two of the prongs have been removed.

The inductor-meter combination used here at W2TJX rides the local 1210-kc. channel for continuous monitoring. It takes only a second to slide up to the 1240-kc. conelrad frquency whenever the shift is warranted.

— *Wilbur C. Stevens, W2TJX*

[To assist anyone who wishes to try W2TJX's idea, we made some capacitance checks on Barker & Williamson, Heathkit and Millen grid-dip meters. Approximate values of minimum and maximum tuning capacitances for the three meters tested are as follows:

Type	Min. μμf.	Max. μμf.
B & W 1600	6	55
Heathkit GD-1B	8	75
Millen 90651	7	50

From the above, and with the aid of an ARRL Type a *Lightning Calculator*, it is a simple matter to determine that any one of the three meters will cover the 700- to 1600-kc. range with a 1-mh. inductor in use. And a few seconds more with the *Calculator* shows that the 1-mh. coil may be made with 215 turns of No. 32 enameled wire, close-wound to a length of 1⅞ inches on a 1½-inch diameter form. — *Ed.*]

WARNING — A.C.-D.C. RECEIVERS AND CONELRAD MONITORS

As is the case with almost any piece of a.c.-d.c. equipment, there is always the possibility of *shock* hazard when you start adding outboard leads and devices to an a.c.-d.c. broadcast receiver. Therefore, before installing a conelrad alarm such as described by W3BFO (see pages 36 and 37) it is a good idea to check and rewire, if necessary, the output-transformer and speaker wiring of the set. Make sure that the transformer-to-speaker wiring is clear of the chassis. Then, if random insertion of the line plug or failure of the isolating capacitor places the chassis *above* ground, the a.c. line voltage to the receiver will not be transferred to external leads, exposed terminals or alarm-circuit components.

— *Kermit A. Slobb, W9YMZ*

CONELRAD MONITORING WITH DISCARDED AUTO RECEIVERS

AUTOMOBILE receivers of the 6-volt vibrator type — as well as 12-volt models if your junk box happens to be that modern — that have been set aside for one reason or another can be put to work as fixed-station conelrad monitors by modifying them for a.c. operation. Only a few minutes labor is involved in the transformation, and if the junk box does not contain the main component required a brand-new one will cost much less than the price of an all-new monitor.

The first step in modifying the car receiver is that of removing the vibrator and locating the primary winding of the power transformer. This is usually a center-tapped winding having the outer ends connected to the vibrator socket and the c.t. connected to the d.c. input (battery) terminal. Next, connect the secondary of a 6.3-volt filament transformer between the c.t. and one end of the vibrator transformer primary winding, and then ground one side of this circuit to the chassis. Now, install a 115-volt a.c. line cord for the filament transformer. The on-off switch on the receiver can probably be easily rewired to serve as the on-off control for a.c. operation.

Chances are better than average that the ends of the vibrator transformer primary winding will be terminated directly at the vibrator socket and that these leads need not be disconnected from any other part of the power supply circuit when the above modification is made. However, it is advisable to make a thorough check of the circuit just in case. The resistor and capacitors that are usually connected across the primary winding need not be disconnected.

Naturally, it is advisable to determine how much current the radio normally takes from the car battery in order that you can estimate the required current rating for the filament transformer. If the fuse is still mounted in the receiver, it will give you a clue as to normal receiver power ratings.

— *Kendall Young, W5OCV*

3. Hints and Kinks . . .

for the Transmitter

"MAGIC EYE" TUNING INDICATOR

Occasionally the need arises for a really low-cost transmitter, one such as might be built and paid for by an individual and then left to sit at the local civil defense station. Here is a suggestion that will help cut the cost. The author makes no claim of originality of the idea because it has been used in both amateur and commercial designs.

The idea is that of using an inexpensive "magic eye" tube as the tuning indicator for the output stage of the transmitter. If you can not *steal* a type 6E5 from an old broadcast receiver, a new one won't cost much more than a dollar. Properly installed, this simple indicator will serve the purpose just as well as its more expensive counterpart, the customary plate milliammeter.

A typical installation is shown in Fig. 3-1. In this case, the power-amplifier tube is a type 2E26

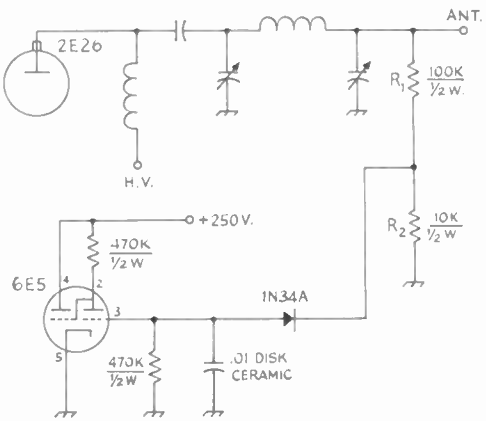


Fig. 3-1—Circuit of the "magic eye" tuning indicator as connected to W9KLJ's transmitter. Components without values are parts of the power-amplifier output circuit.

running at 16 watts input. For other values of power input, the resistance of R_2 can be altered from that shown. Indicator tubes other than the type 6E5 will require appropriate changes in both R_1 and R_2.

— John W. Wilder, W9KLJ

PROTECTION OF TETRODE SCREEN GRIDS

One of the disadvantages of using a fixed screen supply is the excessive screen dissipation that occurs when plate voltage is unintentionally removed from the tube. This drawback of the fixed-supply system can be overcome by feeding the screen through the contacts of a normally open s.p.s.t. relay as shown in Fig. 3-2. Voltage for the relay is obtained from the

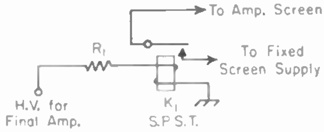


Fig. 3-2—Protective circuit for fixed screen-supply operation.

high-voltage plate supply through the dropping resistor, R_1. The value of resistance and the wattage rating of R_1 will be determined, using Ohm's Law, by the resistance of the relay winding and by the output voltage of the h.v. supply.

The most desirable feature of the system is that it is automatic. If the plate voltage is removed from the tube because of a blown fuse, defective component or the unintentional opening of a control switch, the relay opens and breaks the screen voltage lead.

— Don Priebe, W8MQQ

OSCILLATOR MODIFICATION FOR THE "GLOBE SCOUT" TRANSMITTER

The 6V6 oscillator tube in the W.R.L. "Globe Scout" transmitter requires more drive than some of the small v.f.o. units will deliver. This condition can be quickly remedied by changing the oscillator tube to a 6AG7, as suggested to me by W1DJC. The oscillator tube socket must be rewired to accommodate the new tube, but it is not necessary to after the basic circuit.

After the modification, the transmitter can be driven by a small v.f.o. such as the Heathkit VF-1, and will work as well with crystal control as it did before.

— R. A. Laine, W1CDD

RE THE 4X150A

We have found that some 4X150As "go west" due to a short between control grid and screen grid. If a d.c. potential of 1800 to 2000 volts is impressed across these grids, the short is vaporized, and in many cases, the tube is returned to operative condition.

Any good v.t.v.m. may be used to check the circuit to show the high-resistance short. Naturally, infinite resistance will appear between grids of a good tube.

— Dwight B. Olson, W9EAM

NEUTRALIZING CAPACITOR FOR SCREEN-GRID TUBES

A simple and inexpensive capacitor for the capacitive neutralizing circuit can be made from a war-surplus slug-tuned coil form and a strip of flashing copper. A ½-inch strip of copper wound around a ⅜-inch form having a ½-inch slug will provide a capacitance range of 0.6 to 10 μμf. This range of capacitance is ideal for tubes such as the types 2E26, 6L6, 829B, 6146, etc.

Of course, the coil form should be one having a brass slug.

— Lloyd G. Hanson, W9YCB

IMPROVED R.F. CABLING FOR REMOTE-TUNED VFOs

After constructing and using several remote-tuned variable-frequency oscillators, it became apparent that one of the weakest points in this system is the cabling between the frequency-control box and the rest of the oscillator. Instability or intermittent operation of a v.f.o. can frequently be traced to poor contacts in the plugs and receptacles used to terminate the interconnecting coax line. I have found that Amphenol type 83–22SP and 83–22R plugs and receptacles, respectively, used in conjunction with RG-22/U coaxial cable, provide the most reliable tank-to-tube connections yet employed.

— Donald Miller W4VZQ

CRYSTAL SOCKET HINT

An 8-prong tube socket wired as shown in Fig. 3-3 provides the maximum usable number of mounting positions for a crystal. With the socket so connected, it is impossible to insert a crystal without making connection to the oscillator circuit.

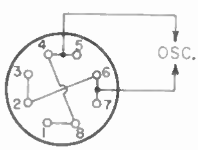


Fig. 3-3—A novel way of connecting an 8-prong socket for use as a crystal holder.

Incidentally, the undersigned claims no credit for the idea. It's just one of those stunts that turned up in a technical article and then seemed to receive no further mention. Let's hope that some of the fellows will find it adaptable to their next rigs.

— Joseph A. Unterkofler

TRANSMITTER NEUTRALIZING WITH THE STATION RECEIVER

Recently, while neutralizing a new transmitter, I tried using the station receiver as a neutralizing indicator. High voltage was removed from the transmitter final-amplifier tubes and a short piece of coax was connected to the transmitter output. The coax was terminated with a wide-spaced two-turn coil about ⅝ inch in diameter. A one-turn coil of the same diameter was connected to a short piece of Twin-Lead which in turn was connected to the receiver's antenna input terminals. The receiver was then tuned to the transmitter frequency.

With drive applied to the transmitter final amplifier, adjust both the coupling between the above coils and also the receiver's r.f. gain control for maximum S-meter reading. To neutralize; adjust the neutralizing circuit in the transmitter for minimum S-meter reading.

— Corwin Butler, K5INC

CORRECTING WRONG-WAY GRID CURRENT IN THE HEATHKIT DX-100 AND APACHE TRANSMITTERS

Under certain conditions during tune-up the final grid current reading on both the DX-100 and Apache transmitters will go below zero. With the change shown in Fig. 3-4, the meters will read actual grid current without going below zero.

On the Apache, the change is easily made by shifting the yellow wire from terminal C1-2 to CJ-1, as shown in Pictorial 22, page 67 of the Apache instruction book. On the DX-100 it will be necessary to add an insulated terminal. Mount the terminal on the spade bolt that holds the v.f.o. bracket adjacent to the 500,000-ohm clamp-circuit potentiometer (see Pictorial 7, page 34 of the DX-100 instruction book).

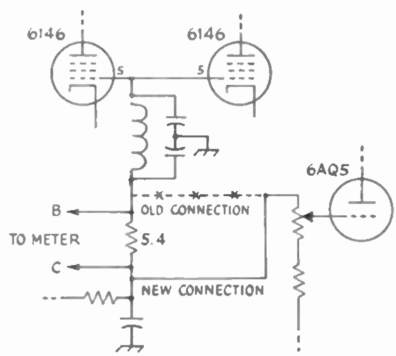


Fig. 3-4—New connection to improve the DX-100 and Apache meter circuit.

Remove the violet wire and the 5.4-ohm resistor from terminal 3 of the 500,000-ohm clamp circuit potentiometer. Reconnect these leads to the insulated terminal. Now connect the vacant potentiometer terminal (3) to the other side of the 5.4-ohm meter shunt.

— Harold C. Jensen, W1LUW

VIKING RANGER V.F.O. ZERO BUTTON

The circuit shown in Fig. 3-5 was developed to permit zeroing the Viking Ranger v.f.o. without operating any switches after the transmitter is tuned up. Normally, in order to zero beat a received station, the OPERATE switch has to be turned from C.W. to STANDBY and the key pressed. This requires two switch operations each time the v.f.o. is tuned to the frequency of the received station. During a contest this might require hundreds of switch operations.

The zero button S_1 keys the v.f.o. independently

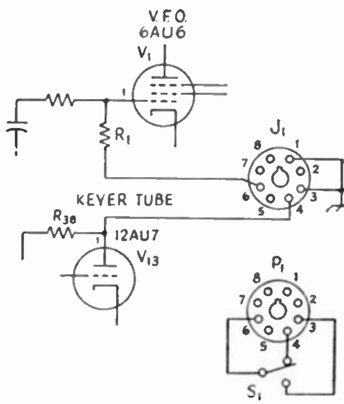


Fig. 3-5—Diagram showing the v.f.o. zero addition to the Viking Ranger.

J_1—Existing octal socket.
P_1—8-prong octal plug (Amphenol PM8-11).
S_1—S.p.d.t. push button switch (General Cement 1340).

of the rest of the transmitter. The level of the "v.f.o. only" signal in the receiver is adequate on 80 and 40 meters and reduced somewhat on 20 meters but still usable.

Unused pins on the existing octal socket J_1 (the one provided for plugging in crystals) are used to bring out the oscillator grid connections without the need for drilling any holes and destroying the resale value of the transmitter. An Amphenol octal type plug, P_1, is connected to the push button zero switch by a short length of cable and is mounted at the operating position. To restore the transmitter to its original circuitry, merely connect pins 4 and 6 of the crystal socket together. — *Lewis E. Flicker, jr., W3ADE*

KEEP IT CLEAN

Users of forced air-cooled tubes such as the 4X150, 4CX250B, PL172, etc., should pay attention to the small print on the tube data sheet which says, "Clean the air system periodically." The blower blades in particular will pick up quite a bit of dust and lint which becomes packed between the blades, with the result that the output of air and the life of expensive tubes are reduced considerably. A pipe cleaner moistened in water is ideal for cleaning both the blower blades and the cooling fins of the tube. Cleaning should be done every two months.

— *Melvin Leibowitz, W3KET*

RELAY-CONTROLLED SEND-RECEIVE CIRCUIT

The circuit shown in Fig. 3-6 was built into a small control box for use with a type BC-458-A transmitter. However, it may be used with any transmitter that uses a separate power supply for the oscillator.

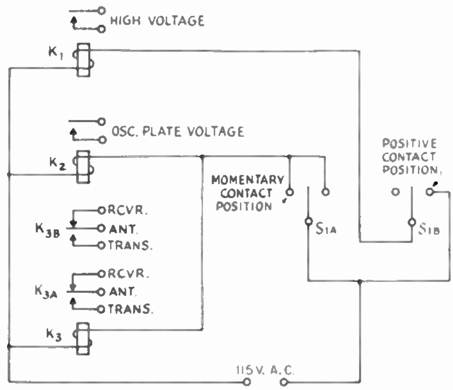


Fig. 3-6—WØYVA's send-receive circuit. K_1, K_2 and K_3 are 115-volt a.c. relays. S_1 is shown in the "receive" or neutral position.

In the arrangement, K_1 and K_2 are normally-open s.p.s.t. relays. K_3 is a normally-open d.p.d.t. antenna changeover relay. S_1 is a d.p.d.t. switch having a center-off position in addition to the momentary- and positive-contact positions. Of course, if this particular type of switch is unavailable, any d.p.d.t. switch having a neutral position will do the trick.

The circuit functions as follows: With S_1 in the "receive" or center position, all relays remain open and the contacts of K_3 connect the antenna to the receiver. For zero-beating or other adjustments involving only the oscillator section of the transmitter, S_1 is thrown to the momentary-contact position. This causes K_2 to apply plate voltage to the oscillator and K_3 to disconnect the antenna from the receiver. In the "transmit" or positive-contact position, S_1 feeds 115 volts a.c. to all three relays, thereby activating the entire transmitter.

— *Bob Sullivan, WØYVA*

CRYSTAL HOLDER HINT

Anyone who does much crystal grinding probably has frequent occasion for dismantling surplus-type crystal holders. And it's probably just as true that the grinder has had his share of trouble keeping track of the small nuts and lock washers that fall free of the holder when the latter is opened.

There is a very simple solution to this problem. Merely cover the back side of the holder with a strip or two or Scotch tape. This prevents the nuts and washers from falling free and, of course, each piece of hardware will be right where it belongs when assembly time comes due.

— *Bert Felsburg, W3VN*

HI AND LO-BAND EDGE MARKERS FOR "COMMAND" TRANSMITTERS

Some operators may be interested to know that the "resonance-indicator" circuit in the popular Command transmitters will work with two crystals. Therefore, it is possible to use the arrangement for marking both the upper and lower limits of a band.

The two crystals must be connected in parallel before being inserted in the original crystal holder. An adapter for a pair of FT-243 holders can easily be made by wiring an 8-prong octal socket to an 8-prong octal plug. The latter may very well be the base of an old tube. Prongs 1 and 7 of the socket should be connected to Pin 7 of the base, and socket prongs 3 and 5 to Pin 3 of the base. Remove the unused prongs from the socket to prevent shorting, and bind socket and base tightly together with friction tape.

The magic eye (1629) may not open as wide with the dual-crystal arrangement as it does when a single crystal is used, but it will give a positive indication of resonance as the v.f.o frequency slides onto either crystal frequency. The frequency of the oscillator may "pull" slightly toward the crystal frequencies, but this slight pull may even help so far as staying in the band is concerned. Of course, when using this system, one must first make very sure that the marker crystals are *within* the band.

— *Joseph W. Thane, KØGGL*

MODIFYING 1625s FOR GROUNDED-GRID OPERATION

In *QST*, June, 1955, W9MOW and W9SAR called attention to the desirability of providing a direct ground for the beam-forming plates of the type 1625 when the tube is used in grounded-grid applications. Although the previous modification instructions work well in practice, there is a simple method of providing the separate ground that does not require removing the original base and replacing it with a 6-prong type. At least, the method under consideration can be applied to Ken-Rad (GE), Canadian GE, and some unknown brands that come in Sky-tron cartons.

To get *into* the base of a tube, support it horizontally in a cradle such as a vise with Pins 5 and 6 at the top. Then, use either a rat-tail file or a jeweler's saw to cut a slot in the base directly above Pins 5 and 6. Make the slot about ¼ inch wide and long enough to permit working around the two pins with a small tool such as a soldering aid. Now, apply heat from a soldering iron to the cathode pin, slip the beam-forming lead out of position, and insert it in Pin 5. Solder where needed, and the tube is ready for use.

— *Harry W. Land, W5ZBF*

Editor's Notes:

1) Capt. Jesse F. Adams, MC, USN, WA2EBW, also submitted the above hint for modifying type 1625s after he had picked the idea up from W6ESE. And he also reminds us that tubes made by National Union and Raytheon have the beam-forming lead brought out of the glass envelope (to Pin 6) where it is accessible after cutting into the base.

2) W. E. Howard, W8PWS, pulls the beam-forming and cathode leads *out* through a ¼-inch hole drilled in the side of the base in between Pins 5 and 6. The hole is centered ¼ inch above the bottom of the base and is drilled with care to prevent shattering of the glass stem at the center of the base. After the leads have been identified by means of an emission test, they are passed down over the *outside* of the base to Pins 5 and 6, and soldered. A few drops of Duco cement secure the leads to the side of the base.

3) Our own interest in modified 1625s led us down to the lab, the tube bin and then to the workbench. We not only found out that the above suggestions are indeed effective, but that the RCA 1625s — the ones we happen to have the most of — do not have the separate leads for the beam-forming and cathode elements. So here is one brand that there is no need for hacking into "just to find out."

USING THE MEISSNER TYPE EX SIGNAL SHIFTER AT 1.8 MC.

During the transatlantic tests on 1.8 Mc. last year I soon tired of my one crystal-controlled frequency. This condition was soon remedied by modifying the transmitter so as to permit using the Shifter as a source of 160-meter excitation. The method outlined below should work with any turret-type Meissner Signal Shifter and with many other types of exciters using doubler (to eighty meters) output stages.

The Signal Shifter here at W9PNE drives a bandswitching 809 buffer stage that is in turn followed by an 8005 final. A 365-μμf. variable capacitor was connected in parallel with the regular 100-μμf. job already in the 809 grid circuit. The 809 grid coil was then rewound so that it resonated at eighty meters with the 365- and 100-μμf. capacitors set for minimum and one-third capacitance, respectively. The tank circuit then tuned to 160 meters with the large capacitor nearly meshed. Several turns were added to the large 300-ohm coupling link which was wound directly over the grid coil at the grounded end.

With the Shifter tuned for output at 3.6 Mc. and the 809 grid circuit resonated at 1.8 Mc. the 809 gave more than enough drive to the 8005 amplifier running with 200 watts input at 1.8 Mc. High-*C* was used in the plate tank of the 809 to minimize 3.6-Mc. output.

There is nothing mysterious about this method of operation. The Signal Shifter uses a 6V6GT oscillator-doubler followed by an 807 doubler. In this case, use is made of the fact that most single-ended doubler stages do deliver appreciable output at the fundamental frequency. Furthermore, the 807 output stage has a low-*C* plate circuit and uses fairly tight output coupling. This combination closely coupled to the high-*C* input tank of the 809 results in adequate excitation for the tube at 1.8 Mc.

There has been found no tendency toward instability with this arrangement. Keying is excellent and the note is T9x with negligible drift. The output frequency of the exciter is exactly one-half of the normal output frequency for any setting of the Shifter dial.

— *Brice Anderson, W9PNE*

IMPROVED CONTROL CIRCUITS FOR THE DX-35

The accompanying diagram, Fig. 3-7, shows how a d.p.s.t. toggle switch can be used to advantage in the send-receive circuit of a Heathkit type DX-35 transmitter. Once the simple modification involving mounting and wiring the switch is completed, it will provide *one-switch* control of the transmitter plate voltage and any external relays that may be used for antenna changeover, receiver muting, etc.

S_{1A} of the new arrangement provides on-off switching of 115 volts a.c. that has been piped over to previously unused terminals 5 and 6 of the auxiliary power socket. This voltage may be cabled out to the aforementioned relays. S_{1B} of the modified circuit is connected in series with the on-off contacts of the "Operation" switch for the transmitter. Thus, S_1 provides simultaneous control of the transmitter, the antenna relay, and the receiver muting circuit.

In making the modification, first remove the key jack from the front panel of the transmitter. Drill a hole in the rear apron of the chassis, in between the coaxial receptacle and the microphone jack, and remount the key jack. The hole left vacant at the front of the rig should now be enlarged slightly to accommodate the toggle switch, S_1.

Next, replace the lead between Terminal 6 of the operation switch and ground with a pair of leads which terminate at S_{1B} as shown in Fig. 3-7. The second wire originally connected to Terminal 6 of the operation switch (the one that goes to the slide switch) should be disconnected at Terminal 6 and then returned directly to ground.

Pin 11 or 12 of the operation switch is connected to the a.c. line cord at the 4-terminal tie-point strip identified as part "AA" on Heathkit pictorial drawings. Using an ohmmeter, or other means, determine which switch pin is so connected, and then run a wire from this pin to one terminal of S_{1A}. Connect the other side of S_{1A} to Pin 5 of the auxiliary power socket, and then connect Pin 6 of the socket to Terminal 1 of lug strip "AA." This completes the wiring except for adding by-pass capacitors, C_1 and C_2 in Fig. 3-7, to Pins 5 and 6 of the power socket. These capacitors should be similar to those already connected to other terminals of the auxiliary power socket.

The filaments of the transmitter are still turned on and off with the operation switch after S_1 has been installed. The operation switch is set at either the c.w. or the phone position depending on the mode of transmission and is not used again until the transmitter is turned off. Turning the toggle on will apply high voltage — with operation switch on either phone or c.w. — and will activate the external antenna or other relays.

— *Reagin Warren, W4RVH*

When using a v.f.o.–DX-35 setup it is necessary to have the carrier on the air when zeroing in on the desired frequency. This forces the operator to sweep the band with a carrier and causes receiver blocking. The number two fault is minor in comparison. It is just that in changing back and forth from send to receive, the usual combination of switches on the transmitter and receiver have to be operated quickly and in the proper direction and sequence. Both of these faults are easily corrected by a simple modification without impairing the operation or basic design of the set. In fact, with the modification in effect, a shorting loop shoved into Pins 5 and 6 of the auxiliary socket leaves the operating circuits set up as described in the instruction manual.

What do we need for the big job? One 20,000-ohm 10-watt resistor, three .001-μf. disk ceramic bypass capacitors, fifteen inches or so of hookup wire and about 30 minutes. To accomplish the modification, refer to the pictorials in the instruction manual and perform the following steps:

1) Remove the two white wires on Terminal 6 of the operation switch, solder together and tuck out of the way. No insulation is necessary because they are grounded about three inches away.

2) Remove the connecting wire between Terminals HH-1 and E-1.

3) Connect a piece of wire from Terminal 6 of the operation switch (S) to Terminal HH-1 (S).

4) Move the transformer high-voltage center-tap lead from FF-5 to FF-3 (S).

5) Move the lead of the 20K 10-watt resistor from FF-4 to FF-5 (NS).

6) Connect one lead of the additional 20K 10-watt resistor to FF-4 (NS) and the other lead to F-3 (NS).

7) Connect a wire from FF-4 (S) to F-6 (NS).

8) Connect a wire from FF-5 (S) to F-5 (NS).

9) Connect one lead of a 0.001 disk ceramic capacitor to F-3 (S) and the other lead to the nearest ground point (S).

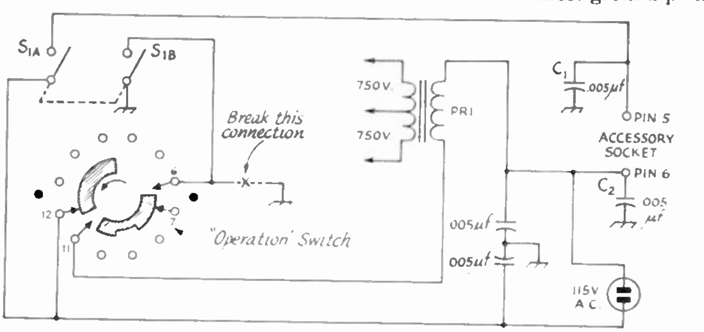


Fig. 3-7—Circuit of W4RVH's improved control circuit for the DX-35 transmitter. C_1 and C_2 (see text) must be rated for 115 volts a.c. S_1 is a d.p.s.t. toggle switch.

10) Connect one lead of a 0.001 disk ceramic capacitor to F-5 (S) and the other lead to the nearest ground point (S).

11) Connect one lead of a 0.001 disk ceramic capacitor to F-6 (S) and the other lead to the nearest ground point (S).

With the above connections made, Terminals 5 and 6 on the auxiliary socket connect to the remote operating switch if one is used for push-to-talk operation. If such a switch is not used, 5 and 6 must be jumpered with a short piece of wire. The addition of a s.p.d.t. switch to any v.f.o. used with the set now will allow the v.f.o. to be turned on without turning on the transmitter since B+ to operate it appears on Terminal 3 of the auxiliary socket regardless of the position of the operation switch.

— *Glen R. Jackman, K6ETG*

WIDE RANGE LOADING CAPACITANCE USING ONLY FOUR CAPACITORS

ALTHOUGH the circuit shown in Fig. 3-8 is not new, it has not recently been presented in connection with the popular pi-section tank circuit. Its versatility should make it useful in the output portion of a pi-section tank or in other applications where a wide range of capacitance is required. The novel feature of the arrangement is that only four fixed capacitors are required for a ten-step capacitance range covering 100 to 1000 μμf. in steps of 100 μμf. each.

S_{1A} and S_{1B} are mounted on a common index and therefore rotate together. Switch positions 1, 2, 3 and 4 connect the output terminals across capacitors C_1, C_2, C_3 and C_4, respectively, giving a total capacitance determined by the particular capacitor in use. Notice that the capacitance of C_2 is twice that of C_1, and that C_3 and C_4 have a capacitance of 300 and 400 μμf., respectively.

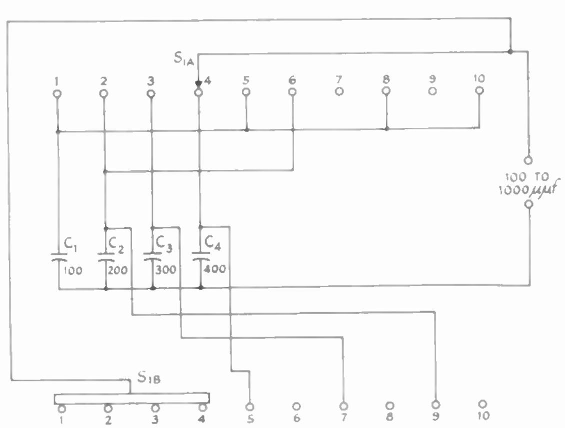


Fig. 3-8—Circuit diagram of the ten-step capacitance system described by W2RIZ. Capacitances are in μμf. S_{1A} is a Centralab type Y wafer and S_{1B} is a type P1S progressively-shorting section. Both switches are mounted on a type P121 index assembly. C_1 through C_4 are discussed in the text.

Switch positions 5 through 10 connect to various parallel combinations that provide 100-μμf. steps from 500 up to and including 1000 μμf.

Naturally, other ranges of capacitance may be obtained by using proper values of fixed capacitance. For instance, the range will be 200 to 2000 μμf., in steps of 200 μμf. each, if C_1 through C_4 have capacitances of 200, 400, 600 and 800 μμf. in that order.

— *H. E. Preston, W2RIZ*

STABLE OSCILLATOR

HERE is a circuit which will be of interest to those who are experimenting with stable oscillators. The diagram in Fig. 3-9 shows the oscillator. The tuned circuit L_1C_1 determines the frequency of oscillation. Capacitor C_2 is a 50-μμf. variable and is fairly critical in adjustment when the oscillator is first tuned. However, once set, it doesn't require readjustment throughout the tuning range of the oscillator — in my oscillator this was 3.8 to 6 Mc.

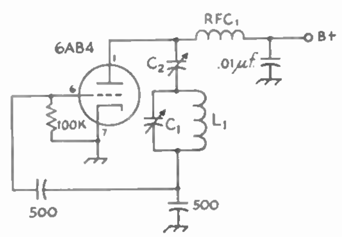


Fig. 3-9—Circuit of the oscillator. Unless otherwise indicated, capacitances are in μμf. The tuned circuit L_1C_1 is tuned to the operating frequency.
C_2—50-μμf. variable capacitor.
RFC_1—2.5-mh. choke.

I plan to add another triode as a cathode follower and to use the oscillator as a v.f.o. There are several points in the circuit from which the output can be taken but the best will have to be found experimentally.

— *Clarke Redfield, K2DIG*

A SIMPLE METHOD TO LOWER CRYSTAL FREQUENCY

INSTEAD of rubbing a crystal with solder to lower the frequency, rub one side with an ordinary lead pencil. This will lower the frequency much more effectively with less danger of fracturing the crystal itself.

If you overshoot your mark by applying too much lead you can erase it with an ordinary pencil eraser. The first time this method was tried I succeeded in lowering the frequency of a crystal about 36 kc. without breaking or chipping the crystal. The frequency of the crystal has since remained very stable.

— *Mike Kaufman, K6VCI*

NOTES ON THE HEATHKIT DX-100 TRANSMITTER

The following suggestions are offered to anyone who owns or contemplates purchase of a DX-100 transmitter. Although the unit is a popular rig as it stands, it can be made more convenient to handle, operate and service by the addition of several minor modifications.

First of all, the four crystal sockets for the transmitter are mounted on the *inside* of the cabinet. Therefore, crystal changing requires the removal of a dozen or more screws and some wrestling with a chassis weighing approximately 100 pounds. This problem can be easily and quickly solved by mounting a crystal socket on the front panel just above the power switch. A short length of 300-ohm cable and a Twin-Lead plug may be used for connection between the new socket and one of the internal sockets.

A pair of utility handles mounted on the top edges of the cabinet will permit more convenient handling of the rig. Mounting of the handles on the sides of the cabinet is not recommended because it prevents a receiver or other piece of equipment being placed directly next to the transmitter. A second pair of handles, mounted on the front panel, will facilitate more convenient removal of the chassis for crystal changing, tube replacement, etc.

The type 1625s in the modulator are the only tubes in the transmitter that may, in the case of failure, create a local procurement problem. Should this situation arise, it may be solved by adapting the modulator circuit to use 807s. This is accomplished by replacing the existing 7-pin sockets with a pair of 5-pin medium sockets, and by wiring the latter as indicated in Fig. 3-10. Except for the sockets and tubes, no other substitution of components is necessary.

Finally, it is recommended that the "Plate" switch be replaced with one of the compact

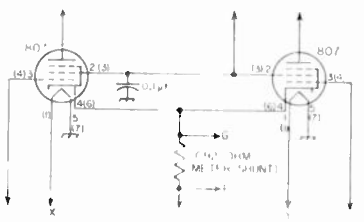


Fig. 3-10—Wiring of the 807 tube sockets for the DX-100 transmitter. Pin numbers in parentheses apply to the 7-pin sockets for the 1625s. Arrows marked F, G, X and Y are designations found on the Heathkit circuit diagram. All other arrows point to original circuit wiring.

heavy-duty types. Considerable sparking occurs within the original switch whenever it is thrown from the transmit to the receive position, thereby indicating the possibility of breakdown at some inopportune moment.

— *Paul B. Boivin, jr., W1ZXA*

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While investigating the cause of a gradual dropping off of drive to the final amplifier of a DX-100 transmitter, it was determined that the 27K ½-watt grid resistor in the 5763 driver stage was changing resistance due to overheating. Replacement of the ½-watt job with one of larger wattage rating cured the trouble.

Incidentally, a small electric fan was used to locate the overheated resistor. The beam of air from the fan was shot around various components until the culprit was located. Naturally, once the overheated resistor was cooled, operation of the transmitter returned to normal. This little hint is passed along because it may prove useful in many other cases of trouble shooting.

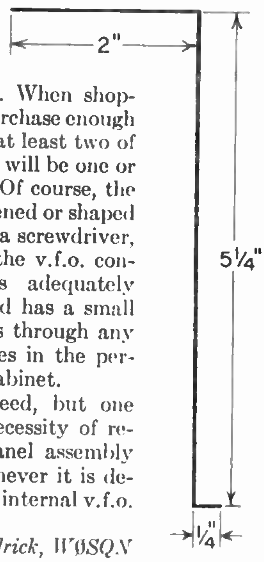
— *Charles M. Kugel, W4KOS*

[Editor's Note: Capt. Gilbert L. Countryman, USN-Ret., W4JA, reports that drive difficulties encountered with his DX-100 were also cured by substituting a 2-watt resistor for the ½-watt unit referred to by W4KOS.]

[Editor's Aside: The scheme used by W4KOS is just the reverse of an old Navy system, where we let it run and watched for smoke!)]

— • • • —

The little gimmick shown below is used for the alignment of the v.f.o. when the transmitter is enclosed in its cabinet. The stiff piano wire used in making the tool is available at most hobby shops. When shopping for piano wire, purchase enough for the fabrication of at least two of the tools so that there will be one or more spares on hand. Of course, the ¼-inch section is flattened or shaped to resemble the tip of a screwdriver, and fits the slots on the v.f.o. controls. Piano wire is adequately rugged for the job and has a small diameter which passes through any of the ventilation holes in the perforated cover of the cabinet.



A simple tool, indeed, but one that eliminates the necessity of removing the chassis-panel assembly from the cabinet whenever it is desirable to touch up the internal v.f.o. controls.

— *T. G. Pedrick, WØSQN*

CURING REGENERATION IN THE BAND-SWITCHING KILOWATT

The following will be of particular interest to those who employ the circuit described in "High-Power Pi-Network Amplifier with Parallel Tetrodes," *QST*, May, 1954. One such amplifier, bothered by a case of persistent regeneration, was made completely stable by removing one tube from the circuit. Because of this, it was suspected that screen-circuit difficulties were involved. This reasoning was substantiated, and a cure effected, by installing a screen-trap arrangement suggested by the diagram of the Collins KW-1. The circuit as applied to the parallel-tetrode amplifieris shown in Fig. 3-11.

As installed in the amplifier, the traps are mounted above the chassis deck with the bypass

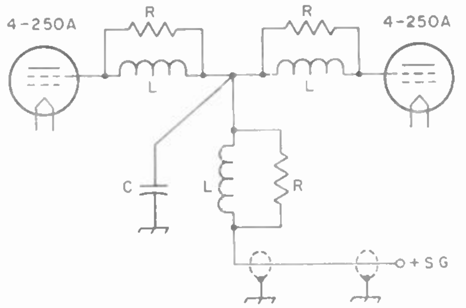


Fig. 3-11—Circuit of the screen trap for the high-power pi-network amplifier.
C—470-μμf. ceramic.
R—47 ohms, 2 watt (carbon).
L—5 turns No. 18 or 20, ½-inch diam.; wound around associated resistor in each case.

capacitor returned to a grounded lug located at the base of the tubes. The 330-μμf. ceramic capacitors — all four — used to bypass the screen grids of the original amplifier must be removed from the circuit when the traps are installed. Of course, the incoming screen-voltage lead is made with shielded wire. — *Willard Bridges, W1NWO*

MULTIPLE POSITION CRYSTAL HOLDER

A SIMPLE and inexpensive holder for a group of crystals may be made by mounting salvaged tube socket clips in a sheet of plastic.

Holes drilled to accommodate the clips should have a diameter slightly smaller than that of the clips. This will allow the clips to be force fitted into place. Heating each one with a hot soldering iron will seal it to the plastic. Naturally, the heat should be applied with caution so as not to completely melt the holder.

— *Lowell F. Lind, K4AWQ*

HOMEMADE NEUTRALIZING CAPACITOR

A HOMEMADE neutralizing capacitor that has some advantages over commercially-made units is shown in Fig. 3-12. The method of construction permits bringing one terminal of the capacitor directly through a chassis, thus eliminating the extra feed-through insulator ordinarily required. The capacitor requires a minimum of

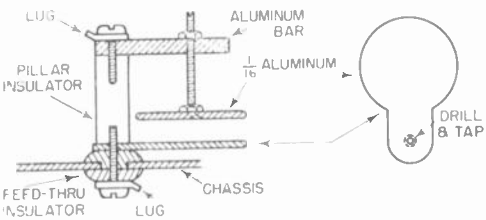


Fig. 3-12—Drawing of the homemade neutralizing capacitor used by W1SIZ/6.

chassis area for mounting, and can be made to any desired maximum capacitance commensurate with high-voltage spacing requirements.

Capacitors of this type may be tailor-made for the popular capacitive neutralizing systems such as those described in Chapter Six of *The Radio Amateur's Handbook*.

— *Thomas F. Snyder, ex-W1SIZ*

DECAL COATER

THE exasperating experience of having decals wrinkle because of a slight overdose of lacquer or plastic spray induced me to find a sure-fire non-curl method of coating. The solution — Polaroid Print Coater. It comes supplied with every package of Polaroid Land film and is used to protect the pictures from grease and give a lustrous finish to the print. Place some of the solution over the decal with the applicator and you have a non-wrinkle coating.

— *Richard E. Bakula, KØMOD*

A TRANSISTORIZED OSCILLATOR FOR 3.5 MC.

HAMS have found many applications for junction transistors, even though many previous types have been limited to audio and intermediate frequencies. A recent transistor is Raytheon's type 2N112 (formerly known as CK760). It has a cut-off at 5 Mc. and easily oscillates at 3.5 Mc. and above with only a 1.5-volt source of power.

The schematic in Fig. 3-13 is that of a simple oscillator useful at 3.5 Mc. and its harmonics. With a crystal inserted into the socket, C_1 tunes broadly to the desired frequency. For v.f.o. output, remove the crystal and insert a dummy crystal holder with its ***terminals shorted***. Then C_1 tunes the band with sufficient overlap at each end. The tone is T9 and remains steady as a rock after a minute or two drift.

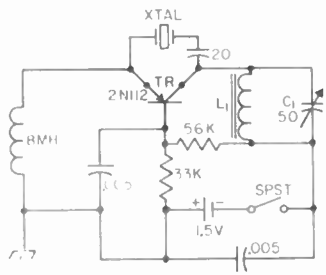


Fig. 3-13—Circuit diagram of the transistorized oscillator. L_1 is the plate winding of a broadcast-oscillator coil (Meissner 14-1058 or equivalent).

This circuit may be used as a signal generator for ham frequencies, calibration purposes or as an external b.f.o. for a short-wave receiver having no beat oscillator of its own. Simply tune the transistor circuit approximately to that of a c.w. signal. This creates a beat with the incoming signal. No need to alter the receiver.

The oscillator uses less than 0.5 ma. at 1.5 volts, but it can be driven safely with up to 6 volts.

— *Nathaniel Queen, W2CPA*

CAPACITIVE NEUTRALIZING HINT

The capacitive neutralizing circuit for screen-grid tubes shown in Fig. 3-14 will be recognized as the basic arrangement described in Chapter 6 of *The Radio Amateur's Handbook* (see "Stabilizing Amplifiers"). It differs from the *Handbook* system only in that the grid bypass, C_1, is the *variable* control while the neutralizing capacitor, C_2, has a *fixed* value.

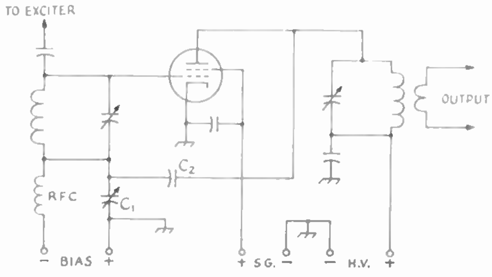


Fig. 3-14—Circuit of a screen-grid amplifier using the capacitive neutralizing arrangement suggested by W1LU. Notice that a variable capacitor, C_1, is used as the grid-circuit bypass, and that the neutralizing capacitance is of fixed value. Neutralizing is accomplished by adjustment of C_1.

In practice, C_2 usually has a very low value of capacitance — approximately 2 to 10 μμf. Voltage rating for the capacitor must be the same as the amplifier plate voltage for c.w. work and twice this value when plate modulation is used. A *variable* capacitor that will meet these specifications is not always easily come by. However, a suitable fixed unit can usually be easily located or quickly fabricated from scrap aluminum. Of course, the fixed capacitor may be used as long as the grid bypass capacitor, C_1, is variable. Fortunately, compact wide-range padder capacitors that have adequate voltage rating for grid-circuit duty are available. The voltage rating required must equal the operating bias of the amplifier tube. The knowing ham will select a conservative rating that allows some safety factor.

— *William S. Allen, W1LU*

NEUTRALIZING HINTS

An ordinary vacuum-tube voltmeter, coupled by means of an r.f. probe to the output circuit of a transmitter, serves well as a sensitive "feed-through" indicator while neutralization adjustments are being made. With excitation and filament voltage applied to the final amplifier tube (be sure to kill the plate and screen voltages), adjust the neutralizing capacitor for minimum reading on the v.t.v.m.

If the transmitter is completely shielded and coupled to a coaxial output line, insert a coax Tee-coupler between the amplifier and the line to provide a tap point for r.f. probe.

— *V. L. Clark, W6ZW*

When experimentally determining values for a capacitive neutralizing system, it is extremely convenient if both the grid bypass and grid-plate capacitors can be of variable design. The variable grid-plate capacitor, usually a tab of aluminum or a commercial unit, presents no problem, but a 1000-μμf. variable for the grid bypass may be a bit hard to locate, unless you happen to remember that a 3-section broadcast tuning capacitor, used with all three sections connections in parallel, will give a total capacitance of better than 1000 μμf.

After adjusting the circuit for neutralization of the amplifier, the capacitance of the large variable may be estimated so that the unit may be replaced with a fixed capacitor.

— *Charles R. Brown, W1HZE*

CHANGING CRYSTAL FREQUENCIES

The usual procedure for changing crystal frequency involves grinding, which is fine for making large changes or for certain low-frequency crystals. However, for small changes insuring stability of frequency when reached, and also for insuring that the activity of the crystal is not diminished by the change, etching is preferred.

Etching material used commercially (ammonium biflouride) is not commonly found at the corner drugstore. Fortunately there is a ready source of this chemical in a preparation sold as an aluminum cooking utensil cleaner called "Aluminum Brite." Since it attacks glass or ceramics, it comes in a plastic bottle.

When etching crystals, put about an ounce in a plastic dish (or you can use copper or stainless steel) at room temperature. The action is greatly accelerated by heat but by the same token becomes harder to control. Bend a copper wire hanger to hold the crystal blank in the etching solution. As an indication of the speed of etch, it takes about eighteen minutes to move a 7-Mc. crystal 8 kc.

Determine the frequency accurately before starting, and make a trial etch of five minutes. Wash and dry the crystal and contact electrodes and reassemble in the holder. Use the same holder for checking that will finally be used with the crystal so that capacity, pressure, etc., will not be changed. Cleaning is important for high frequency crystals for two reasons. First, the crystal will have difficulty oscillating if not clean; second, the solution apparently leaves an invisible deposit, which if not removed will load the crystal and give a lower than true frequency.

Since etching reaches all surfaces of the crystal there are no changes in the proportions. Hence the activity is unchanged for moderate frequency shifts. There is less danger of chipping or breakage since handling is at a minimum. Grinding leaves a microscopically fine dust in the surface pores of the crystal which gradually comes off and causes an upward drift in frequency. Etching eliminates this problem.

— *J. H. Ellison, W6AOI*

4. Hints and Kinks . . .

for the Phone Rig

NOVEL PUSH-TO-TALK CIRCUIT

IMPULSE or latching relays are a handy means of providing push-to-talk operation without need for holding the talk button down during transmissions. The button, in such applications, is pushed momentarily to turn the transmitter on and pushed momentarily again to turn it off. The main disadvantage of such relays is the price tag, which generally starts at about eight dollars and goes up. However, a simple counting circuit using two surplus relays can be employed to achieve the same end.

Fig. 4-1 shows the circuit with the two relays energized. Here's how it works: When the button is pushed, K_1 is grounded through the normally-closed contacts of K_2. When K_1 operates, the transmitter control circuit is completed through contacts K_{1B} and the top end of K_2 is grounded through contacts K_{1A}. Notice that the bottom end of K_2 is permanently grounded and that the return supplied through K_{1A} does not cause the relay to close. Nothing further happens until the push button is released.

Releasing the button removes the ground from the junction of K_1 and K_2, leaving the two relays in series across battery BT_1. K_2 now operates. Contacts K_{2A} transfer one side of the button to the coil of relay K_2, while contacts K_{2B} connect the other side of the button to battery BT_2. Nothing comes of this since both relays are locked in the "operate" position and the push-button is released.

When the push-button switch is is again closed, voltage from BT_2 is applied to both relays through contacts K_{1A}, K_{2A} and K_{2B}. K_2 will "hold," but K_1 will open because it now has plus-voltage at both ends of its solenoid. When the button is released, voltage from BT_2 is removed from K_2, the relay opens and the circuit is ready for another complete cycle.

Proper operation of the circuit necessitates that both relays have the same coil resistance and current rating, and that the supply voltage be twice the rated voltage of a single relay (24 volts for two 12-volt relays, 12 volts for two 6-volt relays). One other requirement is apparent from close examination of the circuit: with the button released after having turned the transmitter on, it is essential that contacts K_{1A} must maintain a voltage path (from BT_1) for K_2 long enough for the current to build up to the point where the resultant voltage drop will hold both relays closed. Should K_1 open before this happens, K_{1A} will remove voltage from K_2 and *both* relays will open. This means that relay K_1 should have a reasonably long time constant, which most relays have. If both relays drop out after the button is released, the release time of K_1 is too short and the effect can be remedied by connecting a crystal diode across the coil. Also, the spring tension can be reduced for increased "hold" time.

For the purpose of description, it was assumed that d.c. relays would be used. A.c. relays would do just as well as long as the above requirements are met. — *Robert S. McMullen*

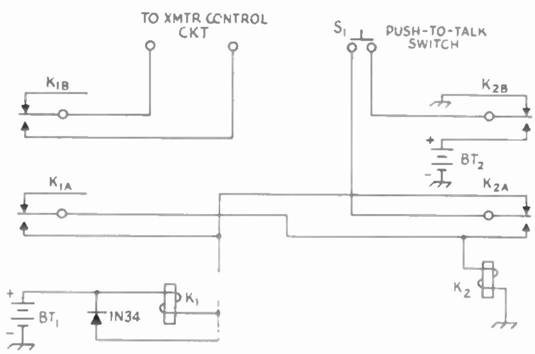


Fig. 4-1—Schematic diagram of WØLOV's push-to-talk circuit. See text for component specifications. S_1 is the push-to-talk switch or microphone button of the momentary contact type.

EMERGENCY MODULATOR

After many enjoyable hours using my 80- and 40-meter c.w. rig I decided to try my luck on phone. I didn't have a modulator so I tried to think of an inexpensive way to convert to phone operation. I had an old television power transformer and an old phonograph audio amplifier with a microphone preamplifier stage. These parts connected as shown in Fig. 4-2 made up my new modulator.

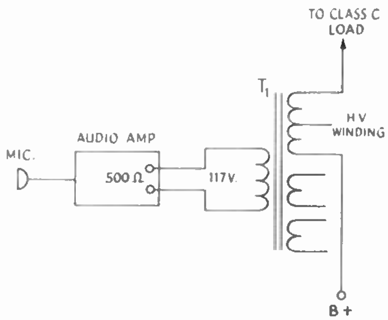


Fig. 4-2—Circuit showing a modulator using a power transformer modulation transformer.

T_1—Power transformer.

Only a few connections are required for the modification and it is an easy job to shift back to c.w. Reports on the voice quality are excellent and many successful phone contacts have been made. — *David T. Saussier, jr., W3MLE*

INPUT CIRCUIT FOR EITHER CRYSTAL OR CARBON MICROPHONES

The circuit shown in Fig. 4-3 permits feeding the output of either a crystal or a carbon microphone to the speech-amplifier tube. The closed-circuit jacks automatically convert the circuit

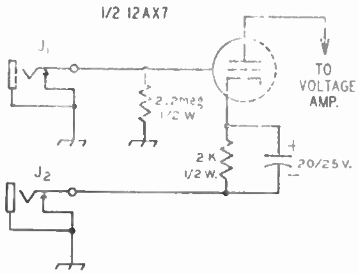


Fig. 4-3—Schematic diagram of the speech amplifier designed for either crystal or carbon-microphone input.

for whichever type of microphone is used. When using a crystal or other high-impedance microphone, it is plugged into J_1. In this application, the cathode circuit for the 12AX7 is completed through J_2. With J_1 closed (microphone plug removed) and with a carbon microphone plugged into J_2, the stage operates as a grounded-grid amplifier. The second half of the dual triode is used as a conventional voltage amplifier with a gain control in the grid circuit. — *Vernon Phillips, W7NPV*

REMOTE F.M. MODULATOR FOR V.F.O.s

The circuit in Fig. 4-4 shows a six-meter remote tuned f.m. modulator and v.f.o. that makes use of the junction capacitance of a silicon semiconductor diode.

The v.f.o. consists of a standard 8-Mc. Clapp oscillator with the diode (CR_1) connected in the tuned circuit. The 12AX7 modulator is connected to the v.f.o. through a length of shielded wire.

When audio is applied across the diode, the junction capacitance varies and changes the frequency of the oscillator at an audio rate, producing frequency modulation. Deviation of the system is controlled by the gain of the modulator. — *Leonard Kudravy, K3ASU*

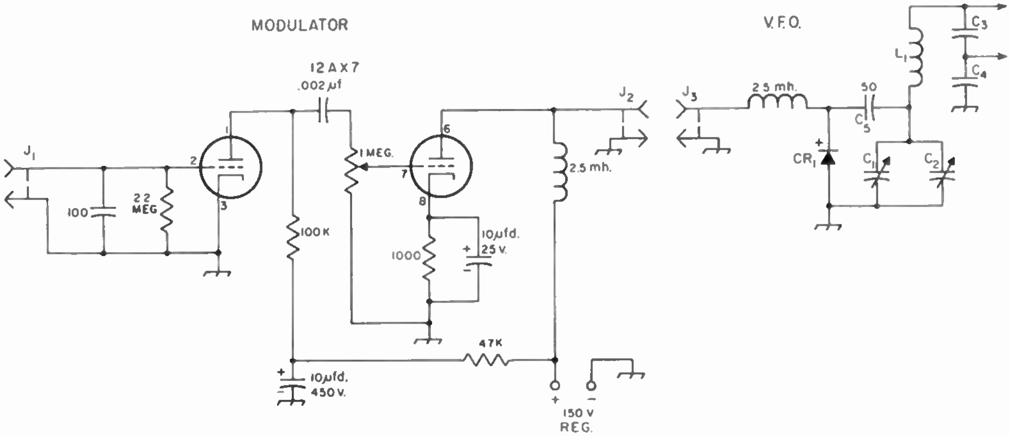


Fig. 4-4—Circuit of the f.m. modulator. Unless otherwise indicated, capacitances are in μμf., resistances are in ohms, resistors are ½ watt. L_1, C_1, C_2, C_3 and C_4 determine the frequency of oscillation of the Clapp oscillator.

C_1—15 μμf. variable.
C_2—75 μμf. variable.
C_5—50-μμf. silver mica.
CR_1—Westinghouse 1N1169 diode.
J_1—Microphone jack.
J_2, J_3—Phono connectors.

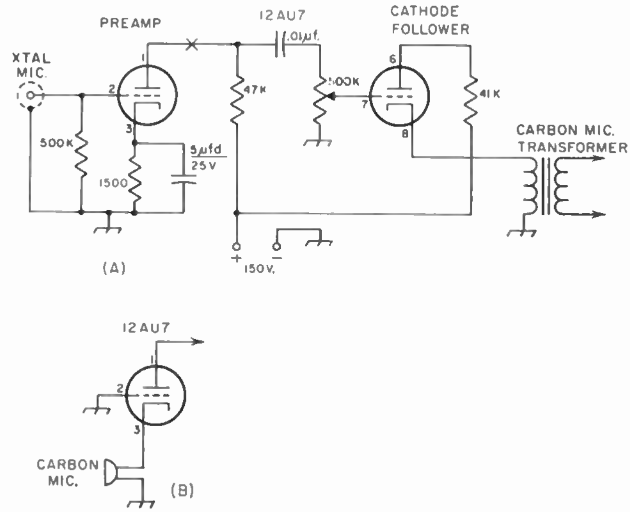


Fig. 4-5—Microphone circuits. All resistors are ½ watt. The cathode follower plate load resistor is 47,000 ohms.

MICROPHONE CIRCUITS

The speech quality of a transmitter that uses a carbon microphone can be improved by substituting a crystal microphone. The diagram shown in Fig. 4-5(A) shows a 12AU7 crystal microphone preamplifier and cathode follower which feeds into the low-impedance winding of a carbon microphone transformer. Fig. 4-5(B) shows an alternate preamplifier circuit which will provide more gain for a carbon mike. Here, the tube is connected as a grounded-grid amplifier. The carbon microphone receives its operating voltages from the 12AU7's cathode current. If this circuit is used, it should be substituted for the part to the left of point "X" in Fig. 4-5(A).

— *H. J. Hoechestetter, W6UVM*

REVAMPED AUDIO CIRCUIT FOR VIKING TRANSMITTERS

Because of low output from a microphone or the desire to modulate when located some distance from the microphone, many amateurs appreciate information directed at increased output from existing audio gear. The following is a report of work done on the audio circuits of a Viking I transmitter used here at W6ZLW. Prior to the modification, and when using my particular microphone, it was necessary to talk loud and *close* with the gain turned full on in order that adequate modulation might be obtained. With the new speech layout, it is possible to obtain 100 per cent modulation while talking at a normal level when located 4 or 5 inches away from the microphone and with the gain control set at the approximate middle of the scale. On-the-air reports indicate that the quality of the system is still excellent even though the low-level stages have been completely done over.

Fig. 4-6 shows the new tube lineup that is used to replace the original speech-amplifier and driver circuits. One half of a Type 12AX7 is used as the input tube and the second section of the envelope is used to excite a 12BH7 dual triode (connected in parallel), which in turn drives the 807 modulator for the transmitter. The original gain control for the rig, R_1 of Fig. 4-6, is connected in the grid circuit of the second half of the 12AX7. Incidentally, a 12AU7 may be substituted for the 12BH7 with very little difference in actual operation. However, no suitable substitution for the 12AX7 has been found.

When making the modification, it is necessary to replace the old 6AU6 tube sockets with 9-prong jobs. Be sure to use shielded sockets and place them exactly where the original ones were located (enlarge the old mounting holes). When removing components, do so with care because several parts can be used in the new layout. Make certain that the 12BH7 occupies the spot previously used by the 6AU6 driver tube. Also, notice that shielded wire is used between the microphone jack and the 0.005-μf. coupling capacitor.

Several other W6s have been highly pleased with the results obtained by the above means. Furthermore, no one who has faithfully followed instructions pertaining to tube layout reports feed-back difficulties at any of the frequencies for which the rig is designed. On the other hand, failure to follow instructions has resulted in audio problems.

— *William T. Seeley, W6ZLW*

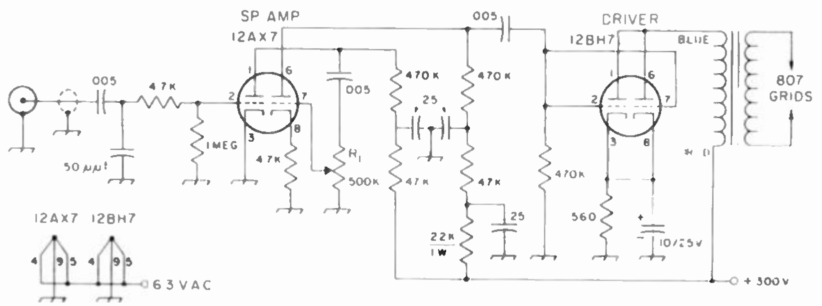


Fig. 4-6—W6ZLW uses this low-level speech arrangement to drive the 807 modulator of a Viking 1 transmitter. Unless otherwise specified, capacitances are in μf.

MORE ABOUT THE 6Y6 AS A CLAMP TUBE

RECENTLY, while attempting to plate and screen modulate one of the *Handbook* rigs, severe downward modulation occurred. The transmitter uses a Type 807 in the r.f. amplifier and employs a 6Y6 clamp-tube protective circuit. Although voltages on the 807 checked normal under static conditions, the plate current dipped from the full-load value to about 60 ma. when modulation was applied. A cure for this condition was effected merely by removing the 6Y6 from the circuit.

The problem and its cure led to an investigation of clamp-tube operation of several 6Y6s. It was determined that the tubes went into conduction with as much as -90 volts applied to the control grid whenever the plate-screen potential was raised to approximately 350 volts. Obviously, this is an undesirable condition for phone operation for it permits the clamp tube to operate as a clipper on the positive peaks of the modulation cycle.

The only solution to the problem appears to be either the removal or the disabling of the clamp tube when the r.f. amplifier is to be modulated. Of course, this leaves the modulated amplifier without protective bias unless some other form of fixed bias is installed.

— *William F. Baumruck, W9DTC*

USING A CLAMP TUBE WITH PLATE-MODULATED R.F. AMPLIFIERS

THE problem of clamp-tube conduction on positive modulation peaks, described by W9DTC above, finds a ready solution. A clue is contained in the words "whenever the plate-screen potential is raised to approximately 350 volts."

If the tube is pentode-connected, using the plate alone to provide the clamping load, while feeding the screen from a separate voltage source, advantage may be taken of the characteristic of screen-grid tubes which makes their plate-current roughly dependent upon screen voltage rather than plate voltage.

In the circuit shown as Fig. 4-7, the plate of the clamp tube is connected to the screen of the protected stage and the screen of the clamp tube is tied to a bleeder tap providing approximately 100 volts. If this tap is properly selected, screen dissipation may be kept within rating under key-up conditions, while the protected stage actually has lower key-up screen voltage and therefore lower idling plate current. Since the bleeder tap does not change in voltage with modulation, the clamp tube will not conduct on modulation peaks. Key-up, however, the stiff voltage on the clamper screen allows its plate to draw a heavier current than can be drawn if triode connected.

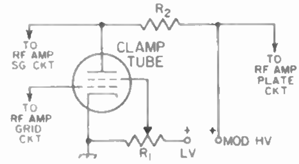


Fig. 4-7—Screen clamper circuit for protecting plate-modulated screen-grid power tubes. R_1 is referred to in the text. R_2 is the screen-dropping resistor for the r.f. power tube.

This clamp-tube circuit was not originated at W2KTF. It is used in several commercially designed amateur transmitters.

— *Charles Baker, W2KTF*

6BE6 PREAMPLIFIER FOR BOTH HI- AND LO-Z MICROPHONES

PREAMPLIFIERS constructed here in the past have always employed either two high-gain tubes or a dual-triode in order that both crystal and dynamic (low-put type) microphones could be used.

Recently, while working out design details for a completely new amplifier, the thought occurred that one of the popular r.f. mixer tubes might operate satisfactorily in a *single-tube triple-purpose* circuit having provision for both crystal and dynamic-mike input and, at the same time ability to serve as the mixer.

To test the theory, a type 6BE6 pentagrid converter tube was tested in the circuit shown as Fig. 4-8. After settling on the component values listed, the arrangement actually exceeded my fondest hopes. By connecting the dynamic-microphone transformer to grid No. 1 of the tube, and the crystal mike to grid No. 3, not only did a rather neat mixer result, but the over-all gain of the amplifier remained essentially constant regardless of which microphone was used. Apparently, the difference of approximately 20 db. in gain that the No. 1 grid arrangement has over the grid No. 3 circuit compensates for the difference in microphone output levels.

It is reasonably certain that the idea is not completely new, but it is one that I have never seen in print. Perhaps the circuit won't find too much application in ham-band equipment, but it may appeal to amateurs interested in hi fi, recording, etc.

— *Fred L. Mason, KH6OR*

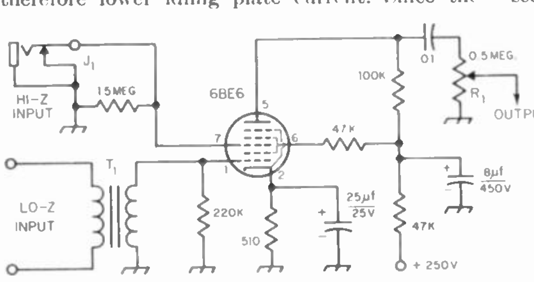


Fig. 4-8—KH6OR uses this preamplifier-mixer circuit with both crystal and dynamic microphones. R_1 is the gain control for the amplifier stages following the 6BE6. T_1 is a dynamic-microphone-to-grid transformer. All resistors except R_1 are ½-watt composition. Capacitors marked with polarity are electrolytic.

INEXPENSIVE SCREEN-GRID MODULATOR

HERE is a simple method of screen-grid modulation. It makes use of a low-power audio amplifier with a low input impedance. A radio, TV or phono amplifier may be used for the modulator. The audio amplifier used here at K2MYC is a phono amplifier capable of two and a half watts maximum output of audio, more than ample to modulate a pair of 807s.

The only change necessary in the audio amplifier is to disconnect the two wires coming from the audio output transformer to the speaker. The audio output transformer T_1, Fig. 4-9, was salvaged from a junked radio. The screen-grid voltage should be obtained from a fixed voltage supply with a voltage divider, R_1. Tune the transmitter for maximum output on c.w. using heavy loading; then reduce grid drive until a slight increase in plate current is observed. Note the plate current, then reduce the screen-grid voltage until the plate current is one half the original value. Connect the microphone to the audio amplifier input, then advance the volume control on the amplifier until small upward kicks of plate current are observed on voice peaks. The transmitter is now modulated.

— *Frank Seier, K2MYC*

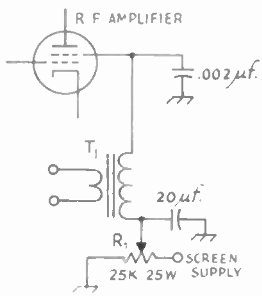


Fig. 4-9—Diagram of the screen-grid modulator. T_1 is a small audio output transformer, pri. 4000–10,000 ohms, sec. 4–8 ohms.

"HOW'S MY MODULATION?" INDICATOR

SELDOM are "on-the-air" reports critical enough, particularly as to quality of modulation, and since it is virtually impossible to tell anything by listening to yourself with a monitor, the following scheme has been adopted at W2PFU for adjusting the phone rig for minimum distortion, correct clipping level, general speech quality, hum, etc.

A three- or four-foot length of wire and a 1N34 germanium diode are coupled into the microphone input of a wire recorder placed on a table a few feet from the transmitter, as shown in Fig. 4-10. The wire recorder is turned to "record" position, the transmitter is turned on, and, while the adjustments are being made, the operator describes the adjustments, dial settings, and other pertinent data. At the conclusion of the series of adjustments the transmitter is turned off and the material recorded on the wire is played back. This gives the operator a personal and first-hand description of just what his modulation does sound like. Obviously, during the test the input level to the wire recorder must be adjusted to the proper recording level.

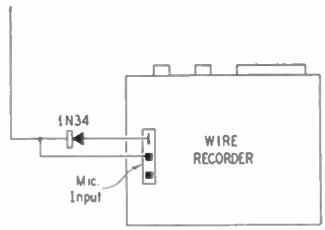


Fig. 4-10—Connections used by W2PFU to permit recording of his own signal.

Tests can be made with the transmitter loaded into a dummy antenna or while the operator is in QSO with another amateur. Broadcasting your tests to the world is not recommended.

— *Dallas T. Hurd, W2PFU*

MORE ABOUT THE "HOW'S MY MODULATION?" INDICATOR

WHILE TRYING to apply W2PFU's hint for checking modulation (see above), I found myself without a germanium diode. Needing to make the check in a hurry, the demodulation probe for an oscilloscope was put to work. Output from the probe was fed directly to the tape recorder. A short length of wire connected to the tip of the probe provided adequate r.f. pickup.

In some later checks made with both the probe and the plain diode, it was determined that the use of the probe resulted in best reproduction of the modulated signal. This does not mean that you *must* run out and buy a probe if you want to use the W2PFU system, but it certainly means that the probe *should* be put to work in this application if you already have one on hand.

— *David Berkley, K2MUN*

CRYSTAL MICROPHONE TIPS

MOST crystal microphones contain a Rochelle salt crystal which should be protected from high temperature, humidity, and high voltage. The Rochelle salt crystal can be permanently damaged by temperatures above 125 degrees F. (50 degrees C.) and by excessive humidity. The best service from a crystal microphone will be obtained if it is used at room temperature, at a humidity of about 50 per cent. Since inside automobile temperatures rise to high values in the summertime, it's not a good idea to use crystal microphones for mobile service during hot weather. Be careful when soldering connections to a crystal mike. Don't connect the mike to speaker or power outlets carrying high voltage.

— *R. Bruce Campbell*

THE SIMPLEST MODULATOR

MANY c.w. operators have been looking for an easy way to modulate their rigs, and this little modulator may be the answer.

The interesting point about it is that it can be plugged into the cathode circuit of any final amplifier and you are on phone. No separate plate supply or matching output transformer is needed. The plate voltage for the unit is derived from the final plate supply.

As shown in Fig. 4-11, the audio output voltage is impressed between the r.f. amplifier cathode and ground, giving principally grid-bias modulation of the amplifier although there is a small amount of accompanying plate and screen modulation. You can modulate triodes, tetrodes or pentodes, single-ended or push-pull. The efficiency is comparable with that of other grid- or screen-modulation systems and so, of course, cannot equal plate modulation, but good quality reports will be obtained. One feature of the system is that, with most finals at least, proper operating conditions for good modulation are attained practically automatically.

The speech amplifier uses a double-triode 6SL7GT with resistance coupling, and gives adequate gain for a crystal microphone. Plate voltage comes from the amplifier cathode, with C_1, C_3, C_6, R_3, R_7, and R_{10} providing additional filtering as well as decoupling. The voltage will vary with the power of the transmitter, but in any event the measured voltages at the 6SL7 plates are quite low. R_{11} is not needed if the modulated amplifier is operating at such low power that the voltage at the screen of the 6Y6G does not exceed the maximum rating of 135 volts.

To use the modulator, first tune up the transmitter for c.w. operation and load it to normal input. Then connect the modulator into the amplifier cathode circuit — it can be plugged in in place of the key if there is a key jack in the cathode — and the plate current should drop to about half its c.w. value. Then talk — that's all there is to it! The r.f. amplifier plate current should remain steady except possibly for a slight flicker on voice peaks. In the event that the plate current with the modulator plugged in is considerably above half the c.w. value, it can be brought into the right region by increasing the value of resistor R_9.

Fig. 4-12—Practically any layout you want can be used for the modulator. The unit at W6LNN uses the circuit of Fig. 4-11 and has ample gain for a crystal microphone. A carbon microphone could be coupled to the modulator grid through the usual transformer, without speech amplification.

One word of caution, especially when using powers over 200 watts or thereabouts: Be sure the modulator filaments are ON before applying plate voltage. This will insure the proper path of the final cathode current and prevent possible burnout of the small audio filter choke in parallel with the 6Y6G circuit. This applies particularly to separate control of filament voltages.

The unit is built into a 6¼ × 3½ × 2-inch

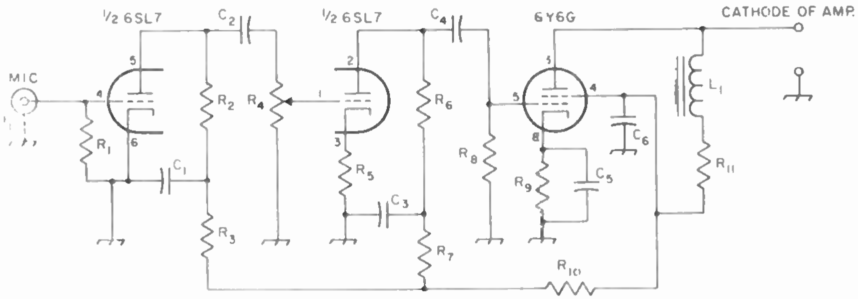


Fig. 4-11—Circuit diagram of the speech amplifier and modulator.

C_1, C_3—0.1-μfd. paper, 400 volts.
C_2—0.005-μfd. paper, 400 volts.
C_4—0.01-μfd. paper, 400 volts.
C_5—50-μfd. electrolytic, 50 volts.
C_6—8-μfd. electrolytic, 450 volts.
R_1—2.2 megohms, ½ watt.
R_2—0.22 megohm, ½ watt.
R_3, R_7, R_{10}—22,000 ohms, ½ watt.
R_4—0.5-megohm volume control.
R_5—2200 ohms, ½ watt.
R_6, R_8—0.1 megohm, ½ watt.
R_9—50 ohms, 2 watts (see text).
R_{11}—2000 ohms, 2 watts (see text).
L_1—Small filter choke, "a.c.-d.c." type satisfactory.

"channel-lock" box. This size accommodates all the parts except the small audio choke.

In estimating the number of tubes required to modulate a given transmitter, allow one 6Y6G for each 200 ma. of c.w. plate current or 100 ma. when the modulator is plugged in. One tube will modulate up to 200 ma. c.w. current, two tubes up to 400 ma., and so on, it being understood that these values should drop to one-half when the modulator is in circuit. Type 6L6 tubes can be substituted for the 6Y6G but are not as desirable because higher plate and screen voltage are required for the same cathode current. Since the voltage drop across the modulator tube or tubes subtracts from the voltage actually applied between plate and cathode of the modulated amplifier, a larger tube drop means a reduction in power input to the final amplifier stage.

In typical cases, scope patterns have shown that with tone input very good waveform is obtained up to about 80 per cent modulation. The positive peaks are somewhat clipped with heavier modulation, but the distortion is not particularly noticeable even at 90 per cent modulation.

The simplicity of the unit makes it readily adaptable to portable rigs. It would also be useful as a spare modulator when the regular high-powered speech system needs attention.

— *Ira F. Gardner, W6LNN*

THREE-WAY SWITCH FOR THE SIMPLEST MODULATOR

Operators who employ the "Simplest Modulator" for casual phone operation with their existing c.w. rigs must remember to unplug the modulator whenever the mode of operation is changed from phone to c.w. Of course, if the cathode of the final is keyed and if the modulator output terminals are connected in parallel with those of the key, the unplugging motion is unnecessary. However, in installations where the oscillator or a low-level stage is keyed, it is necessary to disconnect the modulator so that the r.f. output tube may work at normal input.

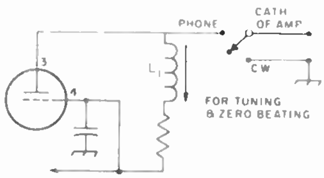


Fig. 4-13—Circuit diagram of the switching system described by W3PVY. (If the leads to the switch are long, be sure to connect an 0.001-μf. disk ceramic between amplifier cathode terminal and ground.)

The circuit shown in Fig. 4-13 shows how a single-pole three-position switch has been put to use with the transmitter and modulator used here at W3PVY. Two of the switch positions provide for rapid change over from phone to c.w. operation, and the center or third contact allows the final to be disabled during zero-bearing or tuning adjustments.

To clarify the circuit of Fig. 4-13, it should be mentioned that all components other than S_1 are ports of the modulator circuit appearing on the previous page.

— *Ed Rittenhouse, W3PVY*

PARALLEL 6Y6s FOR THE SIMPLEST MODULATOR

The simple grid modulator described by W6LNN on the previous page has usually lived up to its name if constructed with a single tube in the output stage. However, the installation of parallel 6Y6s in the modulator has occasionally resulted in instability within the unit. With the assistance of W8RXX, and with the addition of a few inexpensive components, it has been possible to stabilize the parallel-tube arrangement. Fig. 4-14 shows the revised circuit which, incidentally, is used to modulate the popular 4–250A amplifier described in recent editions of the *Handbook*.

Many of the components shown in Fig. 4-14 bear designations — R_6, C_6, L_1, etc. — which refer to the original diagram inasmuch as these parts remain unchanged in both value and placement. With respect to the original circuit, it should be mentioned that the 6SL7 section of the unit requires no modification. L_2 and L_3 and resistors R_{12} through R_{15} are the recent additions to the modulator and are the components which stabilize the new arrangement. R_9 of the one-tube layout has been replaced with a 100-ohm variable to provide a convenient means of adjusting the plate current of the r.f. amplifier. This adjustment is particularly helpful when re-setting the plate current to *half value* after band changing.

— *Philip J. Hart, W8MMK*

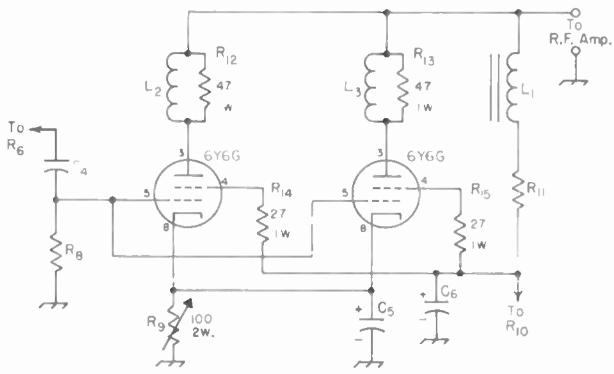


Fig. 4-14—The simple grid modulator circuit used by W8MMK. L_2 and L_3 are each 10 turns of No. 26 enamel wire wound over R_{12} and R_{13}, respectively.

5. Hints and Kinks . . .

for the Power Supply

GROUND AND POLARITY TESTER

In the interest of safety, it is advisable to test all leads to ground (earth) for resistive characteristics. A resistive circuit or lead to ground is not a safe one and may not be depended on as a means of preventing accidental shock.

The simple circuit shown in Fig. 5-1 may be as familiar to many hams as it is new to others,

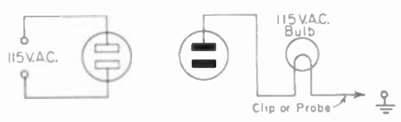


Fig. 5-1 — Diagram of the simple ground tester.

but it does provide one of the quickest means of checking the effectiveness of a ground lead. An ordinary lamp bulb of almost any wattage rating is used as the indicator for the tester. One terminal of the bulb is connected to a standard 115-volt plug and the second terminal of the lamp is connected to a heavy clip or probe which in turn is used to make contact with the ground point under test. The bulb will light to full brilliancy when connected between the a.c. line and a good ground point. On the other hand, less than normal brilliancy indicates a poor ground connection.

A second use for the simple circuit is that of testing for either the hot or the grounded side of the a.c. line. The bulb will light when the active side of the plug makes contact with the hot side of the a.c. receptacle and will fail to glow when contact is made with the grounded side of the line.

— Joseph A. Wright, jr.

[EDITOR'S NOTE: Two precautions should be observed when using the lamp-bulb ground tester. When testing the effectiveness of a lead, make sure that the test lamp is lighted to full brilliancy by checking it against a lamp of similar rating that has been plugged into a convenient 115-volt socket. Second, when attempting to determine the polarity of an a.c. outlet, make sure that the test lamp is a good one; remember, a *burned-out lamp won't glow* even when connected to the *hot* side of the line.]

FINDING PORTABLE GENERATOR FREQUENCY

Browsing through old copies of *QST*, I came across an article in the October, 1956 issue, page 39, entitled, "Checking the Frequency of Portable A.C. Generators." Having wrestled with the same problem recently myself, this article interested me, but the author specified one thing that I did not have — commercial power of accurate known frequency. Being located in the southern part of the Philippines, the nearest commercial power of any accuracy was 200 miles away!

I had heard that ordinary electric clock accuracy is controlled by the frequency of the power. If the clock were plugged into a generator with an output frequency of 60 c.p.s., it should keep perfect time. However, if the generator frequency were fast or slow, the clock would gain or lose time. When I want to check the speed of the generator I plug in an electric clock and time the interval for the sweep second hand to make one complete revolution with a stop watch. If it takes over a minute I know the frequency is low, and if it takes less, the generator is running fast. The formula used to find the generator frequency is 3600 divided by the number of seconds for a complete revolution of the clock second hand.

— John Lawless, W1YEF

REPAIRING ELECTROLYTIC CAPACITORS HAVING BROKEN LEADS

Many junk-box electrolytic capacitors having broken leads too short to solder to can be salvaged as follows. If the lead has been broken off right at the retaining rivet, pry up the edge of the rivet from where the lead enters to a point 180 degrees around. Then, carefully force a half turn of the broken lead from under the pried-up section of the rivet, thus providing a short stub to which an extension may be soldered. Be sure and leave a full half turn of the old lead clamped under the rivet.

— Allen Podell, W3WDA

BLEEDER SAFETY LIGHT

Power-supply bleeder resistors sometimes do burn out despite conservative ratings. One method of insuring against burnout is to use two bleeders in parallel, each one having a higher value than the original single one. It is rather unlikely that both resistors will open up during the normal life of a power supply.

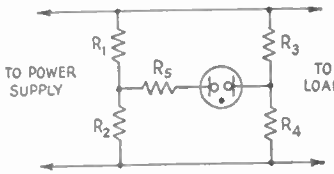


Fig. 5-2—Power supply bleeder circuit with burn-out indicator.

Another solution, shown in Fig. 5-2, gives a visual warning whenever a bleeder resistor opens up. Four resistors, R_1, R_2, R_3, R_4 each of the same resistance but rated one-quarter of the power of a single bleeder resistor, are used in a bridge along with a neon bulb connected between the two junctions. When any one of the four resistors opens up, a voltage difference will appear across the neon bulb, causing it to ignite and thus giving indication of a burnout. In most power supplies, additional current limiting resistance, R_5, will be needed to protect the neon bulb; the value of R_5 can be calculated or found experimentally. If a 1/25-watt neon bulb is used, try a value around 500,000 ohms for each kilovolt of total power-supply voltage.

— *Harry L. Cox, jr., W3MJC*

USING 115-VOLT AUTOTRANSFORMERS IN 230-VOLT PRIMARY CIRCUITS

Many amateurs who have graduated from 115-volt primary circuits to the 230-volt system have no doubt wondered how to utilize their 115-volt autotransformer (Variac, Powerstat, etc.) in the new installation.

A simple and practical method of using the 115-volt units for control of primary voltage for 230-volt transformers is shown in Fig. 5-3. The

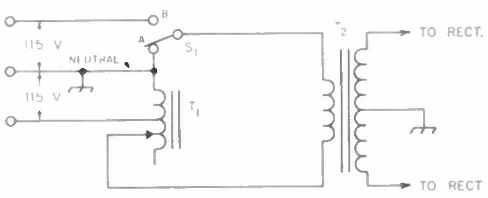


Fig. 5-3—Circuit diagram showing how W7DET controls output from a 230-volt primary circuit with a 115-volt autotransformer. Both the autotransformer, T_1, and the control switch, S_1, must be rated for the current flowing through the primary of the plate transformer, T_2

s.p.d.t. switch, S_1, provides a "two-step" operation. With S_1 in position A, the primary voltage for the power transformer, T_2, may be varied between zero and the upper limit of the autotransformer (usually around 130 volts). With S_1 at position B, the primary voltage may be adjusted from 115 volts to something above 230 volts with the highest voltage again being determined by the capabilities of the autotransformer, T_1.

— *William Vandermay, W7DET*

CONTROLLED CHARGE-UP TIME FOR HIGH-VOLTAGE FILTER CAPACITORS

Many high-voltage supplies using large values of filter capacitance draw a heavy surge of current from the line and through the rectifiers when the supplies are turned on. Should this condition be serious enough to warrant remedy, it may be almost completely eliminated by installing a simple *time-delay* circuit in the supply.

Fig. 5-4 shows how three time-delay components, C_1, K_1 and R_1, are connected into a typical 1000-volt choke-input supply. For the sake of simplicity in the diagram, the primary windings of the transformers and the control switches are not shown. Notice that R_1 is connected between the plate-transformer (T_1) center tap and ground, and that it is in parallel with the contacts of K_1. K_1 is connected between the bottom end of the bleeder resistor (R_2) and ground and is shunted by the 100-μf. capacitor, C_1.

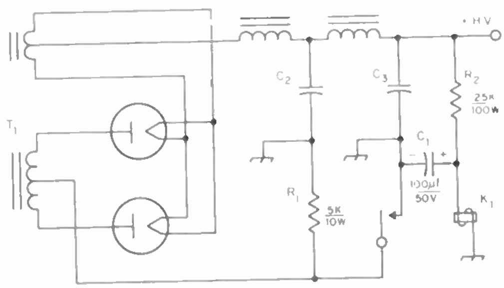


Fig. 5-4—Schematic diagram showing W2LYH's controlled charge-up-time arrangement installed in a typical 1000-volt power supply. K_1 is a s.p.s.t. normally-open relay having a 200-ohm winding.

In operation, K_1 does not close until after the supply has been turned on and C_1 has charged through the bleeder. With the 200-ohm relay and the other supply-components used here at W2LYH, the actual *delay-time* is approximately one half-second. With K_1 open, R_1 is effectively in series with the filter capacitors (C_2 and C_3) and, as a result, the capacitors charge at a relatively slow rate. Just as soon as K_1 closes, the limiting resistor is shorted and the supply is back in normal operation.

— *R. V. McGraw, W2LYH*

Caution: The bleeder circuit becomes *inoperative* if the relay winding opens up! — Ed.

600–1200-VOLT POWER SUPPLY COMBINATION

While building the "Final Rig" (that's the one that you think will be the last rig you'll ever build since it's going to have everything in

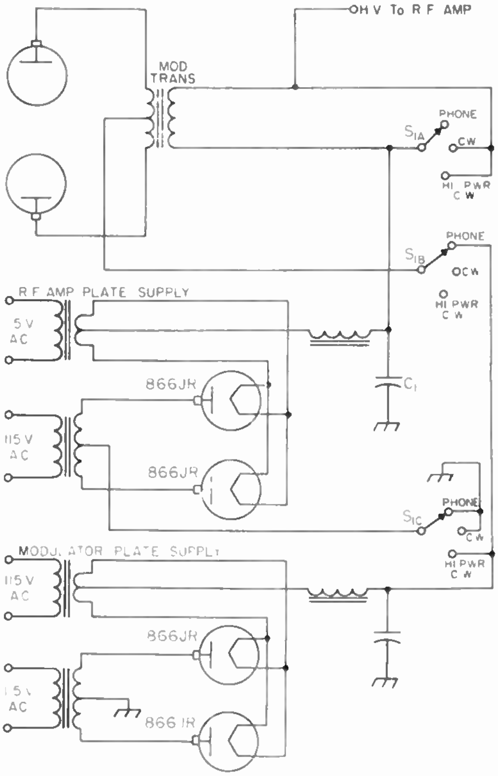


Fig. 5-5—Circuit diagram of the 600–1200-volt power supply. C_1 should be rated at 1500 volts or more. S_1 is a 3-pole 3-position ceramic rotary switch. Power transformer ratings are discussed in the text.

it), I came up with the following gimmick which may be of interest to some rig builders.

Originally I planned to put a pair of 807s or equivalent tubes in the final, and so provided a 600-volt 250-ma. power supply for them. I also planned to use a pair of the same tubes as modulators, and provided a separate 600-volt 250-ma. power supply for them. After both power supplies were installed on the chassis and working, I considered the fact that half of my available d.c. power was unused on c.w. A little thought evolved the circuit shown in Fig. 5-5.

Basically, the control is a 3-pole 3-position switch. In the phone position it runs the r.f. section from one 600-volt supply, and the modulator from the other. In the c.w. position it removes plate power from the modulators and shorts out the secondary of the modulation transformer. In the third position, called hi-power c.w., it places the two 600-volt supplies in series, giving 1200 volts at 250 ma. for the final r.f. section. Ordinary 807s won't take that sort of power so I used a pair of 4-65As. These tubes draw practically the same plate current over a wide range of plate voltages — ratings being 150 ma. each through the 600–1500-volt range. Screen voltage comes from the 250-volt supply used for the exciter and speech-amplifier sections.

— *Howard J. Hanson, W7MRX*

TIME-DELAY PROTECTIVE CIRCUIT FOR HIGH-VOLTAGE POWER SUPPLIES

A well designed power supply using mercury-vapor tubes includes protective circuitry which assures adequate filament warm-up time for the rectifiers. The simple circuit shown in Fig. 5-6 will, with the thermal relay specified, provide a thirty-second delay or warm-up period before the high-voltage transformer is turned. The circuit is used here at VE3AXC with an 866 supply and functions as follows.

When S_1 is closed, 115 volts a.c. is applied to the heater of the thermal relay, K_2, through the normally-closed contacts of K_1. The rectifier-tube filament transformer also receives primary power with the closing of S_1, K_2 closes thirty seconds later and completes the a.c. circuit for the solenoid of K_1. K_1 now closes, feeds power through its normally-open contacts to the primary of the plate transformer, and breaks the 115-volt connection to K_2. The thermal relay cools off and opens, but K_1 remains closed to complete primary wiring for the plate transformer.

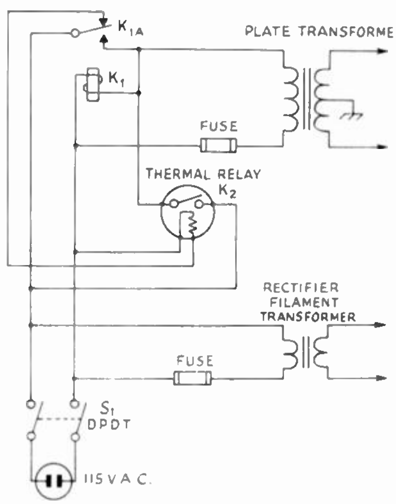


Fig. 5-6—Schematic diagram of VE3AXC's time-delay protective circuit for high-voltage power supplies.
K_1—S.p.s.t. normally-open 115-volt a.c. relay.
K_2—S.p.s.t. normally-open 115-volt a.c. thermostatic delay relay (Amperite 115N030).
S_1—S.p.d.t. power switch.

A break in a.c. primary power (power failure or accidental unplugging of the line cord) will open K_1 and disconnect primary voltage from the plate transformer. When a.c. power is restored the complete cycle of relay operation will repeat itself as long as S_1 is closed.

— *T. R. Baker, VE3AXC*

RELAY POWER SAVER

Most relays require only about ⅓ to ½ the initial closing current to hold them in the closed position. This fact can be used to reduce the size of the relay power supply.

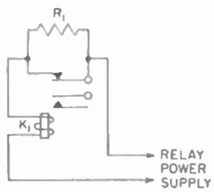


Fig. 5-7—Circuit of the relay power saver.

The circuit in Fig. 5-7 shows a current limiting resistor R_1 across a set of normally-closed contacts on relay K_1. These contacts are adjusted to open when the armature is near the end of its travel. When these contacts open, R_1 is placed in series with the relay coil winding thus reducing the coil current to a lower value.

The resistance of R_1 can be calculated by using Ohm's Law.

— D. C. Mead, K2ZZF

SERIES-PARALLEL SWITCHING CIRCUIT FOR POWER TRANSFORMER PRIMARIES

The use of a d.p.d.t. toggle switch to obtain full or reduced plate voltage from dual-primary types of power supplies may not have occurred to the newly-initiated ham. The writer used the idea with a surplus transformer having dual primaries, and more recently with two identical low-voltage plate transformers of single primary design.

Fig. 5-8 shows how the d.p.d.t. toggle switch, S_1, is wired to provide either series or parallel operation of the primary windings. To avoid

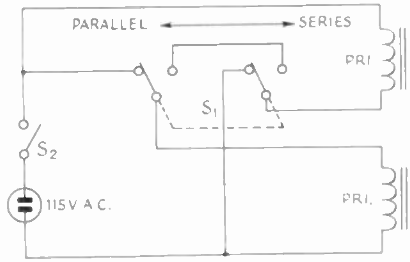


Fig. 5-8—Diagram of the series-parallel switching circuit for plate power transformers. The d.p.d.t. control switch S_1 is shown in the parallel-connection position. S_2 is a conventional on-off switch.

complication in the diagram the secondary circuit is not shown. If two transformers are used in the circuit, the secondary windings should be joined together to form a center tap and then connected to a typical full-wave rectifier system.

— Lyle S. Moyer, VE5LW

Editor's Note: A typical full-wave rectifier circuit will be found in the Power Supply chapter of *The Radio Amateur's Handbook*. The full-wave center-tap rectifier section of the *Handbook* also advises concerning polarity and ratings which must be observed when two transformers are connected in series to provide a center-tapped secondary winding.

ADDITIONAL OUTPUT TERMINALS FOR THE RECEIVER'S AUXILIARY POWER SOCKET

In this day of many accessories to communications receivers, it is frequently desirable to connect more than one low-current accessory to the auxiliary power socket of the receiver. Fig. 5-9 shows an open-for-inspection view of a dual output connector that combines the plug-in feature with clean-cut construction.

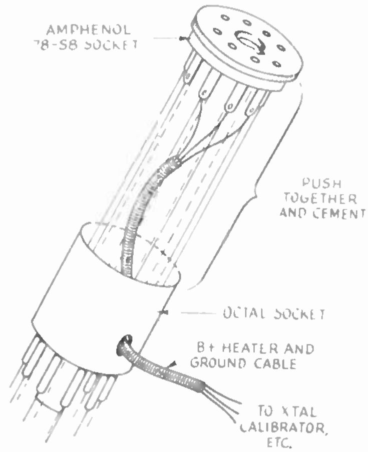


Fig. 5-9—Sketch showing construction of the dual output connector for use with a receiver's auxiliary power socket. The idea can be extended to accommodate more than two accessories providing that the receiver power supply can safely deliver the extra current.

Drill a ¼-inch hole in the side of a salvaged octal tube base that has been cleaned free of cement and anode leads. Feed the power cable for one of the accessories through the hole in the side of the base, and then connect the individual leads of the cable to the terminals of an Amphenol type 78-S8 socket. Before soldering at the socket terminals, provide short bare wire jumpers for connection between the socket and the base. Pass the jumpers down through the prongs in the base, making sure that the guide slot in the socket is properly orientated with respect to the guide pin on the base. Press the socket down onto the base after applying cement where required. Clip the wires extending through the base prongs and solder.

A little thought as to the direction in which the accessory cable should extend from the assembly, given at the time the hole is drilled, will add to the neatness of the unit. Eyes may be protected while salvaging the base of a glass tube by putting the envelope in an empty cigarette package or other recovering while the glass is smashed.

— Thomas B. Hedges, W3BKE

POWER-SUPPLY HINT

When a tube such as the 807 is used, it is frequently desirable either to increase or reduce the power-supply output voltage, depending on the mode of operation — phone or c.w. If the power transformer is one designed for two levels of output voltage, the change from high to a low voltage, or vice versa, can be made quickly and inexpensively by employing the circuit shown in Fig. 5-10. This particular supply will deliver either 600 or 750 volts d.c. and selection of the desired voltage is made by inserting the Type 5R4GY rectifier either in the left- or right-hand socket.

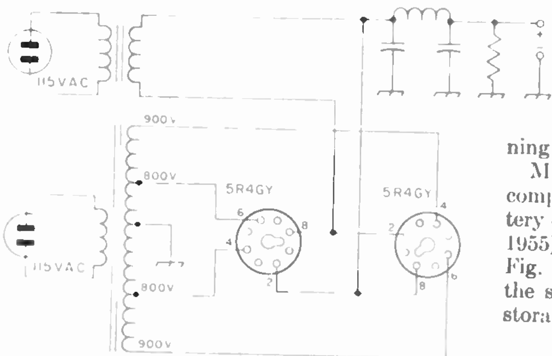


Fig. 5-10—Simple method of selecting voltage output from dual-type power transformers.

Thus, the cost of an expensive well-insulated high-voltage switch is replaced by the small expenditure for an additional tube socket.

Caution: Be sure power is off and filter discharged! — *Gerald L. Collins, W4ZPX*

NOVEL REGULATOR

Regulator tubes can't be paralleled directly to obtain greater current capacity because one tube will always ionize at a slightly lower voltage, thus preventing the other tube from firing.

The diagram in Fig. 5-11 shows how parallel operation of VR75s may be used without the usual equalizing resistors in series with each tube.

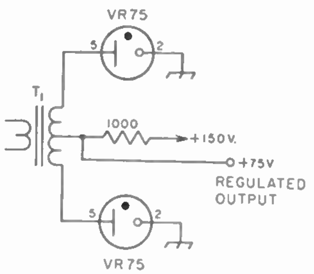


Fig. 5-11—WØDYW's voltage regulator.

The transformer T_1 can be any universal output transformer having a center-tapped primary. The secondary winding is not used. The d.c. resistance of the transformer winding is sufficient to accommodate the slight difference in operating potential of the two VR tubes.

— *W. E. Witte, WØDYW*

A "FIXED-LOCATION" POWER SUPPLY FOR MOBILE EQUIPMENT

Mobile equipment permanently mounted in a car can usually be operated "fixed location" for extended periods of time only at the expense of either an overheated engine or a run down battery. And, of course, gallons of gasoline can be consumed while the car motor is being used to generate primary power for the mobile supply. If operation takes place during a hot afternoon, you're also in for some personal discomfort caused by the extra heat radiated from the motor. Ignition noise generated by your own car is still another annoyance that results from "leave-your-motor-running" operation.

Most of these problems may be miminized or completely eliminated by using a field-type battery charger as suggested by W7FVI (*QST*, July, 1955). Our version of this supply, shown here as Fig. 5-12, is used to charge the car battery, but the same unit may be used to keep life in any storage battery being used in the field.

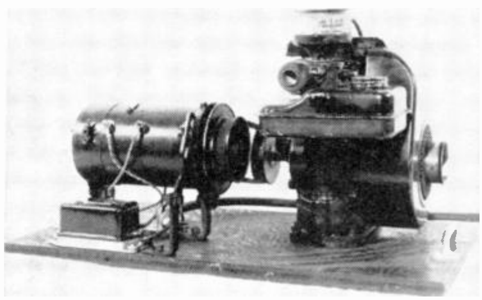


Fig. 5-12—W9WTY's version of the field-type battery charger described previously by W7FVI. This particular unit is used to charge the car battery during extended periods of car-not-in-motion mobile operation.

The charger consists of a small gasoline engine, an old auto generator and a voltage regulator. These are mounted on a plywood base equipped with handles. Output from the generator is coupled to the car battery through a long length of heavy duty two-wire cable. Naturally, the length of the cable will be determined by how much you want to separate the charger and the battery. If you want lots of separation so that racket from the charger can be kept in the background as much as possible, just remember that the cable may have to carry 30 amperes or more if the generator-battery system is designed for 6 volts. Figure on a wire size that will handle 15 or 20 amperes if the charger is a 12-volt affair.

— *Jack Miller, W9WTY*

SWITCH-TO-SAFETY IDEA

Having in mind the worthwhile purpose of increasing the longevity of ARRL members and other amateurs, I would like to add a suggestion to the several technical Switch-to-Safety items which have appeared in *QST*. Fig. 5-13 illustrates a simple power wiring arrangement which provides continuous safety checks on power and ground connections. With this arrangement, all switches and fuses are located in the "hot" side of the 117 volt a.c. line, carrying through the scheme used in standard house wiring. (When fuses are installed in both sides of the line, it is possible for the cold fuse to operate from overload and still leave equipment and wiring energized with 117 volts with respect to ground.)

One side of a neon panel light is connected to the "hot" side of the a.c. line after the fuse and main power switch. The other side is connected to station equipment cabinet ground through a 50,000 ohm resistor. A standard bayonet panel socket with a clear glass jewel is used for lamp (NE-51) installation. Before connecting the power plug to an outlet, the main power switch, S_1, is placed in the off position. Some resistive load normally connected after the main power switch should be present. This fixed load may be provided by a desk lamp and a receiver.

If the NE-51 illuminates when the power plug is inserted in an outlet, reversed polarity is indicated. The NE-51 will then go out if the main power switch, S_1, is placed to on. Reversing the power plug will result in opposite- and proper-operation of the panel light. It will illuminate only with the main switch on. Failure of the light to glow with either position of the power plug indicates an absence of the vital connection between chassis and actual ground (shown as heavy line in Fig. 5-13). With the power plug properly installed, all station equipment is completely de-energized by operation of the main switch or fuse. Improper installation of the plug is immediately apparent from the appearance of the neon lamp.

In addition to the main power switch, S_1, the circuit includes S_2 and S_3 for control of the filament and plate supplies, respectively. Of course, S_2 and S_3 may be used to control additional transformers provided these are properly connected in parallel with the primaries of T_1 and T_2. Ratings shown for fuses F_1, F_2 and F_3 may be varied to suit individual requirements.

— *John W. Browning, W8DDF*

INEXPENSIVE CIRCUIT BREAKER

A model railroad item which may have some utility for builders of ham gear is a 3-amp. thermal-type circuit breaker, also called a "grasshopper." It resembles a small fuse, and consists of a cartridge about one inch long which mounts on fuse clips which are supplied with the device. A bimetallic strip on top heats up on overload, springing up and breaking the circuit; the strip is pushed back into place to reset.

The circuit breaker's strong points are its small size, low cost (about 50 cents complete with clips and mounting screws) and simplicity of mounting. It also does away with the need for replacing fuses which blow on week ends when the radio stores are closed. Chief disadvantage is its slow action; the strip must heat up before it opens, and it must cool off before it can be reset. Also, the voltage appears across the exposed ends, so if the circuit breaker is mounted on a panel, for which it was apparently designed, it should be provided with an insulated cover. It also places some resistance in the circuit.

It is available in most hobby shops as the Mantua Metal Products Co. Kit No. 708.

— *Julian N. Jablin, W2QPQ*

CONVERTING FILAMENT TRANSFORMERS FOR PLATE-SUPPLY USE

In searching for miniature power transformers for such low-power items as grid-dip oscillators, etc., I have found it convenient to make my own, using small filament transformers. Since most of these have the low-voltage winding wound on the outside, it is easy to remove the few filament turns to make room for the rewinding.

The procedure is simple. Count the turns removed to determine the turns-per-volt ratio for the core. Now rewind the filament turns with a smaller size wire. Follow this with the "high-voltage" winding using the number of turns per volt previously determined. The wire sizes should be chosen so the I^2R losses in the two secondaries under load do not exceed the rated I^2R loss for the removed turns. This allowable loss is fairly flexible and can be exceeded by 50 per cent or so for intermittent duty or where some ventilation is present.

— *Ben Vester, W3TLN*

[Editor's Note: Additional data pertaining to the rewinding of transformers will be found in Chapter 7 of *The Radio Amateur's Handbook.*]

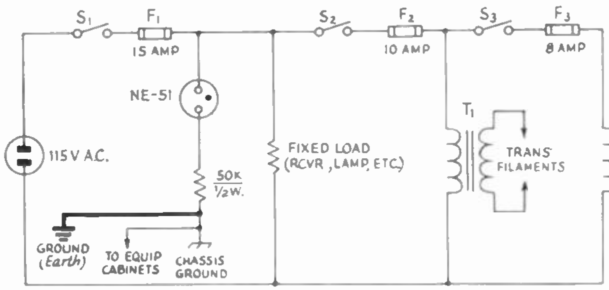


Fig. 5-13—Diagram of W8DDF's switch-to-safety power control circuit.
F_1, F_2, F_3—Line fuses; see text.
S_1, S_2, S_3—S.p.s.t. power switches.
T_1, T_2—Filament and plate transformers.

STATION CONTROL CIRCUIT

A novel method of switching line and plate voltages is shown in Fig. 5-14. Two momentary contact switches, S_1 S_2, are used, one being of the normally open type, the other a normally closed type. The relay is of the d.p.s.t. variety. One pair of contacts is used as holding contacts, while the other pair is used to break the circuit.

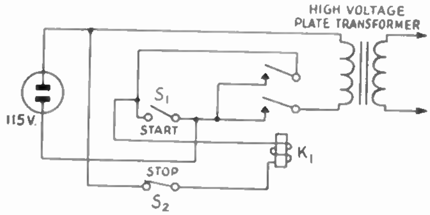


Fig. 5-14—Diagram of the control circuit.

S_1—S.p.s.t. normally open switch.
S_2—S.p.s.t. normally closed switch.
K_1—D.p.s.t. relay normally open.

This method is often used in commercial broadcast equipment, and is especially useful for remote control applications. The switches can be color coded to show their functions; red and green seem to be appropriate colors for start-stop and on-off. — *Earl A. Carron, jr., W1WRW*

SCREEN-GRID PROTECTION WITH A SURPLUS RELAY

While overload relays operating in the region of 100 to 500 ma. are readily available, it may be difficult to locate one suited for use in the screen-grid circuit of an r.f. amplifier which employs a tube such as the 4X250B. The requirements in this case call for a relay that will disconnect screen voltage at a screen current of 50 ma. or somewhat less.

Use of an inexpensive surplus relay of the dual-winding type provides a simple solution to the problem. Fig. 5-15 is the diagram of a relay-type protective circuit that was whipped up and placed in operation in less than one evening. Although no new principle is involved, the system does provide dependable protection for those expensive pentode and tetrode tubes which ruin so easily because of excessive screen dissipation.

The s.p.d.t. surplus relay has a pair of 200-ohm windings on a common core. One of these windings is connected in series with the screen-grid lead, the normally-closed contacts of the relay and the line from the screen supply. The path between supply and screen grid remains closed until a predetermined value of screen current activates the relay and opens the normally-closed contacts. When the relay is tripped by overload current, voltage is transferred to the second winding which now receives voltage through the normally-open contacts and R_1. The second coil will hold the screen circuit "open" until the relay is re-triggered by the opening of reset switch S_1.

R_2 is a sensitivity control for the relay and, in the original circuit, is adjusted so that the relay kicks over at screen current in excess of 35 ma. Of course, any abnormal operating condition that usually causes excessive screen current will operate the relay.

Reverse the leads to one of the windings if the relay chatters or fails to hold when activated by screen current. If the relay has a spare set of contacts, these may be used to control a "screen-on — screen-off" pilot lamp.

— *I. S. Simpson, W1FYN*

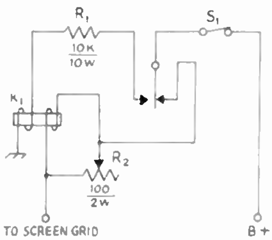


Fig. 5-15—Diagram of W1FYN's, screen-grid protective circuit.

K_1—Surplus relay; see text.
R_1, R_2—See text.
S_1—S.p.s.t. toggle switch.

THE "A.C. VARIVOLTER"

Most experimentally-inclined hams will agree that the compact type 10 Powerstat (Superior Electric Co.) variable autotransformer, which gives a range of voltages all the way from 0 to 132 volts, is a mighty handy device to have around. As purchased, however, it is unmounted, which makes it rather awkward to use. Maximum convenience, as well as maximum performance of the unit, may be easily obtained by mounting the Powerstat in a 4 × 5 × 6-inch aluminum box with an on-off switch, a 0-150 a.c. voltmeter, a chassis type outlet and a pair of binding posts.

An assembly as described is shown in Fig. 5-16. Decals are used to label the controls, and the handle at the top of the box is an ordinary screen-door pull.

— *Frank H. Tooker*

Fig. 5-16—Front view of the "A.C. Vari-volter." The bakelite binding post must be well insulated from the panel.

IMPROVED BLEEDER CIRCUIT

THE arrangement shown in Fig. 5-17 provides a warning *before* the bleeder resistance burns out, and also a voltmeter for the output of a power supply.

The normal bleeder resistance is made up of two branches in parallel, each branch having twice the resistance of the normal bleeder. A milliammeter connected in the common negative leads reads the normal bleeder current. If one branch of the bleeder opens up, the other branch will still discharge the filter capacitors, but the meter reading will fall to half its original value, warning the operator that one branch has burned out and should be replaced as soon as possible.

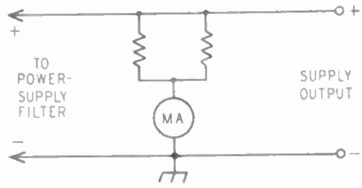


Fig. 5-17—Schematic of the improved bleeder circuit.

If the branches are made of equal resistance, each branch of the bleeder can have half the power rating of the normal bleeder. If, for example, the normal bleeder resistance is 25,000 ohms, 50 watts, each branch can be 50,000 ohms, 25 watts.

The output voltage of the supply can, of course, be determined easily by multiplying the current indicated by the milliammeter and the bleeder resistance in series with it. When the branches are equal, this resistance will be half the resistance of either branch.

Any milliammeter will read directly in voltage if the bleeder resistance is 10,000 ohms, or 100,000 ohms, the voltage being 10 or 100 times, respectively, the reading in milliamperes. A 25-ma. meter, for instance, will read 250 volts full scale with a 10,000-ohm bleeder, or 2500 volts with a 100,000-ohm bleeder.

— *Rev. Joseph A. Terstegge, W9LQE*

Caution: The bleeder circuit becomes inoperative if the meter opens up! — ED.

IMPROVING THE "IMPROVED" BLEEDER CIRCUIT

THE one objection to W9LQE's improved bleeder circuit is that the bleeder becomes inoperative in the event that the meter opens up. This possibility can be avoided by borrowing a trick employed in the metering circuits of some commercial transmitters. The use of one additional resistor, R_3 of Fig. 5-18, does the trick.

The resistance of R_3 should be high enough to prevent any practical effect on the calibration of the meter. The wattage rating of the resistor must be in keeping with the power to be dissipated in the event of meter failure.

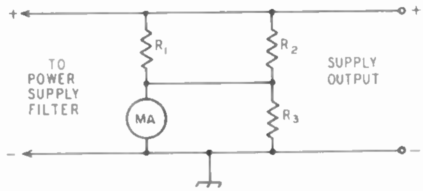


Fig. 5-18—The addition of R_3 to the original "Improved Bleeder Circuit" provides additional protection.

— *Neil Johnson, W2OLU*

HANDY SOURCE OF POWER FOR D.C. RELAYS

DISCARDED pinball machines, old juke boxes and ARC-5 gear are just several sources of excellent d.c. relays. All too often, though, this type of relay is passed over by amateurs because of the d.c. power requirements. However, it is *not* necessary to provide a special d.c. pack for this type of relay and the following explains how relay power is obtained by several of us fellows up here in W8-land.

Here at W8NOH, we connect the d.c. relays in series with the center tap of a low-voltage plate supply. Not only does this method of connection provide relay power, but it provides a source of negative voltage that may be filtered and used as fixed bias for a keyed c.w. stage. Approximately 18 volts was developed across one of the relays so connected and about −35 volts was obtained across the windings of a pair of relays connected in series. In each case, adequate filtering was provided by an 8-μf. capacitor. Naturally, the relays contacts may be employed for a variety of switching operations such as the control of other supplies, receiver muting, antenna changeover, shorting of a modulation transformer, etc.

W8PUV has a d.c. relay connected in the grid-circuit return of his final amplifier. With the relay contacts controlling the screen and the plate supplies for the stage, it is impossible to apply power without first having excitation available.

W8GJS uses a d.c. relay in the negative return of his plate supply to control a red *warning* light.

Of course, with the relay connected in series with the center tap of the supply, the voltage developed across the solenoid must be subtracted from the original effective value of plate voltage. In other words, if you pick up −18 or −20 volts of bias, you lose that amount at the positive output terminal of the supply.

— *Louis A. Gerbert, W8NOH*

[EDITOR'S NOTE: When using this system, it is advisable to study the current handling capability of the relay winding, remembering that the solenoid must pass the full-load current of the supply. Furthermore, this method of developing bias should be installed only when the supply load is reasonably constant. Serious fluctuations in bias voltage would result if, for instance, a relay was so installed in a supply delivering power for a Class B audio stage.]

LOW-VOLTAGE REGULATION

If it is desired to obtain low voltages with good regulation, voltage-regulator tubes connected in a differential circuit, as shown in Fig. 5-19, can be used to yield a good many values of output

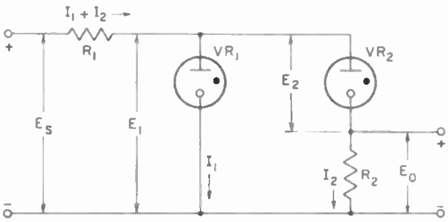


Fig. 5-19—Circuit diagram of the low-voltage regulation system.

voltage. The output voltage E_O is the difference between two regulated voltages and, as such, possesses fairly good regulation. General design equations are given so that resistor values may be determined in terms of supply voltage, rated tube-voltage drops, and permissible tube currents:

$$R_1 = \frac{E_s - E_1}{I_1 + I_2}$$

$$R_2 = \frac{E_1 - E_2}{I_2}$$

E_s = source voltage;
E_1 = rated voltage drop across R_1;
E_2 = rated voltage drop across R_2; and
I_1, I_2 = currents in VR_1 and VR_2, respectively, under no-load conditions.

I_1 should be in the vicinity of 20–40 ma., as in the case of orthodox regulator circuits. I_2 should be about the same for bias circuits where grid current is involved; however, if used only to feed a resistive load, I_2 may be the minimum current necessary to keep VR_2 ionized (about 5 ma.).

E_o is the difference between the rated operating voltages of VR_1 and VR_2, and utilizing Type 0A2, 0B2, 0A3 (VR-75), 0B3 (VR-90), 0C3 (VR105) and 0D3 (VR-150) tubes in correct combinations will yield the following voltages: 3, 15, 18, 30, 33, 42, 45 and 60 volts. Other voltage combinations may be derived if desired by substituting two or more VR tubes in series for VR_1 and VR_2; however, this results in bulkier equipment, and may prove economically unfeasible.

The writer is using this circuit to furnish 42 volts of regulated bias to a pair of 807 modulators. In this case, VR_1 is an 0A2, VR_2 an 0B2, R_1 is 1000 ohms, 10 watts, and R_2 is 1500 ohms, 2 watts. Supply voltage E_s is about 200 volts, and I_1 and I_2 are calculated as 23 and 28 ma., respectively.

—*James Fernane, WØJOP*

OUTBOARD VOLTAGE REGULATOR

Many hams would like to have a source of regulated voltage for experimental use, but do not care to tie up a transformer and the necessary filter components in a supply that will be employed only at irregular intervals. The late W5LS designed an *outboard regulator* that may be used with any small power supply capable of delivering up to 100 ma. at 350 to 400 volts.

The circuit diagram of the regulator is shown in Fig. 5-20. Tests of the circuit, made with the out-

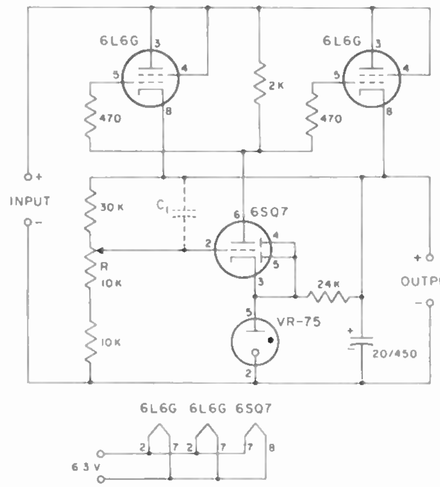


Fig. 5-20—Circuit diagram of the voltage regulator. All resistors, except R_1, 1-watt carbon.
C_1—Optional ripple filter, 0.1 µf., 600 volts.
R_1—10,000-ohm 3-watt wire-wound potentiometer (Clarostat Series 58).

put control, R_1, adjusted for an output of 225 volts, showed no voltage drop at loads as high as 77 ma. When adjusted for an output of 250 volts, the regulation was constant up to loads of 60 ma. and a drop of no more than 5 volts was measured with the load increased to 77 ma. At 275 volts, the output remained steady with leads up to 54 ma. and fell to approximately 240 volts with the drain raised to 77 ma.

Variations in the design to meet special conditions are possible. In addition to the ripple filter shown, the connection of a 0.002-µµf. mica capacitor across the VR-75 will reduce the noise amplification, in which case the 20-µf. capacitor can be eliminated. Of course, the filament voltage applied to the regulator tubes cannot be used for equipment powered by the regulator unit.
—*E. P. Prass, W5AFL*

6. Hints and Kinks . . .

for Keying and Monitoring

A NEON-TUBE KEYING MONITOR

WHILE the use of a neon bulb as an r.f. indicator is well known, and its properties as a discharge device have been used in many ways, it may not be generally appreciated that it may also be used as a relay. This application is based on the fact that the gas in the bulb becomes conductive when it is ionized, not only when a suitable voltage is applied to the electrodes, but also when the bulb is located in a strong r.f. field. In the latter case, the bulb can act as a relay, controlling the flow of current in an external circuit when ionized by proximity to an r.f. field. This characteristic makes possible the construction of a very simple keying monitor as shown in Fig. 6-1.

In Fig. 6-1, V_1 is a neon bulb located near the final tank, an antenna wire, or wherever the r.f. field is strong enough to ionize completely the gas in the bulb as evidenced by a strong glow.

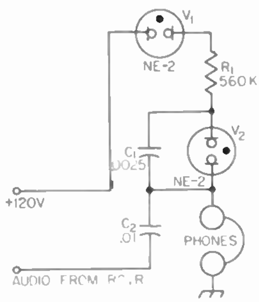


Fig. 6-1 — Circuit diagram of the neon-tube keying monitor. C_2 is a coupling capacitor for the audio output from the receiver. V_1 and V_2 are 1/25-watt neon bulbs. GE type NE-2. Other component values are discussed in the text.

Incidentally, it is better to keep the bulb out of the field of the tank coil itself to minimize any possible r.f. pick-up on the leads. A suitable location would be adjacent to the stator plates of the tank capacitor, being sure that all leads are well insulated against direct contact. No perceptible detuning of the tank should result, and the power absorbed by the device is negligible. As a further precaution against any unwanted radiation, the leads to the relay bulb should be shielded. They may, however, be as long as necessary.

The rest of the circuit is the familiar neon-bulb audio oscillator connected in series with the headphones. The values of R_1 and C_1 will determine the frequency of the tone generated. The values shown will give about an 800-cycle note, and provide a comfortable volume in high-impedance headphones. If greater volume is desired, the ratio of C_1 to R_1 should be increased. Increasing C_1 alone, of course, will lower the frequency, so that for the same audio frequency, R_1 must be reduced as C_1 is increased.

There are a few precautions to be observed in building the monitor If the voltage is too high, it may be found that the oscillator continues to operate after the key is released. If the voltage is too low, the neon bulb may not strike. Also, the voltage source should be well regulated, as otherwise a most annoying chirp will result. For this reason, as well as for convenience in construction, the use of a bleeder across the receiver power supply will usually be most satisfactory. Since very little current is drawn, a high-resistance bleeder can be used In the version at WØSOL the source is the junction of two 100K resistors across the 240-volt receiver power supply.

The components of the audio oscillator are small and can be located wherever convenient, either within the receiver, if space permits, or in an external match-box-size housing, or even simply wired together and taped to the leads to the relay bulb.

— *Preston B. Tanner, WØSOL*

SIMPLE KEYING MONITOR

IF the keying circuit uses a low-voltage relay, and if you want a simple means of following your own fist, try hooking an ordinary buzzer in series with the line to the relay. The stunt has been used here at W4TP for about 15 years. The buzzer requires adjustment and the tone emitted, with 6 volts a.c. applied to the sounder, is a not unpleasing T6.

— *Hugh W. Holt, W4TP*

THE "SIAMESE PADDLE"

Almost anyone who has built an electronic keyer has gone through the experience of discovering, usually after completing the electronic part, that the control mechanism — the switch, or key — can be much more of a problem. A glance at the circuit of one of these devices fails to show why an old hack-saw blade wouldn't do the trick. But this is far from the truth. Positive and reliable control requires a considerable degree of mechanical refinement, as attested by the fact that a ham will often chop up a twenty-dollar bug to get the few essential parts he needs. Satisfactory homemade substitutes require greater than an ordinary amount of skill with tools.

However, I recently discovered that there is a very simple solution to the problem. A pair of ordinary inexpensive straight keys can be made into a de luxe keyer control in less than an hour, if you don't insist on trimming it up. It not only supplies a good wobble-free mechanism, but it also provides for convenient adjustment of tension and contact spacing, satisfying the most finicky operator.

As Fig. 6-2 shows, it is simply a matter of mounting the two keys back to back in a vertical position. The keys shown in the photograph are Type J-38, selling in surplus for as low as 85 cents each, although almost any other type can be adapted. The J-38s are particularly suitable because they come mounted on bakelite bases, one of which can be put to use since most electronic-keyer circuits require insulation for all three terminals of the control.

First remove the two keys from their bases, strip one of the bases of the remaining hardware and remove the shorting levers from both keys. It may be necessary to lift the key arm out of its bearings to get at the screw holding the lever. Now place the keys on edge, with their bottoms facing, and clamp them together with a 6-32 machine screw through the upper mounting-screw hole. Using another 6-32 screw through the lower mounting hole, fasten a 1-inch hardware-store angle piece on each side with the legs extending outward. (The brass-plated pieces usually found in hardware stores, but less often in dime stores, make a much neater job than the common iron variety.) Make sure that the strap connecting the stationary key contact to its terminal doesn't short-circuit against the angle piece.

The front end of the assembly is supported on 1½-inch hardware-store angle pieces. One leg of each of the two pieces is shortened by cutting it off about midway between the two holes. One of these angle pieces is then fastened to the lower terminal of each key, using the terminal cap screw through the top hole in the longer leg of the angle piece. The short legs should point inward.

One of the J-38 bakelite bases is then marked and drilled to fit the holes in the feet of the mounting angles. The key should be placed with the feet centered on the base. The holes should be well countersunk underneath so that flat-head mounting screws do not protrude.

The paddles are made of pieces of ⅛-inch polystyrene or lucite sheet, 2½ inches long and 1 inch wide. A hole to pass a machine screw that fits the knob hole in the key arm is drilled in each paddle, ½ inch from one end. Most key knobs have a standard 8-32 thread. The exact manner of mounting the paddles depends on factors to be discussed presently.

If you can locate a piece of ½-inch steel or brass, you can add a weighting base with rubber feet like the conventional bug. The base shown is 6 inches long and 3 inches wide. Be sure that the mounting screws on the underside of the bakelite base don't protrude so as to short on the metal base. If the weighting base is omitted, the key can be screwed or cemented to the operating table. Rubber cement sets quickly and yet permits removal without difficulty. Also, it will not mar the finish of an operating table.

The adjustment of the key depends largely on the personal preferences of the operator. I have mine adjusted so that both sets of contacts cannot be closed simultaneously. However, many of those who are using electronic keyers of the self-completing type find possible many short-cuts in the forming of certain characters and increased ease of handling in other ways if it is possible to close both circuits at once when desired. For instance, closing the dot side while dashes are being sent does not interfere with the sending of dashes. Therefore, when both sides are closed, the change-over from dashes to dots can be accomplished merely by opening the dash side.

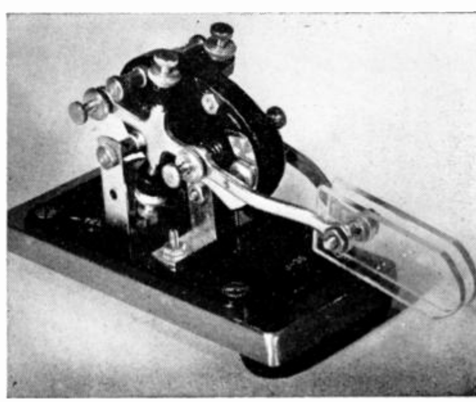


Fig. 6-2—By simply mounting two standard keys back to back in this fashion you can have a de luxe control for an electronic keyer in less time than it takes to tell about it.

Actually, it is necessary to open the dot side only for spaces.

As shown in the photograph, the paddles are mounted on the inward sides of the key levers, with the heads of the 8-32 screws also on the inside. With this arrangement, it may be necessary to bend the key levers slightly if it is desired to prevent closing both circuits at the same time. Place a thickness or two of paper between the contacts of each key and press the two paddles together between the thumb and forefinger. Then bend the levers slightly so that when the paper is pinched securely between both sets of contacts, the heads of the screws are in contact.

After the photograph was made, an arrangement making this adjustment more convenient was found. The paddles were placed on the outer side of the key levers and the screws were reversed with the heads on the outside. A locknut was first run onto each screw. Then the screw was passed through the paddle, threaded into the key lever, and then fastened with another locknut on the inside. Now the above adjustment can be made simply by adjusting the screws with a screwdriver and locking with the two nuts. I prefer the wider paddle spacing that results with this arrangement, although others may prefer the closer spacing when the paddles are on the inside. It will usually be possible to use the screwdriver adjustment, even with the paddles on the inside, although it may be necessary to file the nuts down to fit the space between the key levers.

If simultaneous closing of both sides of the circuit is desired, adjustment is merely a matter of setting the contact spacing, bearing play and spring tension to suit the operator, using the adjusting screws already provided on the keys for these purposes. If you have a light touch, it may be necessary to change the springs to lighter ones, or to cut a turn or two off the existing springs and stretch to fit the space.

In the electronic-keyer circuit, the "arm" connection will be made to one of the terminals connected to the frames of the keys, while the two "side"-contact connections will be made to the terminals connected to the straps leading to the stationary contacts. Depending upon how these two "side" contacts are connected, the keyer can be operated either right-handed or left-handed. Simply reversing these connections reverses the operation.

— *Myron Hexter, W9FKC*

CONVERTING THE "SIAMESE PADDLE" FOR BUG-TYPE OPERATION

The simple and inexpensive keying mechanism, "The Siamese Paddle," described above, can be converted to a first-class bug with a minimum of additional cost and effort. The simple modification which provides for bug-type operation of the key is shown herewith as Fig. 6-3.

The vibrating arm for the bug is made from a hack-saw blade or a length of spring steel. A hole drilled in the front end of the arm allows it to be attached to the *dot* lever of the Siamese Paddle by means of the original spacing adjustment screw. A homemade spring contact is soldered to the vibrating arm as shown in the drawing. In a fancier version of the bug, this contact could be made adjustable along the arm. The stationary contact and the contact adjustment for the dot arm may be made from a binding post and a 6-32 machine screw.

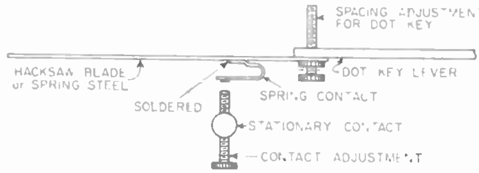


Fig. 6-3—A simple system for converting the "Siamese Paddle" to a bug.

The vibrating arm for the key must be weighted down to slow the dot rate down to a reasonable speed. This may be accomplished by wrapping wire-type solder around the arm. An ordinary clothespin will serve the same purpose for some speeds of operation.

Because the two levers of the bug are not mechanically linked, it is possible to strike a dash character before a dot action has been overcome. However, this tendency can easily be avoided after a little practice.

— *Jack Gjovaag, W7UKI*

WEIGHTED KEY BASE

By using a clean 3 × 4-inch sardine can as a mold, lead can be formed into a neat, easily worked key base. Lead may be obtained from a local tire station that does wheel balancing, from fish-line sinkers, or it may be purchased in bar form at a plumbing supply house.

An ordinary kitchen range will provide heat for melting the lead. Use enough material to fill the can to a depth of ¾ inch (after it has become molten). After the lead has melted, push the topside film to one side and remove with pliers. Then remove the mold from the range, allow a brief period for the lead to set, and then speed the cooling process with the aid of cold water.

Countersink the holes for the flat-head bolts used to hold base and key together. A strip of felt glued to the bottom of the base will prevent scratching of the operating table.

— *John C. Hemby, W5WQQ*

ANOTHER ANTI-SKID TREATMENT FOR BUGS

During a three-week hiking expedition I came across the ultimate answer to the problem of sliding bugs. Dr. Scholl's Adhesive Foam, used to prevent blisters, is available from most drugstores at low cost. These foam-rubber pads are $\frac{3}{16}$-inch thick by 6 inches square and have a layer of adhesive on one side, and a protective gauze covering on the other side.

The foam is cut into ¾-inch squares, the protective gauze removed, and pressed onto the rubber mounting feet of the bug. The feet (of the bug, of course) should be free of dirt and perhaps roughly filed to make a better sticking surface for the Adhesive Foam. The foam pads will hold best on a smooth hard surface such as a table top.

— *Alex Goetz, DJ3BW/K6AGR*

ADJUSTMENT OF SEMIAUTOMATIC KEYS

AMATEURS who use bugs should be interested in learning how to adjust and maintain these keys. The required reading is included in the following instruction which the Bell System furnishes to employees and subscribers who use semiautomatic keys.

General

Semiautomatic sending keys (so-called because they make dots automatically) are commonly used at telegraph stations. Fig. 6-4 is a schematic diagram of one of these keys.

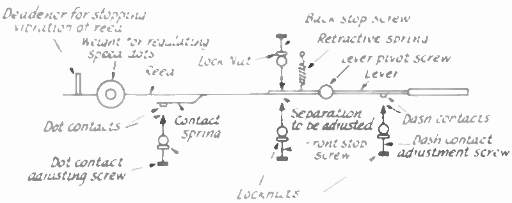


Fig. 6-4—Schematic diagram of the semiautomatic key referred to in the Bell System instructions.

The proper maintenance of these keys in accordance with the following instruction is necessary to insure good telegraph service.

Inspection

When signals are not satisfactory, examine the key for mechanical defects. See that contact points are clean and in alignment, with the faces parallel. The lever pivot screw should be loose enough to permit a free movement of the lever but not so loose as to make signals unsteady. All supporting parts should be rigidly fastened. See that cord and plug are in good condition.

Adjustment

After inspection has been completed, the key should be adjusted as follows:

1) Place the key on a level surface.

2) Adjust the back stop screw until the reed lightly touches the "deadener," and tighten the lock nut.

3) Adjust the front stop screw until the separation between the end of this screw and the lever is approximately .015 inches and tighten the lock nut. A greater separation is permissible if the operator prefers more lever movement.

4) Operate the lever to the right. Hold in this position and stop the vibration of the reed. Adjust dot contacts until they just "make" without flexing the contact spring and tighten the lock nut. As this is a very important adjustment it should be checked after setting up the lock nut to see that it has not changed.

5) In case the dots are either too light or too heavy, move the weight which is provided for regulating the speed (and which generally should be kept well toward the outer end of the reed) nearer the outer end.

Note A: After key has been adjusted as above, do not change adjustments to correct light or heavy signals except by moving weight toward outer end of reed.

Note B: Keys equipped with two weights should always have one weight near the outer end of the reed.

— *Virgil E. Thompson, W1SEJ*

A BUILT-ON CLICK FILTER FOR THE TYPE J-38 KEY

THE popular surplus J-38 key has a set of extra terminals which, when removed, provide space and mounting holes for a small "Minibox." The box may be used to enclose a key-click filter and also as the mounting for a send-receive switch. There is enough room on the rear wall of one of these boxes to accommodate a connector for the leads running to the receiver and the transmitter.

Nice thing about the setup is that the filter is placed right at the key where it belongs, and the send-receive switch is about as close to the key as it can be located.

— *Clifford A. Mason, K2AFO*

FULL RANGE SPEED CONTROL FOR SEMIAUTOMATIC KEYS

A HIGHLY successful method of controlling the speed of a bug or semiautomatic key is shown in Fig. 6-5. With this system, it is possible to slow down the dot frequency instantaneously to any desired rate.

The drawing is more or less self-explanatory. The only parts added to the original key are a hairpin-shaped piece of iron wire and one or more small cylindrical Alnico magnets such as those used in speaker manufacture. The hairpin is held in place under the thumbscrew which normally holds the sliding weight in position and the magnet or magnets hold themselves in the cradle formed by the hairpin.

The hairpin can be made from a section removed from an iron coat hanger. Before mounting the hairpin, move the regular weight up to

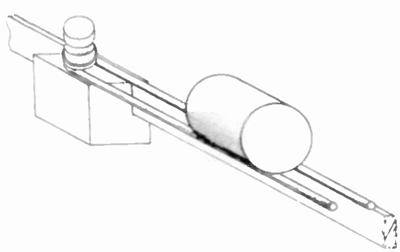


Fig. 6-5—Detail drawing of the speed-control for bugs or semiautomatic keys.

the maximum speed position. When the cradle is locked in position, orientate it with the open end facing toward the rear of the key. Thus, by merely removing the magnet or magnets, top speed is available without need for loosening any screws. To come down to a slower speed, put a magnet or two on the cradle (preferable sizes are those having a diameter measuring between ¾ and 1¼ inches) and slide same to the most effective position. Even with the heaviest combination of weights on my bug, and while keying at the rate of less than six dots per second, I can get over 50 cleanly formed dots before the bug comes to rest.

For a few weeks after this idea was first put to work, I had the extra magnets lying around on the desk where they were easily misplaced. When I finally remembered the basic properties of magnets, I simply placed them against the front panel of my receiver where they stay put until wanted.

— *Cyrus T. Read, W9AA*

TRANSMITTER KEYING WITH THE SURPLUS TG-34-A KEYER

The type TG-34-A keyer is an automatic unit for providing code practice signals from an inked recording. The output of the keyer is an audio frequency note with sufficient power to supply a number of headsets. However, if the machine is to be used for keying a transmitter during code practice transmissions, testing, etc., it is necessary to convert the audio output signals into mechanical energy that will control a keying relay. Fig. 6-6 is a circuit that will make the necessary conversion.

The tapped secondary winding of the keyer output transformer (T_1) is coupled through a crystal diode to the base of a type 2N36 transistor. The transistor operates in a grounded-emitter circuit with the keying relay, K_1, serving as the output load.

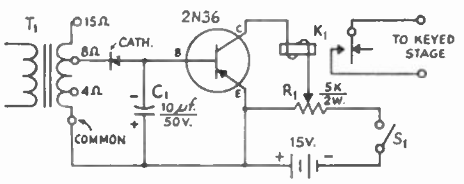


Fig. 6-6—Schematic diagram of the TG-34-A keying accessory used at W8DAP.
CR_1—Type 1N34A crystal diode.
K_1—D.p.s.t. sensitive relay (Advance AM/2C; formerly type K1504RF).
T_1—TG-34-A output transformer.

In operation, CR_1 conducts during negative half cycles of audio voltage, thus providing a negative base bias for the transistor. Although CR_1 rejects the positive audio voltage, it does charge C_1 while conducting. C_1, because of its high value of capacitance, *holds* the transistor base bias during positive-pulse periods of non-conduction with the result that a steady current flows in the base-emitter circuit whenever an audio signal of proper amplitude is applied to the diode. This, in turn, causes the collector current to *follow* the keyed input signal and properly energize the keying relay.

By using the 8-ohm speaker output taps and approximately one quarter "pot" of the bias and volume controls on the keyer, and with 10 to 12 volts applied to the transistor, perfect operation is obtained. The voltage divider, R_1, across the battery is used to find the proper transistor operating voltage and its setting depends on the amplitude of the controlled signal output of the keyer. Almost any type of battery may be used as the current drain is very small. A pair of Burgess type 4F5H $7\frac{1}{2}$-volt batteries is used with the original circuit.

The relay listed is the only one of several tried that will follow the tape and still key the transmitter regardless of speed. This relay has two springs; one is a hinge type which connects the armature to the body, and the other is a "coil type" spring. Removal of the coil spring and adjustment of the hinge type until the relay *pulls in* at 3 ma. is necessary. Although K_1 is a d.p.s.t. affair, only one set of contacts is shown in Fig. 6-6.

With the exception of the batteries, all parts are mounted on a 1 × 3-inch "L" bracket attached to the keyer directly above the audio output terminals.

— *Lee Dilno, W8DAP*

"ANCHORING" THE J-38 KEY

The popular and inexpensive surplus type J-38 key will normally walk, skid or tip during "brass pounding" unless it is secured to the operating table. Fastening the key to a fixed position to prevent movement is not always the most desirable remedy, especially so when you're new at the game and have not yet determined the best layout for the operating position.

One simple method of anchoring the key without permanently bolting it in position is to reverse the key on its rectangular bakelite mounting base. This places the knob *over* the mounting plate instead of allowing it to extend out and away from the base. Thus, pressure created by keying is exerted directly down onto the base instead of being applied to the end of a lever that extends out over the front end of the unit.

— *Don Simon, KNØJCY*

ONE-HAND KEY MONITONE SWITCH

Users of Monitones (*QST*, Sept., 1948) know the inconvenience of not being able to zero beat received signals because of muting of the receiver by the Monitone.

The accompanying sketch illustrates how this trouble was eliminated by making use of a normally closed microswitch directly attached to the base of the bug or straight key. This switch is then connected in series with the r.f. or power supply of the Monitone.

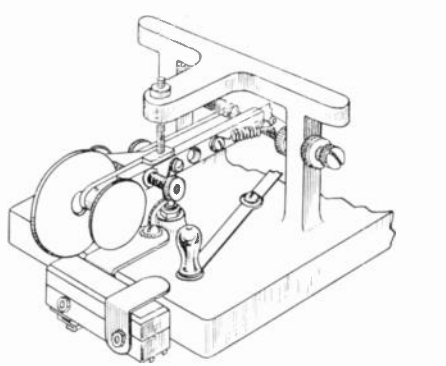


Fig. 6-7—Sketch showing the microswitch attachment to a standard "bug."

The transmitter can then be keyed and, with additional digital pressure on the actuator, the Monitone signal is cut off and the receiver operates normally.

— *A. C. Coggan, VE3BOA*

MODIFYING THE HEATH VX-1 FOR C.W. BREAK-IN

After obtaining a Heath VX-1 voice-controlled break-in unit, I looked about for a way to modify the unit for c.w. break-in. I studied the circuit, tried various methods, and finally arrived at the following changes.

The only additional components needed are an s.p.s.t. toggle switch and a 0.1-μf. capacitor. Remove the ground end of the 100,000-ohm grid resistor on Pin 7 of the 12AX7 speech amplifier tube and connect it to one side of the toggle switch. Ground the other side of the switch as

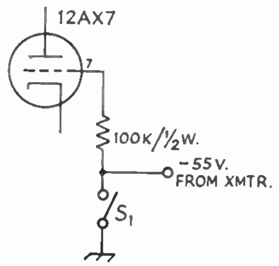


Fig. 6-8—Insertion of switch S_1 allows the VX-1 to be used for c.w. break-in.

shown in Fig. 6-8. Now connect the 0.1-μf. capacitor in parallel with 0.1-μf. capacitor that is already connected to the 7.5-megohm time-

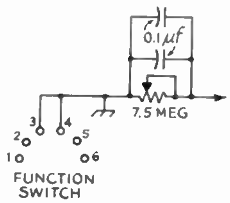


Fig. 6-9—Diagram showing the additional 0.1-μf. capacitor connected across the 7.5 megohm time-delay control.

delay control. See Fig. 6-9. Consult pictorial diagram No. 4 on page 16 of the instruction manual for aid in finding the above components.

If more time delay is wanted, add more capacity in parallel with the capacitor across the 7.5-megohm time-delay control.

The above change will work on a transmitter using grid-block keying or on one that makes use of a blocking bias for keying. The bias can be obtained from a battery that is keyed by a relay.

My transmitter uses −55 volts bias to key the oscillator. With the toggle switch open and the function switch on vox, it is ready for c.w. break-in. With a little practice, the most pleasant setting can be found. When keying begins, the relay in the VOX will close and stay closed until keying is discontinued, then the relay will open after a short delay.

The unit's function can easily be switched to phone operation, of course, by throwing the toggle switch to the other position.

— *Paul G. Marsha, K4AVU*

USING THE SELECT-O-JECT AS A KEYING MONITOR

Anyone who owns and operates one of the National Select-O-Jects may be interested in how the unit is used as a keying monitor here at WNØRVF. The stunt has worked out so well that

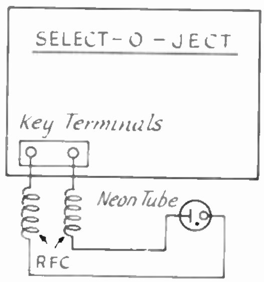


Fig. 6-10—Arrangement employed by WNØRVF to permit using a Select-O-Ject as a keying monitor.

earlier plans to build a more complex monitor have been given up. The system employs a Select-O-Ject keyed by a small neon tube as shown in Fig. 6-10. The r.f. voltage that is used to ignite the bulb is obtained by placing the tube in the r.f. field of the transmitter output amplifier. Lead length between the bulb and the S-O-J is not critical and unshielded wire has been used to date. However, r.f. chokes should be connected in series with the leads and should be placed as close as possible to the key terminals of the S-O-J. The frequency of the tone fed to the phones when the transmitter is keyed may be varied by means of the Select-O-Ject frequency control. My own experience with the monitor is that it follows keying without lag and reacts to bug keying much more favorably than some of the systems which employ relays to obtain the same effect.

— *Tom Bakersmith, WNØRVF*

7. Hints and Kinks . . .

for V.H.F. Gear

USING THE BC-459 WITH THE V.H.F. OVERTONE OSCILLATOR

Although using the BC-459 (7 to 9 Mc.) as the v.f.o. for a 50-Mc. transmitter may be old stuff to many v.h.f. men, it is possible that some newcomers to the World Above 50 Mc. may not realize how easy it is to couple one of these Command transmitters to the ever-popular overtone crystal oscillator.

Fig. 7-1 shows the method of coupling a BC-459 to the grid of a triode overtone oscillator. The oscillator portion of the circuit (components to the right of the dashed line) is identical to that used in simple transmitters described in the V.H.F. Transmitters chapter of recent editions of the *Handbook*. To the left of the dashed line, we see the coaxial line from the v.f.o., a 220-$\mu\mu$f. coupling capacitor and the connections to the transmitter crystal socket. All connections at the transmitter end of the coaxial line should be as short as possible.

One interesting feature of the arrangement is that the overtone circuit takes on an entirely new look merely by replacing the crystal with the v.f.o. connections. The instant that the crystal is removed and a ground connection provided at the crystal socket, the circuit becomes that of a frequency multiplier. In this case the stage becomes a frequency tripler using 8-Mc. excitation for 25-Mc. output. Incidentally, the stages that follow the 12AT7 oscillator are also of *Handbook* design.

The required v.f.o. range for covering the entire 50-Mc. band is 8.222 to 9 Mc. Stable output throughout this range is obtained here at W9DRY by operating with only 105 volts applied to the oscillator and both the plates and screens of the amplifier tubes of a BC-459. The Heathkit v.f.o. also works well with the arrangement after the 7-Mc. range has been pulled up into the 8-Mc. region, but does not offer the advantage of oscillator-frequency calibration.

— *Ray L. Sherwood, W9DRY*

THE JOHNSON RANGER AS A 50-MC. EXCITER

Owners of the Johnson Ranger transmitter may obtain 25-Mc. output for driving a 50-Mc. doubler in the following way:

Using the v.f.o., tune up the transmitter in the normal way with the band switch in the 11-meter position and the v.f.o. at the low edge of the band. Now switch to an 8-Mc. crystal and retune the buffer and final for resonance points nearer maximum capacitance (toward the 0 end of the dials). With the usual surplus type crystals, it is possible to develop nearly maximum grid drive. Keying ranges from fair to very good, depending on the crystal. The audio output of the Ranger is available at the accessory socket for use in such an application.

The rabid 50-Mc. man may decide to pad the 11-meter position of the v.f.o. to obtain v.f.o. control at the above frequencies. I have not tried this and therefore cannot vouch for the idea.

— *Otto Woolley, W0SGG*

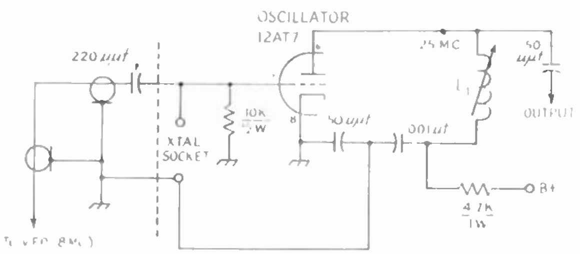


Fig. 7-1—Circuit diagram of a v.h.f. overtone oscillator driven by a Command transmitter. W9DRY uses a BC-459 (7 to 9 Mc.) as the v.f.o. and drives a 50-Mc. frequency multiplier with 25-Mc. excitation obtained from the 12AT7. L_1 is 24 turns No. 30 enam. close-wound on a ⅜-inch slug-tuned form (National XR-91).

NOTES ON THE GONSET COMMUNICATOR III

One possible characteristic of the Gonset Communicator III is hum modulation of the transmitted signal. This occurs only during push-to-talk operation when microphones similar to the surplus T-17 are in use. Under these conditions, modulation by a.c. hum or vibrator whine can be quite severe. A glance at the microphone circuit will show that the relay circuit and microphone "talking" circuit have a common return wire in the microphone cable. Therefore, these circuits are coupled across the resistance of a common wire, namely the resistance of a five- or six-foot length of wire. This condition can be alleviated if a four-wire microphone cable is substituted for the original three-wire cable. This eliminates the common return lead and reduces hum modulation to negligible proportions. Self-coiling four-wire cords which are ideal for this purpose are sold as replacement cords for some types of dynamic microphones. One possible trouble which will remain after this modification is the contact resistance between the sleeve of the PL-68 and the jack. Be sure that the PL-68 is clean and bright, and that it is not worn to a sloppy fit.

— *R. A. Johnson, K2EOC*

Some owners of the popular Gonset Communicator III have run into difficulty with the push-to-talk arrangement. Carbon mikes which do not have a conventional push-to-talk circuit, or do not open the mike circuit when the button is released, have been found to cause feedback. In addition, when a conventional push-to-talk mike is used, hum is often evident. This hum disappears when the front-panel "transmit-receive" switch is used instead of the push-to-talk button. The hum is caused by the a.c. component of the voltage drop in the mike control wire appearing on the grid of the speech amplifier. Both of the above difficulties may be remedied by making the following modifications.

First, locate the 1.5-megohm resistor connected at pin 2 of the 12AX7. This is R_{31} in the 6-meter or R_{32} in the 2-meter model. Lift the other end of this resistor from ground. At this end, connect a 0.1-μf., 200-volt capacitor and a 470,000-ohm resistor. The free end of the capacitor is then grounded to a convenient spot, such as pin A of the heater terminal strip. The free end of the 470,000-ohm resistor is then connected to the tip prong of the mike jack which already has a .01-μf. ceramic and a 68,000-ohm resistor connected to it.

If your transmitter is stamped with "M-1" or higher on the rear chassis lip, the above modification has already been made at the factory.

— *Samuel M. Bases, K2IUV*
— *Rudolph Schwerdt, jr., K2QVU*

To copy c.w. with a Communicator III simply plug in a crystal having a frequency at the i.f. of the Communicator. The function switch is thrown to "spot" for weak signals. For stronger signals requiring greater injection, the switch is thrown to "exciter." In this way, a crystal controlled b.f.o. is furnished. A 2.3-Mc. crystal is used for the 6-meter Communicator and a 6-Mc. crystal for the 2-meter model.

— *Irvin L. Schroeder, W9VCL*

The accessory v.f.o. for the Communicator III can be employed as a b.f.o. for both the 6- and 2-meter Communicators by throwing the v.f.o. switch to "spot" and beating the c.w. signal with the v.f.o.

— *Woodrow Smith, W6BCX*

While trying out a factory-fresh Gonset Communicator III, I was intrigued by how I could arrange my surplus 243 crystals in the six-position socket. The spacing is too close to accommodate more than three crystal holders. Two adjacent crystal positions will accept FT-243 crystal holders back to back.

Examining my 243 crystals I found that they all have about the same outside dimensions, but that some cases are shallow with thick plastic covers and some are deep with thin metal covers. Using parts from a handful of junk crystals, I assembled my crystals in "thin" FT-243 holders made up of a shallow case with a thin cover. The modified cases measured about 3/8-inch thick and racked up neatly in the crystal sockets.

Before starting this project, be sure to clear your working space since crystals may look just alike when out of their holders. Clean the rubber gasket off the metal cover, then insulate the center, at the point of spring bearing, with a bit of plastic electrician's tape. Use the YL's tweezers to handle the crystals and pressure plates. The three screws will be too long, so cut them down with a file using a nut as a thread guard. Seal the modified crystal cases with a plastic spray after assembling and checking. Be sure to mark the cases with the correct crystal frequency if the covers have been changed.

— *Phares W. Calliham, W4ZIO*

Late productions of all models of the Gonset Communicator III incorporate the following circuit modification. The purpose of this change

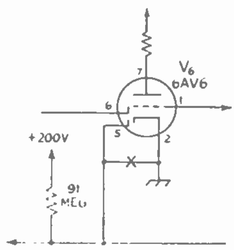


Fig. 7-2—Diagram showing modification to Communicator III a.v.c. circuit.

is to delay the application of a.v.c. voltage to the cascode r.f. amplifier, thereby improving signal to noise ratio on medium strength signals. (Receivers having "a.v.c." stamped on the rear apron of the receiver chassis have been wired with this change at the factory).

First remove the jumper connected between pins 2 and 5 of the 6AV6 socket (X in Fig. 7-2). Also remove the lead between pin 5 and the ground lug. Disconnect the .01-μf. capacitor lead from pin 5 and connect to the ground lug. This frees all connections from pin 5. Next, locate the three lug terminal strip mounted between the v.h.f. oscillator coil and i.f. transformer no 5, see Fig. 7-3. Connect a 3-inch length of No. 20 solid insulated wire between pin 5 of the 6AV6 socket and the forward lug of the terminal strip. Then connect a 91-megohm, ½-watt resistor between the forward and aft lugs of the terminal strip. Now replace the 3rd r.f. amplifier tube (V_5) with a 6BJ6 tube.

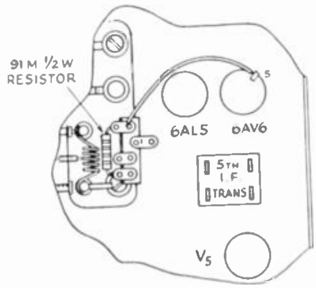


Fig. 7-3—Sketch showing placement of the 91-megohm resistor and the new lead to the 6AV6.

The above modification is very desirable, but obtaining a 91-megohm resistor may be a problem. However, it is a standard Motorola replacement part on certain late model Motorola auto radios and probably can be found in service shops which specialize in repair of Motorola sets.

— *Woodrow Smith, W6BCX*

LOW-FREQUENCY CRYSTALS FOR THE 6-METER GONSET III

While the manufacturer recommends the use of 8-Mc. crystals in the 6-meter Gonset Communicator III, I have found that 6-, 5-, 4-, and 3-Mc. crystals, having harmonics between 50 and 54 Mc., can be used successfully. An approximate check on harmonic frequency can be made by using the Communicator receiver with the meter switch in "Spot" position.

Grid drive may be low while using these crystals, so tune-up is a little more critical than with 8-Mc. crystals. Output may be down 20 or 30 per cent but signal reports from local contacts should not suffer. Performance of individual transmitters varies, therefore it would be well to have a friend check on his receiver to verify that unwanted harmonics are not present.

— *Phares W. Calliham, W4ZIO*

ANTENNA HINT FOR THE GONSET COMMUNICATOR

Horizontal polarization of a Gonset portable antenna can be most easily obtained by mounting the whip in an Amphenol type 83-1AP right-angle connector. When this assembly is mated with the Gonset antenna receptacle, it will cause the whip to extend out in a horizontal plane without need for tipping the Communicator on its side. If the 83-1AP is not too tightly coupled (mechanically) to the antenna connector it will allow the whip to be swiveled about in *beam* fashion, thus introducing some choice of directivity to the system.

— *Lester Reiss, W2BR*

PUSH-TO-TALK FOR THE COMMUNICATOR I AND II

Mobile operation using the Communicator I and II can be made much safer and more convenient by adding a push-to-talk circuit. All that is required is a solenoid, a spring, and a couple of screws. Drill holes in the send-receive knob and in the bottom of the Communicator cabinet. Connect the spring (an old dial spring will do) to the send-receive knob and to the screw that holds the tuning eye shield to the cabinet. (see Fig. 7-4). Mount the solenoid (which can be obtained from an old pinball machine) on a bracket and screw it to the bottom of the cabinet. The solenoid can be keyed by the push-to-talk switch in the microphone.

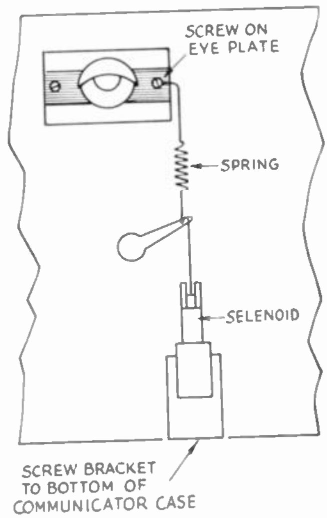


Fig. 7-4—Sketch showing details of Communicator I and II push-to-talk feature.

When you decide that it's time to trade in the Communicator, remove the spring and solenoid and all you have is a scarcely visible screw hole in the cabinet bottom.

— *E. V. Blaize, jr., W5TVW*

A "TEE" TRAP FOR V.H.F.

The construction illustrated in Fig. 7-5 provides a means of connecting a series-tuned v.h.f. trap across a coaxial cable without actually cutting into the line. The idea was developed for use with a 144-Mc. converter that was picking up Channel 7 TV transmissions along with the 144-Mc. signals, but it may be used to free coaxial lines of other types of interference.

The connector used in the assembly may be either a type 83-1T or a 31-008 (BNC), both made by Amphenol. If the former is used, a good joint between coil and connector can be made with a ½-inch No. 8 brass machine screw. A piece of solid copper wire may be used for the same purpose when the connector is a type BNC. If

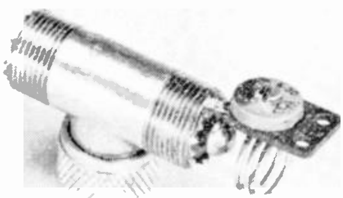


Fig. 7-5—W8TPL's series-tuned "Tee" trap. C and L, discussed in the text, form a series-resonant circuit at the frequency of an interfering signal. Capacitor illustrated is a Centralab type 827-C, 6- to 30-$\mu\mu$f. trimmer.

possible, solder the rotor arm of the padder to the outside of the connector so it will be grounded when the unit is installed in the line. Naturally, tuning adjustments can be made with less difficulty if the rotor is grounded.

Values of C and L that will series resonate at the interfering frequency can be determined quite easily with the aid of a grid-dip meter. If a grid-dipper is not available, the coil size may be varied — by the cut-and-try method — and the capacitor adjusted until the interference is suppressed or eliminated

There is no reason why a trap of this type cannot be used to suppress a v.h.f. harmonic generated by a low-power transmitter. However, it may be necessary to rig a shield around the tuned circuit.

— *Robert V. Nedimyer, W3LJQ*

THE HEATHKIT GRID-DIP OSCILLATOR AS A 144-MC. TRANSMITTER

If you are interested in having a lot of fun with flea power and f.m. at 144 Mc., try getting out with a Heathkit Model GD-1B grid-dip meter. Plug a crystal mike into the phone jack of the unit, couple an antenna to the tuned circuit — and you are ready to go.

After the initial thrill of playing around with flea power, I constructed a 4-element 2-meter beam for use with the dipper. With this antenna in use, I have enjoyed some very fine contacts with K2EHI. In fact, I'm having so much fun with the g.d.o. transmitter that my low-frequency gear is starting to gather dust!

— *A. J. Castellano, jr., W1ZMB*

THE VIKING RANGER ON 50 MC.

Since the 11-meter band is no longer available, the 11-meter section of the Viking Ranger transmitter can be put to use on 6 meters. The Ranger v.f.o. tunes 6550 to 6865 kc. on 11 meters, giving a final output of 26.2 to 27.45 Mc. In order to use the v.f.o. for 6 meters it will be necessary to move the v.f.o. frequency down to 6250 kc. To do this, the small variable 15-$\mu\mu$f. padder C_4 (marked 11M on top of the v.f.o. compartment) is rotated near maximum capacity until it hits 6250 kc. This frequency can be checked by listening on a communications receiver at the proper frequency. The following stages of the transmitter are tuned so that the final output will be on 25 Mc. There is plenty of 25-Mc. output power available to drive an external doubler and amplifier.

For those who would like to have 6-meter output direct from the Ranger, a little more work is involved. The inductance in the grid circuit of the 6146 is too high to hit 6 meters without changing the entire switching circuit. The easiest method is to double to 50 Mc. in the plate circuit of the 6146.

There are two sets of jumpers on the 10- and 11-meter positions of switch SW_{3B} (front and rear sections). These jumpers should be unsoldered from the front and rear sections of SW_{3B}. This gives a spare contact on SW_{3B} rear which can be connected to a tap on L_{11A} for 6 meters. Fasten on a piece of No. 14 solid wire to the turn closest to the plate end of the coil near C_{37} (.002-$\mu\mu$f. capacitor). Very carefully feed this lead through the same hole that the 10-meter lead passes through and connect it to the vacant contact on SW_{3B}. Be sure to space both wires evenly and don't allow them to touch each other or come too close to the chassis.

Put the band switch in the 11-meter position and tune up just as you would for the other bands.

— *L. A. Gerbert, W8NOH*

NOTES ON THE GONSET V.H.F. V.F.O.

In order to minimize spurious emissions, the Gonset V.F.O. for 6 and 2 meters has an output of 24 to 27 Mc. In spite of the fact that this is mentioned in the instruction manual, some hams seem to think that the v.f.o. is operating in the 8-Mc. range. This is not the case. When the v.f.o. is used with equipment other than the Communicator, it may be necessary to modify the crystal oscillator circuitry if the oscillator was designed for 8-Mc. crystals. The Communicator III crystal oscillator is designed to work either with an 8-Mc. crystal or from the 24-27 Mc. output of the v.f.o.

— *Woodrow Smith, W6BCX*

SIMPLE V.H.F. R.F. OUTPUT INDICATOR

An inexpensive trimmer capacitor and an ordinary pilot lamp, wired in series as shown in Fig. 7-6, makes a useful output indicator for v.h.f. transmitters. An indicator of this type is es-

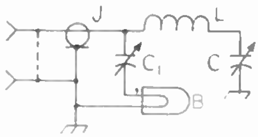


Fig. 7-6—Circuit of the simple v.h.f. output indicator. C, L and J are transmitter components; B and C_1 are indicator components.

pecially helpful at v.h.f. where one of the most common indications of circuit resonance — minimum plate current — is frequently difficult to observe.

The indicator may be permanently connected across the series-tuned output circuit of a transmitter. A 3-30-μμf. trimmer and a 60-ma. bulb are used with the 30-watt rig here at W2FFY. The power consumed by the lamp, about a tenth of a watt, is negligible. By adjusting the trimmer and by employing lamps of various current ratings, the indicator circuit can be used with a wide range of power levels.

In addition to providing means for indicating maximum power output, the arrangement provides a continuous check on transmitter performance. The fact that the indicator is permanently connected across the output circuit prevents the need for retuning as is frequently the case when plug-in or clip-on indicators are temporarily installed.

— *George E. Hyde, W2FFY*

144-MC. TVI TIP

Interference caused by rectification in the first audio stage of either a broadcast or a TV receiver can usually be eliminated by adding a 250-μμf. bypass capacitor between grid and chassis, and by lowering the value of the grid-leak resistance to something less than 3 megohms (see BCI and TVI Chapter of *The Radio Amateur's Handbook*). The most difficult phase in testing to determine the effectiveness of this preventive measure is the pulling of the chassis — particularly if the set is not one's own.

A simple method of making the initial test or making a permanent installation without "pulling" the chassis is to use a CBS-Hytron test adapter that has been equipped with the bypass capacitor and a shunt resistor. Merely remove the audio tube, insert it in the adapter, and then plug the whole business back into the audio tube socket. Types SH-27 and SH-29 adapters are available for the 7- and 9-pin miniature tubes, respectively, and Type SH-28 accommodates the 8-pin octals.

This method of demonstrating how certain types of TVI can be remedied without appreciable bother or fuss is bound to impress the complainant and, in all probability, will result in a better understanding of where the trouble really lies.

— *Jack Livingston, K2POO*

V.H.F. CRYSTAL OSCILLATOR

Shown below is a circuit that gives 2-meter output directly from 8-Mc. crystals. The circuit is actually two oscillators in one; L_1C_1 forms a tank for a conventional ultraudion 144-Mc. oscillator, and the tuned circuit L_3C_2 in conjunction with the crystal forms a tuned-plate crystal oscillator. The purpose of L_2 is to

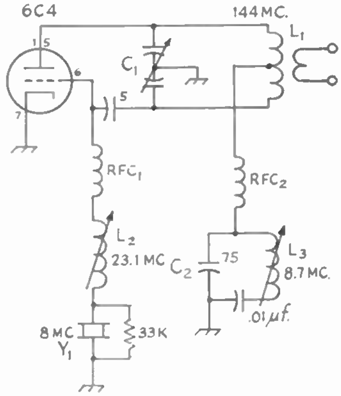


Fig. 7-7—V.h.f. crystal-controlled oscillator. Unless otherwise indicated, capacitances are in μμf., resistances are in ohms, resistors are ½ watt.

C_1—5-μμf.-per-section butterfly capacitor (Johnson 5MB11).
L_1—5 turns No. 19, ⅜-inch diam., ⅜ long, center tapped with 2-turn link.
L_2—17 turns No. 26 enam., ½-inch diam., slug-tuned form.
L_3—12 turns No. 26 enam., ½-inch diam., slug-tuned form.
RFC_1, RFC_2—30 turns No. 26, 3/16-inch diam., ¾ inch long.

add some third harmonic voltage to the grid, thereby giving a more optimum wave form. With the circuit adjusted properly, the 144-Mc. oscillations are synchronized or "locked in" with the 8-Mc. oscillator, and hence give 144-Mc. crystal controlled output.

The circuit is not much harder to adjust than an overtone crystal oscillator. First grid-dip L_1C_1 to 144 Mc., L_2 to 23.1 Mc., and L_3C_2 to 8.7 Mc. These frequencies are about right for an 8-Mc. crystal; if some other crystal is used, they must, of course, be changed proportionately. Next, apply plate voltage and tune in the 18th harmonic of the 8-Mc. crystal on a two-meter receiver. Tune C_1 for maximum S-meter reading (being careful to avoid receiver overloading). It should be possible to find settings of L_2 and L_3 that will permit a very sharp but smooth peak in the tuning of C_1 without plops or heterodynes on either side of resonance. This will not coincide with the settings of L_2 and L_3 that give maximum output. The output is insufficient to drive a Class C amplifier directly but is adequate for local oscillator use.

— *Frederick W. Brown, W6HPH*

IMPROVED V.H.F. COIL FOR GRID-DIP METERS

V.H.F. MEN who use any of the popular makes of grid-dip meters know that they all leave something to be desired when it comes to convenience above about 50 Mc. The coil for the highest range is a stubby loop of such dimensions that it is difficult if not impossible to couple it closely to many of the circuits one wants to check. In addition, at least one manufacturer divides his scales in such a manner that the 144-Mc. band comes close to the ends of the ranges on the last two coils. This makes for frequent coil changes when working in the vicinity of that band.

One method of working in cramped quarters with the coils that come with the instrument is to use a short transmission line, with loops at each end. This link-coupling is likely to be awkward. It also may be confusing, due to resonances in the line.

The plug-in inductor shown in Fig. 7-8 takes into account the fact that a given length of wire formed into a circle or semicircle has a lower resonant frequency than the same length made into a hairpin loop. As the sides of the hairpin are brought closer together the resonant frequency for a given setting of the tuning capacitor goes higher. It is thus possible to make a loop of considerable length that will tune the same frequency range as the stubby loop that is part of the original coil complement of the grid-dip meter. A loop 3 inches long will enable you to couple to many converter and transmitter circuits that cannot be reached with the tiny loop that came with the meter.

The copper wire used in the loops shown in Fig. 7-8 has a rectangular cross section 0.31 by 0.19 inches. Rectangular wire or rod makes a neater looking inductor than round wire, and it is easier to drill, but the same idea may be used with round stock. Inductance for the same loop

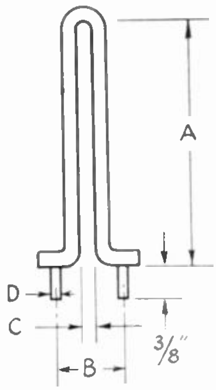


Fig. 7-8 — Dimensions of modified v.h.f. inductor for Heathkit and Millen grid-dip meters. See table.

spacing will be higher for round wire of the same area of cross section. The table gives dimensions of several inductors made for use with Millen and Heathkit grid-dip meters.

It will be seen that Coil 2 duplicates the highest range of the Millen meter, but it is more than 2½ inches long, as compared with the Millen coil that is only about a half inch in length. Coils 3 and 4 give a more useful frequency spread for the amateur who is frequently called upon to work around both 144 and 220 Mc. They hit both amateur bands, with convenient leeway on either side of each band.

To make the loops it is well to start with a piece of wire about 10 inches long, for ease in handling. Secure the wire in a vise, with 5 inches extending. Bend the wire 90 degrees, using a block of wood as a cushion for the hammer. Using a spacer of a thickness determined from the table, bend the other side down and squeeze the sides together in the vise. Bend the ends at right angles, using the hammer and wood block. Drill the legs for proper pin spacing, insert pins and solder them in place. Trim the legs to a suitable length for the instrument.

The finished inductor may be sprayed with clear lacquer, to prevent shorts when using the meter near live circuits. The insulating quality of the lacquer coat should be tested at frequent intervals. It goes without saying that the meter should never be brought close to circuits carrying dangerously high voltages.

The new tuned circuit must now be calibrated. This can be done in several ways. Perhaps the simplest is to borrow another grid-dip meter that tunes the same frequency range. The oscillator may also be monitored in a receiver that tunes the desired range, if one is available. Lacking either of these facilities, calibration at a few points can be made with Lecher wires. As the calibration requirements for grid-dip meters are not critical, any of these methods should give satisfactory accuracy.

Dimensions and frequency ranges for Heathkit and Millen grid-dip meters are given below:

Coil	*Freq. Range*	*A*	*B*	*C*	*D*
1 (Heathkit)	85–240 Mc.	2.69″	0.75″	0.125″	0.116″
2 (Millen)	125–300 Mc.	2.69″	1.25″	0.05″	0.125″
3 (Millen)	120–270 Mc.	2.5″	1.25″	0.125″	0.125″
4 (Millen)	110–260 Mc.	3″	1.25″	0.125″	0.125″

— *A. J. Newland, W2IHW*

A NOISE GENERATOR HINT

HERE'S a noise generator hint that came from W9EHX. It uses a 2-volt 60-ma. pilot lamp instead of a crystal diode, but is otherwise

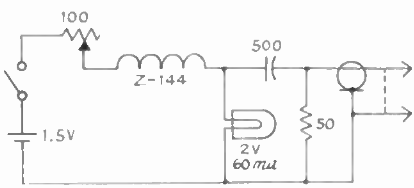


Fig. 7-9 — Noise generator using 2-volt 60-ma. pilot lamp, in place of the usual crystal diode.

similar to the diode job described in *QST* for July, 1953. The r.f. choke didn't appear necessary but is advisable to prevent loss of noise through battery circuit. Output is constant, in comparison to the rather variable results obtained with some crystal diodes. I built mine in an old soup can from junk parts, which kept the cost close to nothing. The load resistance should be equal to the impedance of line used to feed antenna. It shows about 4.5 db. of noise with my best 144-Mc. converter. More noise could be obtained with increased filament voltage, at expense of shorter lamp life. Other types of lamps deliver about the same noise output, so a 60-ma. type is most economical. The coax fitting should match that on converters to be checked. Make all leads as short as possible.

— *W. E. Rose, jr., W9KLR*

TWO-METER TVI HINTS

There's always something new on the TVI front. You think you know all the answers — and then along comes a new model with some special TVI features built in. Such is one of the 1956 RCA receivers. It has a top-tuning setup that requires long leads to the volume control — and, of course, they would turn out to be almost exactly a quarter-wavelength long at 134 Mc.!

W1VSE, New Britain, Conn., ran into a hornet's nest with several of these receivers, the trouble being audio rectification. No picture interference, but W1VSE and any other 2-meter station within a half mile or so came in S9 on all channels. The manufacturer shielded the volume control leads, but the length being what it is the shielding is ineffective at 144 Mc. The solution was twofold.

First, the bracket on which the tuner and volume control are mounted should be bonded to the chassis with a strip of copper or aluminum about one inch wide. Then the shielded volume control leads should be tied together to the strap in at least three places.

Another suggestion that works with all forms of 2-meter TVI where the interfering signal comes in on the TV antenna: Insert traps in each side of the 300-ohm antenna lead. These may have to go right at the point where the lead enters the tuner, if the field around the TV set itself is strong. The traps are made of three turns of No. 18 wire, about ¼ inch diameter, tuned with a 3–30 $\mu\mu$f. trimmer. These can be tuned up at home by putting them on your own TV set and resonating the traps with a grip-dip meter.

No grid-dip meter? No TV set? You can still do it. Put them in the antenna lead to your 2-meter receiver and null out a strong signal near your regular frequency. If your converter uses coaxial input, use a balun to provide a balanced line in which to insert the traps for adjustment purposes.

PUTTING THE DX-35 ON 50 MC.

Here is a simple step-by-step routine for putting the DX-35 on 6, sent in by K2VIN. Changes are made by cutting out the 10-meter band, but replacement of it at a later date should not be difficult. The 10-meter coil has 4 turns; cut it down to 2. Make a new grid coil for the 6146, using 9 turns ¼-inch diameter, same length as the original. Bypass the low end of the 6146 grid resistor. Tune the oscillator plate circuit to twice the frequency of the crystal, which should be in the 8.4-Mc. range.

The second 12BY7 triples to 50 Mc., driving the 6146 straight through. Tuning is similar to that on lower bands, but the operator should be sure that he has the right harmonic at each tuned circuit.

REDUCING SPURIOUS RESPONSES IN 220-MC. CONVERTERS

Reception on 220 Mc. is complicated, in many areas, by the presence of strong TV signals on the high bands. If you have a TV station on Channels 7 to 13 within line of sight, you're likely to hear it (and maybe little else) on 220 Mc. Various means of improving front-end selectivity and eliminating unwanted responses can be used in such cases, but perhaps the simplest is the series trap.

W4UMF, Arlington, Va., had such a bad time from Channel 11 that he used to wait until after the station went off the air to do any listening for 220-Mc. DX. With a 10-Mc. i.f. and a broad-band front end, there was practically nothing to stop the TV signal image from showing up every 15 kc. across the lower portion of the 220-Mc. band. To rectify this state of affairs, Tom made up the simple series trap shown in Fig. 7-10. With it connected directly at the antenna input of the converter, and tuned to Channel 11, practically all the TV buzzes disappeared.

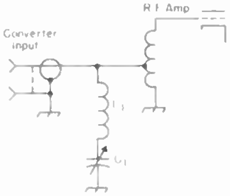


Fig. 7-10—Series trap used by W4UMF to reduce image from Channel 11 in his 220-Mc. converter. Constants given below are for Channel 11. For other frequencies the coil, L_1, should be made as high inductance as possible, with C_1 tuning near minimum.

C_1—1.5-5$\mu\mu$f. miniature variable.

L_1—6 turns No. 12, ⅜-inch diam., close-wound.

At least two dividends came from this simple operation. Expecting to take some signal loss with the trap, W4UMF was surprised to find signals on 220 better than they were before the trap was installed! A quick check showed that the TV signal had been biasing off the mixer, reducing the response of the converter on all signals. Still better, at least a third of the TV oscillator birdies formerly encountered have now disappeared. Apparently, quite a few had been heterodyned in by the Channel 11 energy.

Constants given are for Channel 11, but the same method will work for other frequencies. The trap should be as high L and as low C as possible. Preferably, it should be shielded from the converter circuitry, to prevent unwanted coupling.

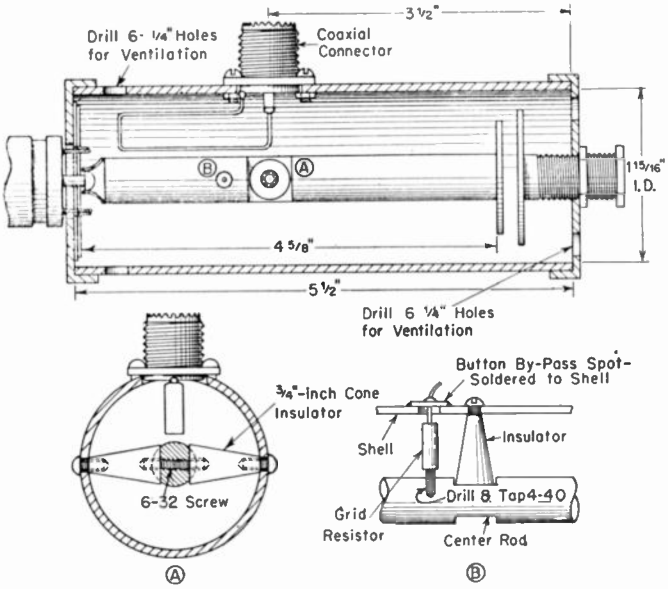


Fig. 7-11—Details of the coaxial-line grid circuit for a 4X-150A amplifier used on 420 Mc. by W1QVF. Modifications of the surplus gold-plated tank are given in the text.

COAXIAL GRID CIRCUIT FOR 4X-150A AMPLIFIER

A squib in April, 1953, *QST* mentioned that we were running a 4X-150A amplifier straight-through on 432 Mc. This resulted in a batch of letters asking, "What do you use for a grid circuit?" Fig. 7-11 gives the details (the plate circuit of our amplifier follows the design by W1PRZ in May, 1951, *QST*). The grid circuit is made from the coaxial tank from a war-surplus item known as the "gold-plated special" test oscillator.

Modification of the tank for our grid circuit application is done in this fashion: (1) Cut it down to 5½ inches. (2) Turn down the disk on the inner conductor to 1¼ inches diameter. (3) Drill ventilation holes, as indicated in Fig. 7-11, in the end plate and at intervals around the outer conductor near the grid end. (4) Mount the output coupling loop and coaxial connector. (5) Mount the inner conductor on stand-off insulators (see Detail A). The inner conductor must be filed flat, or hammered slightly out of shape, to make room for the ¾-inch cone standoffs. (6) Mount the grid resistor and its feed-through bypass. The inner end of the resistor is soldered to a 4-40 screw, and the inner conductor is tapped so that this can be screwed into it (see Detail B).

Where the amplifier is to be grid-modulated with a TV signal, the grid resistor is replaced with an r.f. choke consisting of about 12 turns of No. 22 wire on a 1-watt resistor. The output coupling loop is made of copper or brass strip, ¼ inch wide and 4 inches over-all length. This is soldered to the connector and adjusted to suitable shape before mounting the connector in place.

— Tom McMullen, W1QVF

USING THE T-23/ARC-5 ON 220 MC.

Hundreds of ARC-5 rigs are in use on 144 Mc., a frequency where they work without modification. It's not much of an operation to convert one of the channels to 220 Mc. Here's how:

Convert Channel D to 220 Mc. The oscillator plate coil is changed to 11 turns No. 24 enamel, 5/16 inch long. The 1625 tripler plate winding requires 5 turns No. 20 enamel, ⅜ inch long. The 832A tripler grid circuit has 7 turns No. 22 enamel, ⅜ inch long. Its plate circuit has 1¾ turns No. 20 enamel, ⅜ inch long. The final plate circuit requires 2½ turns of the original coil, ⅝ inch long.

Crystals between 8150 and 8200 kc. are used, providing operation between 220.05 and 221.4 Mc.

— C. R. Barrer, K2GNJ

PUTTING THE DX-40 ON 50 MC.

Here is the procedure used by W5BRQ, Vicksburg, Miss., to put his Heathkit DX-40 on 6. First the 40-meter oscillator coil was removed and replaced with 10 turns of No. 26 enamel on a National XR-50 form, close-wound. (The XR-50 is slug-tuned, ½-inch diameter.) Next the 10-meter buffer coil was replaced with 10 turns of No. 16 enamel, close-wound, ¼-inch diameter.

The last three turns were then clipped from the 10-meter section of the final tank coil, at the bottom of the coil and to the rear of the bottom coil spacer. The three short ends were soldered together, and to the lead going to the final-stage tuning capacitor.

The final amplifier plate choke was replaced with an Ohmite Z-50 (7-μh.) r.f. choke, and an 8.4-Mc. crystal placed in the crystal socket.

To tune the rig up for 6-meter operation, the oscillator plate circuit is tuned to the third harmonic of the crystal. Check this with a grid-dip meter or absorption-type wavemeter. Adjust the "drive" capacitor for maximum grid current to the final, about 3 ma. in this instance. Tune the final amplifier to 50 Mc. in the manner described in the instruction book. Check with grid-dip or absorption wavemeter to be sure signal is on the right frequency.

Because of the relatively minor changes involved, the rig can be put back into service on the lower frequencies with a minimum of trouble.

8. Hints and Kinks . . .

for the Antenna System

"WATERSPOUT" ANTENNAS

Although the "beer-can antenna" certainly caused a lot of flurry, I can't for the life of me see why anyone would want to patiently solder together a long string of tin cans, keeping them in perfect alignment, and then have only soldered joints to depend on for mechanical strength.

If you really want a cheap and rugged vertical, why not use 10-foot sections of waterspout as some of the old-timers used to do? The 2-inch pipe — either round or square — sells for 10 cents per foot out here in Washington, so a "50-footer" doesn't cost much more than five dollars.

The pipes slip together with enough overlap to assure good electrical contact. Three sheet-metal screws at each joint provide the necessary mechanical strength. As you can well imagine, it doesn't take very much time or effort to lash one of these jobs together.

A 50-foot "waterspout" antenna was used here at W7OE for several years before being replaced with a 20-foot job. The latter, mounted on the roof of the garage, has been in use for the past four years. All of which indicates that they *do* stand up quite well.

— *Howard S. Pyle, W7OE*

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Those of us who prefer *bottled* beer have some difficulty in collecting *all* of the material for the "Budget 7-Mc. Vertical Antenna," (*QST*, Nov., 1955). However, an excellent substitute for the beer cans used by W2JTJ is the 3-inch diameter aluminum waterspout available from plumbing supply shops. The tubing comes in 10-foot lengths and sells locally at a cost of 27 cents per foot.

When using the material, it is advisable to extend the crimping at the ends of the tubes so that an overlap of 12 inches or so will exist when the sections are fitted together. Aluminum sheet-metal screws should be used at each joint to add mechanical strength. The rest of the construction is in accordance with W2JTJ's article.

— *D. R. Snyder, W7ZMG*

REMOTE TUNING OF THE CUBICAL QUAD

A great help in receiving through QRM with a cubical quad antenna is being able to phase out interfering stations by adjusting the quad's reflector at the operating position. This may be done with receiving-type Twin-Lead and a 360-$\mu\mu$f. variable capacitor.

Attach one end of the Twin-Lead to the junction of the reflector and the tuning stub and the other end to the capacitor which has been mounted at the operating position in the shack. Set the capacitor at half capacitance, and then adjust the stub for maximum front-to-back ratio as is normally done.

I can adjust for front-to-back ratio over the entire 21-Mc. band with this arrangement. The forward gain remains essentially the same regardless of the setting of the capacitor, but interfering signals from the back may be reduced an average of 30 db. — *Capt. J. R. Hagen*

SEALING OUTDOOR ANTENNA CONNECTIONS

Erratic loading of the transmitter, or noises in the receiver, can sometimes be traced to eroded antenna connections. Some amateurs use candle wax to seal open antenna connections; however, this provides only a temporary seal. Constant beating by the weather will cause this type of seal to crack and allow moisture to enter the connection. What to do about it? Use that old piece of coax! Remove the outside jacket and shield from a piece of the cable. Strip about ½ inch of the insulation from the conductor. Holding the exposed piece of the center conductor with a pair of pliers, bring the flame of a match under the insulation at the other end of the cable. After a few seconds, the insulation will melt and start dripping off in a molten form. Hold the cable over the connection to be sealed and let the drippings fall onto the connection. When the joint is sealed, let it set for an hour or so. Now you have a sealed connection that even old man weather can't touch!

— *David L. Cabaniss, W1TUW*

SERIES OR PARALLEL TUNING WITH THE HEATH AC-1

ONE of the shortcomings of the Heath AC-1 antenna coupler is that it is parallel tuned only. This sometimes makes it difficult to feed certain antennas.

However, the coupler in use at K3BZI was very easily modified for both series and parallel tuning with a minimum of extra components. All that was used was a d.p.d.t. toggle switch and some Scotch electrical tape.

Disregarding the built-in low-pass filter switch and output indicator, which are not affected by the modification, the effective circuit of the AC-1 is shown in Fig. 8-1.

In this circuit, the inductance L_1 and the transmitter link L_2 are in series. The combined in-

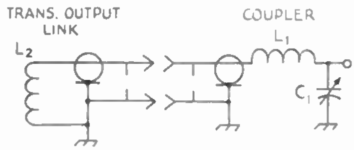
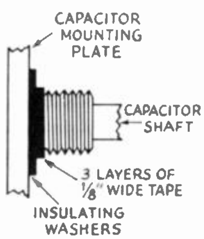


Fig. 8-1—Basic diagram of the AC-1 antenna coupler, C_1L_1—Original AC-1 capacitor and inductance.

ductances are then a parallel-tuned circuit with respect to capacitor C_1. All that is needed is insulation of rotor C_1 from the chassis and provision for a method of switching the circuit to insert C_1 in series or in parallel with L_1 as desired.

To insulate the capacitor, the coupler is removed from its case and C_1 is removed from its mounting hole in the front panel. The bushing for the rotor is insulated by making several washers of electrical tape or other thin insulating material. The washers are cut so that the center hole is a snug fit over the bushing. They are then slid over the bushing to the front mounting plate on the capacitor. After the washers are in place two or three wraps of tape are made around the bushing. The tape should be slightly wider than the thickness of the front panel. This is shown in Fig. 8-2.

Fig. 8-2—Sketch showing modifications to C_1.



The mounting hole is then enlarged sufficiently to allow the tape to go through, and the capacitor is replaced in the panel. Several more of the washers are then placed over the bushing and pushed against the panel. These should be large enough to prevent contact between the panel and the lock nut of the capacitor.

After the capacitor is completely insulated from the cabinet, the leads from the coil to the capacitor are removed from the capacitor and the lead from the neon bulb is removed from the coil. A d.p.d.t. switch is mounted where convenient (at K3BZI the output indicator was moved from the panel to the back of the cabinet and the switch mounted in its place). The switch is then wired as in Fig. 8-3.

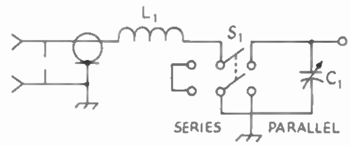


Fig. 8-3—Circuit of the antenna coupler with series-parallel tuning feature added.
C_1L_1—Original AC-1 capacitor and inductance.
S_1—D.p.d.t. switch.

The neon indicator is then capacity-coupled to the tank coil by soldering a piece of insulated wire to the base of the bulb and bending it so that it is near to, but not touching, the coil. The amount of coupling may be changed by varying the distance between the wire and the coil until the desired brilliance is attained.

This modified coupler is being used at K3BZI to load a new 40-meter vertical and the results indicate that the modification was well worth the little effort involved.

— *Walter J. Bannister, K3BZI*
Walter J. Stauffer, jr., K3DWY

LIGHTNING PROTECTION FOR VERTICALS

THE sketch in Fig. 8-4 shows a vertical antenna mounted above and in line with a ground pipe, thus giving spark-gap protection during electrical storms. The top vertical portion of the antenna is supported by stand-off brackets and held to these brackets by U-bolts. A piece of rubber hose or other insulating material is placed around the antenna where the brackets and U-bolts connect.

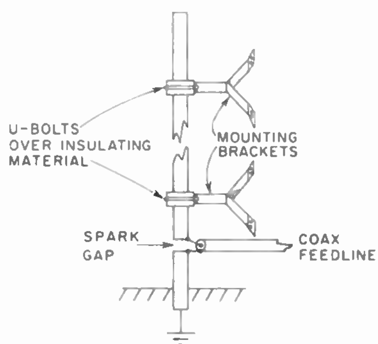


Fig. 8-4—Sketch showing the vertical antenna with lightning protection.

The spark gap should be set as close as possible, but not so close that it will break down with voltages encountered from the transmitter.

— *Luke McCloud, K2DDM*

ELECTRIC FENCE WIRE FOR ANTENNA USE

Many newcomers may not be aware that some supply houses and hardware stores carry ½-mile spools of "electric" fence wire. This 18-gauge wire is labeled as being 30 per cent copper and sells for approximately $9.00 per roll. The fact that it is light in weight and is quite strong (it has a steel core) should interest the long-wire antenna enthusiast. No specific claims for its efficiency as a conductor of r.f. are made at this time, but it is known that 1000- to 2000-foot open-wire TV feed lines have been successfully made with the material. Another added feature of the wire is that the stuff is almost invisible when erected at heights of 30 to 40 feet.

An antenna using electric fence wire has been suspended here at W4ZZ for the past several months and has taken some pretty stiff winds. This radiator is 420 feet long and is supported by a pair of trees located 440 feet apart.

Incidentally, because of the low copper content, the wire does oxidize quite quickly. It is therefore recommended that the wire be treated with plastic spray before it is erected.

— *Herrick B. Brown, W4ZZ*

PERIODIC INSPECTION FOR COPPERCLAD WIRE ANTENNAS

Here is a tip, learned from bitter experience, that should benefit any of the gang who use surplus copperclad wire for their sky hooks. Antennas made from this material require inspection once a year or so if deterioration in advance of actual breakdown is to be detected. In my own case, I *had* a nifty 340-footer about 50 feet high that was made with surplus aircraft-trail wire obtained from a bargain 3000-foot reel. After about four years of service — without inspection — trouble started. Wherever the wire came in contact with stand-offs, strain insulators or other supports, and at points where bends were necessary, the copper coating had worn through and rust had eaten into the core, thus creating about half a dozen high-resistance joints that finally broke down.

— *Wm. Plimpton, W2IXH*

MORE ABOUT COPPERCLAD WIRE ANTENNAS

The deterioration referred to by W2IXH above can be prevented by a practice used in the electrical industry. Wherever the copperclad contacts a stand-off, strain insulator or other support, and at points where bends are necessary, it is covered with a close-wound coil of soft wire or a special wrapping intended for the purpose. The soft wire coating is most practical for ham work. It is advisable to use a wire (for the wrap) that is either the same diameter or one size smaller than the antenna wire.

It is quite a bit of work to provide for this type of protection, but it's well worth the effort if you're building a large permanent system.

— *Eugene Austin, WØLZL*

HOMEMADE LIGHTNING ARRESTERS

Heavy-duty industrial fuses that have outlived their intended purpose may be quickly modified for use as lightning arresters. High-current (70 to 600 amperes) 250-volt cartridge fuses with copper blade terminals are best for the job, and it should be possible to obtain one or more of them from an electrician or the caretaker of an apartment house, a store or a factory.

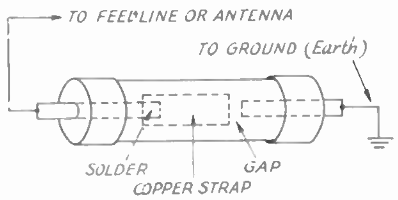


Fig. 8-5—Drawing of the homemade lightning arrester. A blown cartridge fuse and a small scrap of copper are the only materials required.

Fig. 8-5 illustrates a blown fuse revamped for arrester duty. The fuse element normally supported between the copper blades has been removed and a copper strap soldered to the terminal at the left. Notice the gap between the right end of the copper strap and the adjacent fuse terminal. Maximum protection against lightning is afforded by a gap of minimum width. On the other hand, the gap must be wide enough to prevent the arrester from flashing over when transmitter power is fed to the antenna. It is advisable to start out with a real narrow gap and then, by clipping short sections from the strap, adjust for a width that will stand up with the amplifier operating at full input.

The end bells for the fuses are fastened to the main cartridge by either rivets or self-tapping screws and, of course, these must be removed before the fuse can be opened for modification. Have a wastebasket handy during the opening-up operation so that you'll have a place to dump the lime dust packed inside of the fuse. If rivets are used in the original assembly, these may be replaced with self-tapping screws when the bells are refastened to the cartridge.

To give the arrester a real chance to work, use a short heavy lead between the ground terminal and a good ground system (earth).

— *James A. Keesler, K8EXF*

STREAMLINING ANTENNA BOOMS

Hollow booms used in the construction of beam antennas frequently act as air scoops during high winds. This scoop or air-trap action can lead to free turning or other undesirable motion of the beam.

Booms made with round tubing can be streamlined to suppress wind-driven movement by inserting a rubber ball in each end of the tube. Most dime stores carry a large variety of rubber balls — the type children play with — and you can usually find a size that will force-fit into the ends of the boom.

— *William C. Martin, W6PLK*

STOP ROTATOR FREEZING

Amateurs who have experienced difficulty with beam rotators freezing-up in cold weather might be interested in my inexpensive solution to this problem. Position a 150-watt light bulb just below the rotator mechanism and enclose it with asbestos paper. Connect a heavy duty power cord to the lamp and to a power receptacle. When the temperature goes down and the rotator sticks, turn on the light bulb for about fifteen or thirty minutes. The rotator will then turn "free" again.

— *John L. Spencer, KØIUC*

A NOVEL DIRECTION INDICATOR FOR ROTARY BEAMS

The choice of a method of coupling feeders to the rotating portion of a beam usually results in a compromise. The three methods generally used are: (A) inductive coupling, (B) brushes, (C) direct feed.

Inductive coupling and brushes have the advantage of continuous rotation of the beam. On the other side of the ledger is the difficulty of adjustment of inductive coupling, and maintaining uniformity of spacing between the coupling loops. Brushes have a habit of getting dirty and also give a discontinuity in the uniformity of line impedance. Direct coupling avoids these difficulties but raises the problem of twisted and broken feeders. One attack on the problem is the use of limit switches. However, another approach to this problem has been used at W2OXR which permits continuous rotation within reasonable limits without fear of snapped or twisted feeders. Our direction indicator informs us not only where the antenna is pointing but also how many times the feeder is wrapped around the mast. The feeders are loose and can be wrapped around two or three times safely.

Our method is as follows: A transmitting synchro is connected to the worm gear that drives the main gear of an old Mims rotator. The receiving synchro in the shack is coupled to a surplus Veeder Root counter (one buck in surplus) which counts the rotations. The ratio of the worm gear to the main gear is 32:1, so we set the counter to 0 on north, so that 8 indicates east, 16 south, 24 west, 32 north again, and 40 east again. The number 64 is also north, but it indicates that the feeders are wrapped twice around the mast — a little close for comfort. The mast can also be turned west from the zero position so that 92 represents west, and so forth.

A more satisfactory arrangement would exist with a 36:1 turns ratio, for then a counter showing tenths of a rotation (available at the same price) would read directly in degrees for the first time around.

Use of this system is facilitated by having a great-circle map on the table with the counter numbers written around the outer rim, which immediately again translates the bearing into counter numbers.

This system has been in use at W2OXR for over a half year with gratifying results, and adaptations of this system should be useful to others.

— *Reuben E. Gross, W2OXR*

ANOTHER SOURCE OF FEEDER SPREADERS

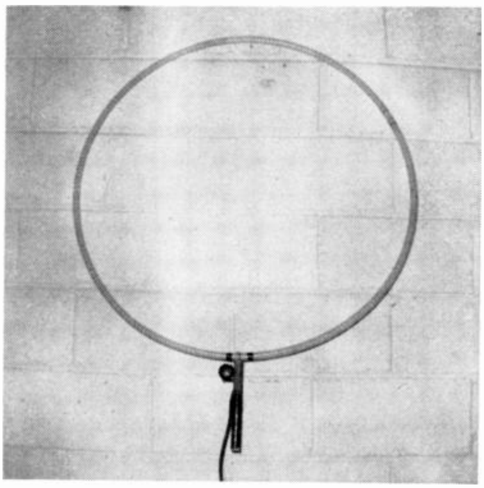
The bakelite spools supplied with Polaroid film make very excellent feeder spreaders. The spools are approximately 4 inches long and include a slot which may be used for fastening tie wires securely in place. The light weight of the spools makes them well suited for use as the spreaders for those extra long transmission-line runs.

Incidentally, I have soaked one of these spools in water for two days, wiped it off with a dry cloth, and then found its insulation resistance (between ends) to be over 1000 megohms.

— *Gene Fry, K2CW*

HULA D.F. LOOP

Shown in the photograph is my revised Hula Hoop. As the name signifies, it is a direction finding loop made from the infamous hula-hoop. Mine was designed for 75-meter operation so that I could participate in the local 75-meter transmitter hunts. Here are the constructional details: First a handle had to be attached. This was accomplished by drilling a hole in the hoop tube and attaching an 8-inch piece of broom handle with a wood screw. The loop consists of 185 turns of No. 18 enamel wire with the turns spaced about 3/8 of an inch apart. A check with a grid-dip meter indicated the resonant frequency of the hoop was a bit high. Rather than add more wire, I attached a 50-$\mu\mu$f. variable capacitor in series with the coil. Now I can tune the hoop from 3.5 to 4.0 Mc. with the capacitor. The addition of a piece of low impedance coaxial cable connected to the capacitor and coil completed the Hula D.F. Loop.



K5AHT's Hula D.F. Loop

— *Bobby J. Bellar, K5AHT*

REMOVING GUY WIRE AND GROUND STAKES

When you next run across a guy wire or ground stake that won't pull up after a few mighty heaves, put the automobile bumper jack to work. As long as the stake or rod has a clamp or other surface to which force may be exerted, it is fairly certain that it will move after a few strokes on the jack handle.

— *Harry M. Engwicht, W6HC*

FIELD-DAY ANTENNA MAST

Since not all Field-Day sites come equipped with trees of adequate height and spacing for antenna supports, here is a design for a lightweight, portable and easy-to-erect 40-foot antenna mast. The drawing in Fig. 8-6 gives most of the details. The carefully selected lumber should be free from knots and as straight as possible. The mast sections should be painted and then marked at the joints for identification when assembling. Guy wires are looped around the mast so that they can be removed easily and coiled for reuse. A four- or five-foot length of rope at the end of each guy wire facilitates fastening and adjustment.

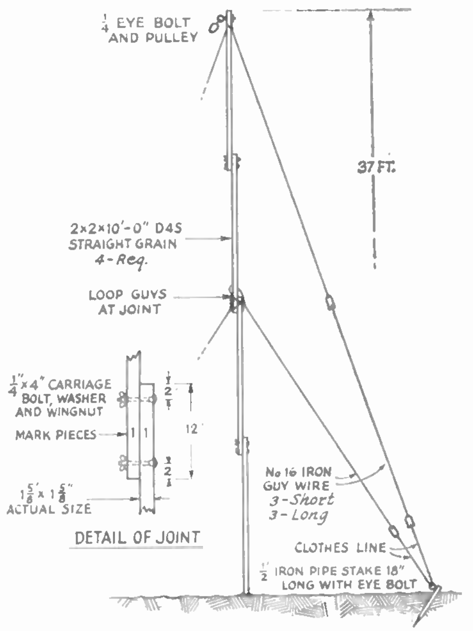


Fig. 8-6—Details of the Field-Day mast.

The mast sections should be bolted together and guys attached before erection is started. When raising the mast, two helpers on the side guys should steady the pole while another holds the back guy. When the mast is in position, the stakes should be placed at equal angles about twelve feet away from the base.

Two masts, when disassembled, can easily be carried on top of a car since they weigh less than thirty pounds apiece.

— *L. A. Cundall, W2QY*

THREE-BAND OPERATION WITH A 7-MC. GROUND-PLANE ANTENNA

Because of the growing popularity of the quarter-wave vertical, especially on 7 Mc., it may interest some of the gang to learn that this antenna can be made to do a fair job at 3.5 and 21 Mc. also. The method used to obtain 3-band operation here at W3NWA is shown in Fig. 8-7.

In the diagram, *L* is a loading coil used when the antenna is operated at 3.5 Mc. When the s.p.d.t. switch, *S*, is in the neutral position, it connects *L* in series with the radiator and the RG-8/U transmission line. In one of the closed positions the switch shorts the coil, permitting normal 7-Mc. operation of the system. The antenna will also take power at 21 Mc. when the loading coil is shorted out. In the third position, the switch connects the vertical to the grounded radial support to provide lightning protection.

In the original installation, the Premax whip was adjusted to favor operation at the low end of the 7-Mc. band. The loading coil used to resonate the system at 3550 kc. consists of 22 turns, No. 12 enameled, 2 1/2-inch diameter, 4 inches long. The coil was cut from a 10-inch length of commercial stock which had been temporarily installed intact and then tapped experimentally during the initial stages of testing. A grid-dip meter may be used to help resonate the coil, provided the feed point (the coaxial connector shown in Fig. 8-7) is connected to the grounded radial support.

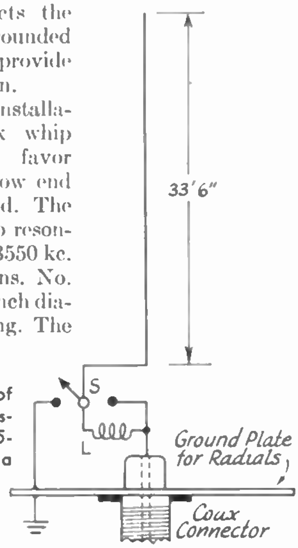


Fig. 8-7—Drawing of the base-loading system which permits 3.5-Mc. operation with a 7-Mc. ground-plane antenna.

A liberal application of Duco cement along the existing support bars for the air-wound coil will provide added strength to the assembly. One coil so treated has been exposed to the weather for an entire winter with no apparent ill effects.

In actual operation at 3.5 Mc., good reports have been received from all over the eastern part of the U. S. A., using 100 watts on c.w. Reports are consistently better than formerly received while using a random-length horizontal wire, probably due in part to the low-angle radiation from the vertical. The s.w.r., while not as low as on 7 Mc. (using the same RG-8/U feeder), is not high enough to cause trouble, provided operation is limited to a 100-kc. band centered on the frequency for which the loading coil has been resonated.

— *R. E. Young, W3NWA*

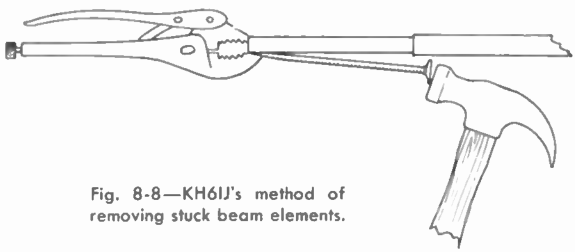


Fig. 8-8—KH6IJ's method of removing stuck beam elements.

REMOVING STUCK BEAM ELEMENTS

There are numerous methods for removing "frozen" telescoping beam elements and they range from the application of a blowtorch to the brute-force method of gas pliers. The following way was found most effective: Firmly clamp the end of the frozen member with a pair of vise-grip pliers as shown in Fig. 8-8. Using a hammer, tap the end of a chisel until the joint comes loose.

To prevent future freezing of telescoped elements, I coat the joint with grease and bind up with plastic tape.

— *Katashi Nose, KH6IJ*

SOME NOTES ON GUYED TOWERS

Wind, Ice and Earthquake Loads

The loads acting on a tower are essentially the same as those acting on buildings and other structures and may be placed in three main classifications: live, dead and erection. Wind is by far the most critical live load. The design wind load is usually set up from references to U. S. Weather Bureau reports and maps for each locality. It varies from a recorded 132 m.p.h. in Miami to 49 m.p.h. in Los Angeles. Velocity is converted into pounds per square feet in accordance with accepted formulas, taking into account the increase of wind velocity with height.[1] Wind tunnel tests have shown that the total wind load should be based on the projected area of 1½ tower faces on square towers. The wind on round members may be figured as two-thirds the load on flat members. Thus the load on a 3-inch rod will be equivalent to the load on a 2-inch flat bar or angle. No attempt, by the way, should be made to design a tower to resist a tornado as the chance of a direct hit is remote and there is no assurance that even a fantastically heavy structure will survive.

Ice load is another important live load. While its occurrence is not as frequent as high wind load, a heavy ice storm or freezing rain can be very disastrous to a tower. High winds seldom occur at the same time as heavy icing. On the other hand, fairly strong winds with light ice and moderate wind with heavy ice are common. Ice from ¼ inch to 2 inches thick is the usual range used for design in the continental United States. However, ice with a thickness of 12 inches or more occurs in some isolated spots. Naturally, the presence of ice on tower members increases the projected area exposed to the wind and the weight of the ice adds to the dead load.

[1] Abraham, Guys for Guys Who Have to Guy, *QST*, June 1955, p. 33.

Earthquake load must be considered in some localities, particularly on the West Coast. This load acts horizontally and is a function of the weight or mass of the structure. Although earthquakes occur infrequently, their threat cannot be ignored.

Erection loads are also very important, especially in the case of guyed towers. Wind on the tower in some stages of erection can subject certain members to loads greater than they will receive in fully erected condition. Loads from large and heavy gin poles add to the burden of erection loads.

Dead loads include the weight of the tower members, antenna, transmission lines, ladders and platforms.

Safety Factor

The term "safety factor" is a much misunderstood and sometimes misleading term. Generally, the term is intended to mean the number obtained by dividing the failure stress of the material by the allowable stress. A more realistic definition of the term would be a relation between the elastic limit of the material and the allowable stress. The elastic limit of the material is that stress below which the material will not take a permanent set or deformation. If a material is repeatedly loaded above the elastic limit it will fail at a load far below the failure limit. A safety factor of 2½ for a guy wire indicates that the breaking strength of the guy is 2½ times the working load.

Guys

The guyed tower depends entirely on the guys to hold it vertical and, therefore, the design of the guys is of prime importance. For a tower with one set of guys, an angle of 45 degrees to the horizontal is good practice. Tall towers with multiple guys require a steeper angle in the top guy. One anchor can then serve several guys and the angle of the lowest guy will not be too flat.

Maintenance

Towers should be inspected at regular intervals, the length of time between inspections depending on weather conditions. If the tower is located in a section of the country where windy seasons have regular cycles, inspections should regularly precede these seasons. The first step in any inspection is a check of the tower connections. Almost all towers have bolted connections with some means of locking the bolts in place. During this climbing inspection the paint should be observed for rust spots. If the tower is galvanized, the coating should be inspected.

The condition of the guys should also be checked periodically. Practically all guys are made of galvanized strand and are very durable even without additional protective treatment. However, if signs of rust appear, protective treatment is a must.

— *New England Professional Engineer*

RG-8/U IN THE GAMMA-MATCH CAPACITOR

Amateurs who contemplate installation of a gamma match may be interested in construction which uses RG-8/U coaxial cable as the inner or variable element for the gamma capacitor. The mechanical details are not difficult to duplicate and the assembly may be easily adjusted and waterproofed.

Details of the capacitor are shown in Fig. 8-9. The fixed section of the capacitor is an appropriate length of aluminum tubing having an inside diameter that will fit snugly over RG-8/U after the latter has been wrapped with good quality tape and then coated with plastic spray. Dimension A controls the length of the gamma rod, and the capacitance is determined by dimension B: the capacitance will increase as B is made longer.

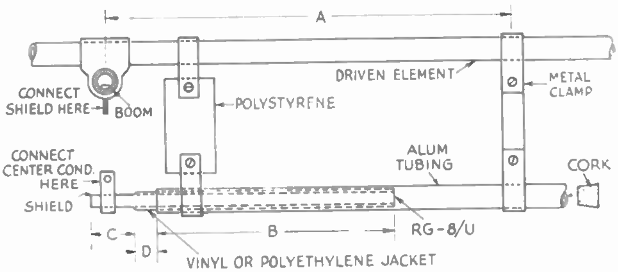


Fig. 8-9—Sketch showing the details of W3KKO's gamma matching section. The gamma capacitor is made from a length of aluminum tubing and a section of RG-8/U coaxial cable. Although the inner conductor of the coaxial cable is not used, it need not be removed.

One inch of the outer jacket must be removed from the input end of the coaxial element (Section C) in order that a copper band for feedline termination may be soldered in place. Be careful not to damage the shield braid when the insulation is being removed because the copper feedline terminal must be soldered to the exposed shield. After the coaxial section has been prepared and then inserted in the aluminum tubing, adjust at D for a spacing that will prevent shorting between the shield braid and the aluminum tubing.

The inner conductor of the coaxial feedline is terminated at the copper terminal provided and the shield for the line is attached to the boom. The coax line should be taped or clamped to the boom to relieve strain at the termination points. Coarse adjustment of the capacitance is made by varying the length of dimension B. Start with more than enough coax encased in the tubing and then clip off short pieces as adjustments and measurements proceed. Fine adjustment may be made by loosening the clamp at the outer end of the gamma bar and then sliding the bar back and forth over the coaxial element.

After the assembly has been adjusted for proper performance, it may be waterproofed by plugging the open end of the gamma bar with an ordinary cork and then coating the entire unit with plastic spray. — *Wm. J. Engle, jr., W3KKO*

FIXED-STATION OPERATION WITH A MOBILE ANTENNA

We recently moved into a new home and although the main equipment was set up and ready to go, I lacked time to work on a permanent antenna installation. Casting about for a temporary radiator, I spotted the family bus adorned with a 40-meter mobile antenna. A high-Q loading coil is used with the antenna, and reports with my 12-watt mobile rig had been pretty good. So why not hook the fixed-station transmitter to the mobile antenna?

A 25-foot length of coaxial cable was run from the shack to the car in the driveway. The mobile rig was, of course, disconnected from the antenna and a straight adapter connector (PL-258) used to couple between the coax cables running from the fixed-station rig and to the whip.

The home station runs about 70 watts for voice-modulated operation and reports are nearly as good with the mobile antenna as with the regular antenna used at the previous location. Obviously, there is some operating inconvenience caused by connecting and disconnecting the coax each time you want to operate fixed-station, but the idea does provide a suitable answer for temporary operation and it may solve the problem when a landlord absolutely forbids even No. 37 wire strung around the premises. Naturally, one should avoid slamming the car door on the coaxial extension.

One final word of caution: Don't drive off before disconnecting the coax! It is reportedly very hard on a transmitter to be dragged down the street at the end of a 25-foot length of cable!

— *Richard F. Van Wickle, W6TKA*

SIMPLE ANTENNA CHANGEOVER CIRCUIT

The circuit shown in Fig. 8-10 uses a d.p.d.t. switch for transfer of the send-receive antenna. Notice that r.f. input terminal of the receiver is grounded when the switch is at the transmit position. This feature of the arrangement prevents receiver overload or hold over that might otherwise be caused by the transmitter output.

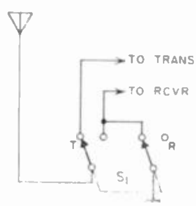


Fig. 8-10—The simple transmit-receive circuit used by ex-KN2OUI

S_1 should be a switch of reasonably good quality such as a knife or rotary type. Ordinarily, a toggle switch would not be suitable for the application.

— *Larry Emerson*

SPLICING 300-OHM LINE

Tubular 300-ohm transmission line can best be spliced by using the method illustrated in Fig. 8-11. The joint so produced is both electrically and mechanically strong and does not

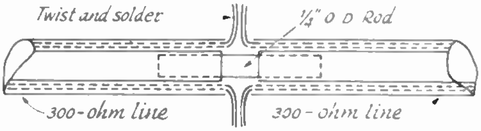


Fig. 8-11—W5DAI suggests this method of splicing tubular 300-ohm transmission line.

adversely affect the r.f. qualities of the line. Measurements made at 100 Mc. on a line so spliced show negligible loss or line discontinuity.

To make the splice, first expose approximately one inch of each conductor by cutting away the insulation. Make a clean cut at right angles to the cable when removing the sections of insulation that bond the conductors together. Next, insert a three-inch length of ¼-inch o.d. insulating rod about half way into one of the cables. Now slide the second piece of cable over the other end of the rod until it butts against the first cable. Twist the conductors together as required and apply solder. The joints may now be clipped down to a length of ½ inch or so and then bent over and laid flush against the long sides of the line. A layer or two of good tape covered with a coating of varnish or plastic spray will protect the joint against weather.

Polystyrene rod is the best material for the plug, which provides mechanical strength for the splice. Of course, since the amount of solid dielectric is physically small, it will do no great harm to use bakelite rod in place of the polystyrene material. — *Henry Smith, W5DAI*

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Sections of flat 300-ohm Twin-Lead may be securely bonded together by using the joint

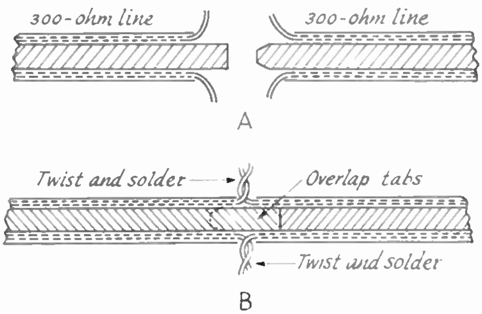

Fig. 8-12—Sketch showing the "W9BPS" method of splicing 300-ohm Twin-Lead. A shows how the sections of line are prepared for the splice. The overlapping tabs in B may be permanently bonded together as explained in the text.

shown in Fig. 8-12. Fig. 8-12A shows how a tab of insulation is left protruding from the end of each cable after the insulation surrounding the conductors has been removed. These tabs are allowed to overlap as in Fig. 8-12B when the two cables are brought together for joining and soldering of the conductors. Additional strength at the splice may be obtained by fusing the tabs together with the aid of a hot soldering iron, or by cementing the tabs together. Ordinary paper staples would provide another means of joining the tabs for mechanical strength. Insulating tape covered with a weatherproofing material will keep the splice in good shape.

— *Harry Fanckboner, W9BPS*

SPLICING 300-OHM LINE: AN ADDITIONAL HINT

I have had excellent results splicing 300-ohm transmission line by extending the system described by W9BPS, above. The method used here assures a strong, weatherproof joint and makes use of some ordinary kitchen-type wax paper and an electric flatiron. The XYL may immediately say "No dice," but you may guarantee her that the surface of the iron will not be damaged. The steps to be followed in making the joint are as follows:

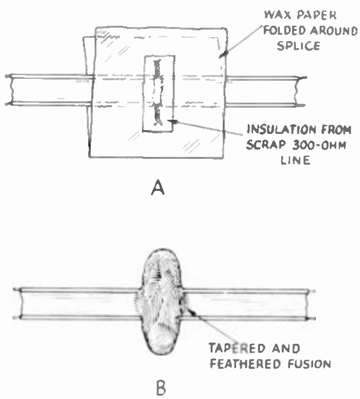

Fig. 8-13—(A) Sketch showing how WØTXP prepares a spliced 300-ohm line before applying heat with a flatiron. (B) The sturdy, weatherproof joint after excess insulation has been trimmed away.

1) Proceed through B (Fig. 8-12) of W9BPS's instructions.

2) Strip wire from scrap pieces of 300-ohm Twin-Lead, leaving only the insulation.

3) Cut insulation into 2- or 3-inch lengths.

4) Place one piece of insulation on each side of the spliced area and cover with a fold of wax paper (double thickness) as shown in A of the accompanying sketch, Fig. 8-13.

5) Apply heat — medium setting of the flatiron will do — to the wax paper until the insulation becomes molten.

6) Remove heat, allow insulation to cool and set, discard wax paper, and trim joint as illustrated in B of Fig. 8-13.

— *Denzil O. Cooper, WØTXP*

COAX-FITTINGS NOTES

It has been found that a considerable amount of energy can be lost on v.h.f. when using the 83-1SP type connector out-of-doors. The fittings are not watertight and they put a slight impedance bump in the transmission line. I have shifted all my v.h.f. connectors over to the HN-82 constant impedance type. Not only do they eliminate the bump on the transmission line but they are also watertight.

— · · · —

For those who need a standard male-to-male connector, here is a way to make your own. It requires two standard male connectors (83-1SP). Cut a short piece of ½-inch copper tubing about 1½ inch long. Slide the copper tubing over one of

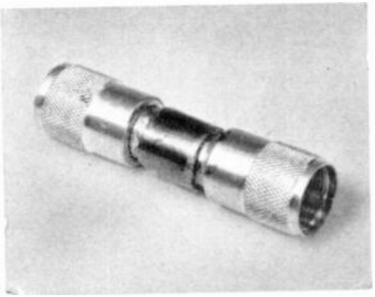

Fig. 8-14—Male-to-male connector made from 83-1SP coax fittings.

the fittings and then push a piece of No. 14 solid tinned wire through the two fittings from tip to tip. Push the connectors tight together with the ½-inch copper tubing centered on the two connectors. Fig. 8-14 shows the finished connector.

This adapter is especially convenient for connecting relays, low-pass filters, etc. directly to he 83-1R chassis connector.

— *Louis A. Gerbert, W8NOH*

MULTIBAND TANK AS A RECEIVING ANTENNA TUNER

Recently, while spending a brief vacation at a new QTH, I found myself with a few idle minutes and no ham gear ready for operation. Because there was not sufficient time for setting up a complete station, I decided to settle for just plain listening-in. Scraps of 300-ohm Twin-Lead provided material for a hastily constructed folded dipole that resonated a megacycle or two above the 28-Mc. band and the receiver was soon in operation. At least, a few signals could be heard above the high noise level that prevailed.

It was soon reasoned that the receiver needed help in the signal-to-noise department so thoughts turned toward an antenna tuner. The first thing spotted in the junk box was a National MB-40 tuner and the idea of using it for antenna matching was born then and there. A three-turn link, wound in between the two high-frequency inductors of the tuner, was connected to the 300-ohm feeder and, of course, the regular output coil was connected to the receiver input terminals.

With the coupler in place and the receiver back in operation, I was pleasantly surprised at the increase in the number of signals that could be heard and at the boost in strength of the few signals that had been tuned in previously. A few quick checks indicated that the 28-Mc. signals came up about 3 S points when the tuner was employed. Similar tests at the lower frequencies showed a gain of 5 to 8 S points when the MB-40 was used between the aforementioned antenna and the receiver.

— *Bob Barth, W7HMP*

LIGHTNING PROTECTION ON PARALLEL-WIRE LINES

Lightning protection at amateur stations using parallel-wire feedlines usually consists of a grounding switch or a homemade needle gap of some kind. The first method doesn't offer any protection for those hardy operators who keep the station going during a thunderstorm, and the second method is often a jury rig that isn't too satisfactory. K1CLD suggests that the high-voltage protectors used on telephone lines might do the trick. He says that the Reliable 20HV and 30HV units (2000- and 3000-volt breakdown, respectively) can be purchased through telephone jobbers, and he gives the address of three such suppliers:

Telephone Repair and Supply Co., 1760 West Lunt Ave., Chicago 26, Ill.

Buckeye Telephone and Supply Co., 1250 Kinnear road, Columbus 21, Ohio

Suttle Equipment Co., Lawrenceville, Ill.

The unit shown in Fig. 8-15 (the 20HV) consists of three carbon electrodes mounted on a ceramic base. Leads from each electrode are

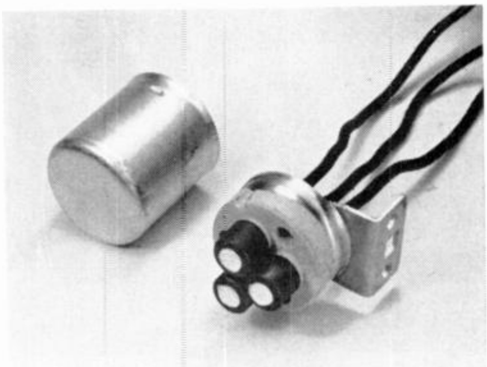

Fig. 8-15

brought out separately through neoprene bushings; the ground lead is 6 feet long and the others, which connect to the feedline, are 2 feet long. A mounting bracket and a protective aluminum housing are furnished with the units. K1CLD says the units were selling singly for a little over $3.00.

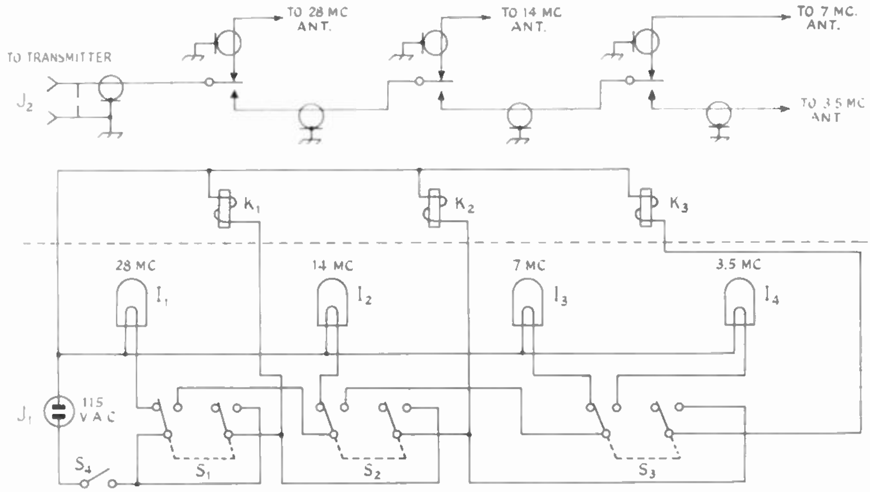

Fig. 8-16—Circuit diagram of the remotely controlled switching circuit for coaxial feedlines.

I_1, I_2, I_3, I_4—115-volt a.c. pilot lamp assemblies.
J_1—115-volt a.c. chassis-type receptacle.
J_2—Chassis-type coaxial receptacle.
K_1, K_2, K_3—S.p.d.t. coaxial relay (Advance CB/1C/115VA).
S_1, S_2, S_3—D.p.d.t. toggle switch.
S_4—S.p.s.t. toggle switch.

REMOTELY-CONTROLLED SWITCHING CIRCUIT FOR COAXIAL FEEDLINES

Anyone using two to four coaxial-fed antennas may be interested in the "cable-saving" selector circuit shown in Fig. 8-16. This system uses a single main feedline followed by short branch feeders to replace the four long and costly cables that would ordinarily be installed between the antennas and the transmitter or shack. In addition, the circuit is interlocking to the extent that there is little chance of feeding an antenna by mistake. It is simple to operate, reasonably economical to build, and has a visual-indicator system for identifying the antenna in use.

The complete system consists of a remotely controlled head located at the operating position and a relay unit mounted outside and adjacent to the feed points for the antennas. The control section (shown below the dashed line in Fig. 8-16) uses S_1, S_2 and S_3 to control the relays and the antenna indicator lamps I_1 through I_4. S_4 is the control head on-off switch and J_1 is a 115-volt chassis-type receptacle.

The relay circuit (section above the dashed line in Fig. 8-16) uses three coaxial relays, K_1, K_2 and K_3, to connect the main feedline from the transmitter to any one of the four short cables which run to the antennas. J_2 is a coaxial receptacle which accommodates the r.f. output cable from the transmitter. Four-conductor antenna-rotor cable is used for the relay control leads which must be provided between the relay compartment and the control head.

Fig. 8-16 shows the relays in the normally closed positions and the control switches in the "up" positions. Under these conditions, and with S_4 turned on, the 28-Mc. antenna will be connected to the transmitter and I_1, the 28-Mc. indicator, will light. When S_1 is thrown "down," a.c. control voltage will be fed through to K_1 and S_2. K_1 will transfer the main coaxial cable over to K_2 and then on to the 14-Mc. antenna. I_1 will go out and I_2 will become illuminated. Bringing S_2 "down" switches the transmitter output cable over to K_3 and permits S_3 to select either the 3.5- or the 7-Mc. antenna.

Construction of the control unit may follow any design that goes well with the other gear at the operating position. The unit here at W9QUW uses red-jeweled pilot lamps identified with white decals. The relay housing is an aluminum box made weatherproof by covering open edges with plastic tape and then spraying with clear plastic. Coaxial receptacles may be used for terminating the antenna and control cables, or these leads may be brought out through grommet lined holes drilled or punched in the bottom of the box.

— *Ronald Tauber, W9QUW*

CENTER INSULATOR FOR FOLDED-DIPOLE ANTENNA

A simple and rugged center insulator for folded dipole antennas is shown in Fig. 8-17. The Mosley type 263S connectors are intended for coupling feedlines to TV antennas, but they beat egg insulators by a mile when used at the center of a ham-band folded dipole. One big advantage of the system is that each Twin-Lead member of the antenna is firmly clamped ahead of the point where the electrical connection is made. This relieves the strain and prevents snapping at the soldered junctions.

If high power is used, it may be advisable to solder the Twin-Lead to the metal bars. If soldering is not deemed essential, the ends of the conductors may be clamped under the screw-type terminals provided for the purpose.

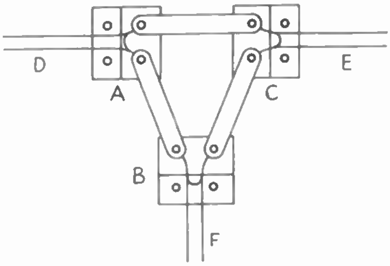

Fig. 8-17—Drawing of the center insulator described by W1CSP. A, B and C are Mosley type 263S connectors. D, E and F are radiator and feedline elements made with 300-ohm Twin-Lead.

The small amount of "fanning" caused at the junction of feedline and antenna does not appear to create an impedance problem. My antenna checks out with an s.w.r. of 1.2 to 1. And, best of all, it has stayed up under weather conditions which no other methods of construction — at least, not those tried here at W1CSP — have been able to take.

— *Marvin Norman, W1CSP*

BAMBOO FEEDER SPREADERS

FEEDLINE spreaders that are light in weight, rugged and as inexpensive as they come can be made from a bamboo pole. Very little labor is involved in making the spreaders and, when finished, you'll have some insulators that won't chip or break when bumped or dropped. One of these homemade spreaders is shown in Fig. 8-18.

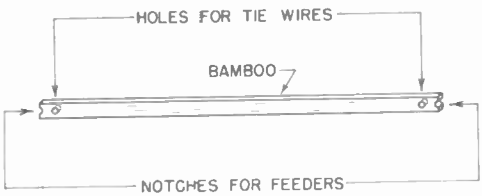

Fig. 8-18—Sketch of a neat, inexpensive and rugged feeder spreader made from bamboo.

Using a hack saw, cut sections the desired length between nodules of a bamboo pole. Make the cuts exactly at right angles and all of the spacers will be the same length. Now split the full length of the tubes with a sharp knife. Start all splits from the same end of the bamboo sections as this makes the pieces more uniform. The first split requires the application of considerable force, but from there on the lengths are easily lopped off. The spreaders don't have to be very wide, so you can get quite a few of them from a single length of bamboo of reasonable diameter.

If you are lucky enough to have an electric hand drill or a drill press, it is quick work to drill the tie holes. A round needle file can be used to notch the ends of the spreaders for the feeder wires. To make them stand the weather, dip in lacquer and hang up to dry.

— *P. C. Holden*

HOMEMADE GUY-WIRE INSULATORS

WHEN the A-frame mast to support a new 7-Mc. antenna was about to be raised, it was discovered that the supply of strain insulators had become exhausted. Waiting for delivery from a mail-order supply house was out of the question at this stage of the game and, as a result, the problem was solved — ham style — as follows:

A plank of well-seasoned hardwood was ripped into several sections measuring 1½ by 1½ by 12 inches. A groove was then cut down the middle of each side of each piece. Each length was then cut into 3-inch blocks and drilled to accommodate guy wire. Final treatment consisted of a boiling in beeswax. Fig. 8-19 is a drawing of the finished product.

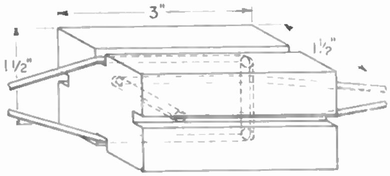

Fig. 8-19—A homemade strain insulator used by W9ALU.

— *Harley L. Christ, W9ALU*

STUB TUNING AID

THE experience of hanging on to the top of a 45-foot pole while tuning the stub for a cubical quad antenna (*QST*, January, 1955), and having the clips on the shorting bar "jump track" during adjustments, inspired me to spend a few productive minutes constructing the tuning aid illustrated in Fig. 8-20.

Construction of the tool and the manner in which it is used become clear after a glance at the sketch. The slotted block may be placed either below or above the shorting bar, depending on whether the bar is raised or lowered. By keeping the tool in alignment with the stub, it is possible to move the shorting bar evenly along stub elements without danger of either clip jumping loose.

— *Robert T. Riser, W5BYK*

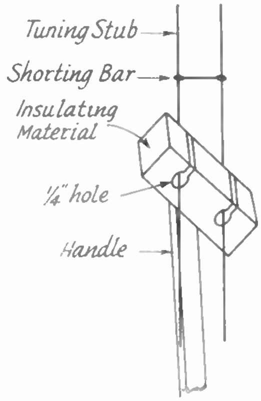

Fig. 8-20—Drawing of the stub tuning aid. The slots in the insulated block must be large enough to slip over the stub bars or wires. The wooden handle should be approximately six inches long.

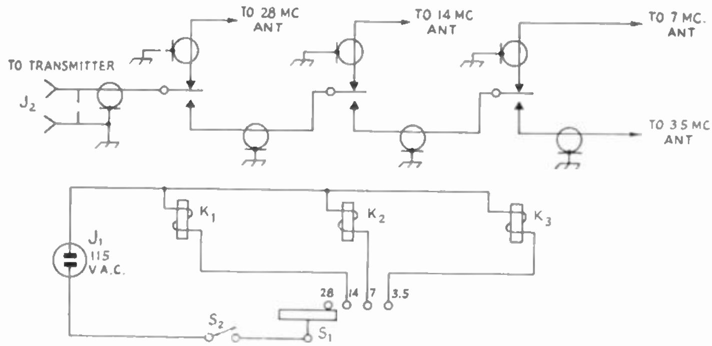

Fig. 8-21—Circuit diagram of the simplified remotely controlled switching circuit for coaxial feedlines

ANOTHER REMOTELY-CONTROLLED SWITCHING CIRCUIT FOR COAXIAL FEEDLINES

Owners of coaxial-fed antennas who contemplate use of the "cable-saving" selector circuit described by W9QUW on page 88 may be interested in a simplified control and indicator circuit for the system.

The relay-controlled setups I've seen usually use a progressive shorting switch wired as shown in Fig. 8-21. This arrangement has only one antenna-selector switch and is extremely simple to wire. Pilot-lamp indicators become more or less an accessory with this circuit, since the selector-switch pointer knob indicates the antenna in use.

S_1, the selector control, may be a Centralab steatite wafer section type P1S, P1SD or PA-12. Phenolic Centralab sections that will do the job are the types P1, P1D and PA-43. A s.p.s.t. toggle switch, S_2, is used as the control head on-off switch. J_1 is a 115-volt chassis-type receptacle mounted adjacent to the selector switch.

— *Eugene Austin, WØLZL*

TWO-METER GROUND PLANE

The two-meter ground plane antenna described here is not only inexpensive but also has good appearance qualities generally nonexistent in ham-band antennas.

Construction is simplicity itself. A standard one-inch pipe end cap available at any hardware store makes up the base. A hole large enough to receive a ½-inch ceramic feed-through insulator is cut in the top of the cap and four equal-spaced ⅛-32 tapped holes are made in the flange. These holes should be at least ½ inch from the edge of the flange to avoid thread damage when the mast is screwed into place. The holes should be drilled with a press if possible to assure perfect alignment.

Next, five pieces of ⅛-inch drill rod are cut to length. We used the formula from the *Handbook* to determine the required length. Four of the rods are threaded for ½ inch and the fifth is threaded approximately 1½ inches.

Prepare the coax feed line as shown in the sketch. We used a solder lug with ⅝-inch inside diameter for the shield and a ⅛-inch solder lug for the center conductor. Assemble vertical, the rod with the long thread, as follows: First, a self-locking nut goes on, then the top half of the insulator. Slip this into the top of the pipe end from the outside, followed by the shield conductor lug, making sure the surface of the inside of the cap and the lug make good contact. Install the other half of the insulator, followed by a washer, the center conductor terminal and a nut. Tighten the assembly with the self-locking nut on the outside to avoid twisting the conductor.

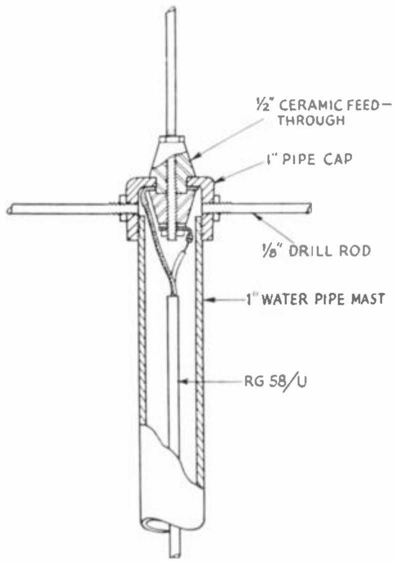

Fig. 8-22—Details of the two-meter ground plane.

Now run a self-locking nut on each of the four remaining rods. Screw the rods into the holes around the flange and tighten up on the nuts. We use a piece of one-inch water pipe 25 feet long fastened to the side of the house at the bottom and at a point six feet from the bottom. No guy wires are needed and no feed lines are visible.

No electrical measurements of the performance of the antenna have been made here, but from an operating standpoint its performance is outstanding.

— *Dale Westfall, W4FDF*

A 2-BAND ANTENNA FOR 7 AND 14 MC.

Having used a ground plane for four years on 7 Mc. with good results, it was decided to try it as a half-wave vertical on 14 Mc. A 3⅜-inch diameter copper-tubing coil, L_1, was constructed, consisting of 3¼ turns wound on a 3¼-inch form, turns spaced ⅜ inch. The coil was mounted just below the vertical element of the ground plane on a stand-off insulator, and was connected by its top end to the base of the vertical and by its bottom end to the radials. RG-8/U coax line was coupled to this coil by a link, L_2, consisting of two turns of lamp cord the same diameter as the copper coil, inserted between the bottom two turns of the tubing and fastened in place. A 100-μμf. capacitor, C_1, is necessary to tune the coil to resonance in the 14-Mc. band and should be a mica rated at about 6000 volts.

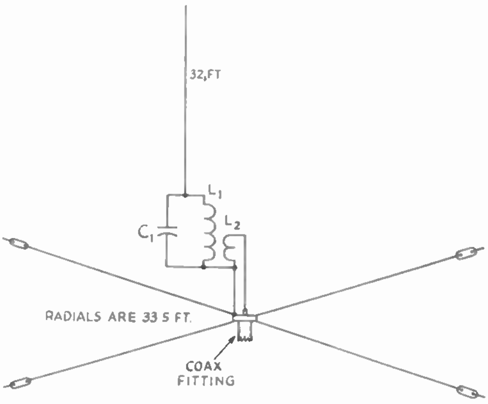

Fig. 8-23—W6TSX's two-band antenna.

While results on 14 Mc. were quite good, it was inconvenient to have to change antenna connections each time band changing was desired. In an attempt to avoid this, the antenna was tried on 7 Mc. while connected for 14 Mc. The transmitter loaded even better than with the regular ground-plane connections and reports on 7 Mc. seem to indicate that the antenna works just as well as with the original ground-plane connection.[1] No measurements have yet been made as to the s.w.r., but results on both bands have been quite satisfactory.

— *Samuel J. Henderson, W6TSX*

[1] Probably because the inductive reactance of the *LC* circuit at 7 Mc. just about equals the capacitive reactance of the vertical element at that frequency — a principle commonly used in trap antennas. — *Ed.*

T.R. SWITCH

Here is a t.r. switch that I use with my Navigator transmitter and HQ-100 receiver. It's easy to build and there is nothing critical to adjust. The circuit for the switch is shown in Fig. 8-24. The output circuit, including the 180-ohm resistor, 0.002 μf. capacitor and the r.f. choke, should be shielded. Ideally, the switch would be mounted as close as possible to the final

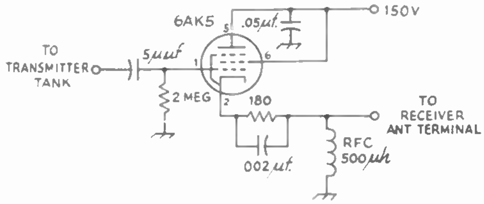

Fig. 8-24—Diagram of the t.r. switch

amplifier tank circuit to prevent stray pick-up. Be sure to use an input capacitor that will safely handle transmitter voltages. Also, use of the switch will depend on the voltage that may be safely applied between the grid and cathode of the tube.

— *Ray Smith, W7UZI*

"ALL-BAND" ANTENNA

Fig. 8-25 is a sketch of an "all-band" antenna system that I have been using with success for some time. The idea is not a new one, having appeared in *QST* at least 10 years ago. However, I feel that there are many newcomers since that time who would be interested in a simple system that can be fed with a single 70-ohm transmission line.

The arrangement consists of dipoles, cut for each band and connected in parallel at the center. Although I have not checked standing-wave ratios, the results seem to indicate that it gets out as well as a bunch of individually-fed doublets. If you haven't tried it, you're in for some surprises.

— *R. L. Cope, W8MOK*

[Editor's Note: As with any system of this type, special care must be exercised in reducing low-order harmonic output, since any harmonic energy fed to the system will be easily radiated.]

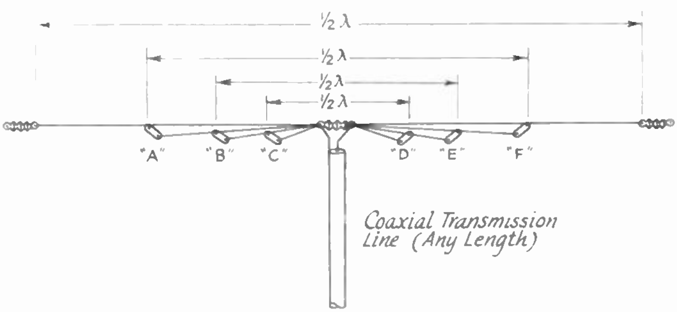

Fig. 8-25—Sketch of W8MOK's "all-band" antenna. Egg insulators are used at points "A" through "F."

A SIMPLE ANTENNA-SWITCHING ACCESSORY

The need for a convenient method of quickly connecting either a receiver or transmitter to any one of four coaxial feed lines led to the development of the simple switching circuit shown in Fig. 8-26. The impedance characteristic of this inexpensive system may not be 100 per cent perfect, but the average amateur, operating on frequencies below 30 Mc., can usually tolerate a slight *bump* in the transmission line in exchange for a *dip* in cost.

Connectors J_1 through J_4 of Fig. 8-26 provide for inside-the-shack termination of four coaxial feed lines. S_1 is a selector switch used to connect any one of the lines to the antenna change-over relay, K_1. The normally-closed contact of K_1 is connected to the receiver jack, J_6 and the normally-open contact of the relay is connected through the r.f. ammeter to the transmitter jack, J_5. The control switch for the relay may be remotely located at the operating position. The ammeter is not a necessary component to the

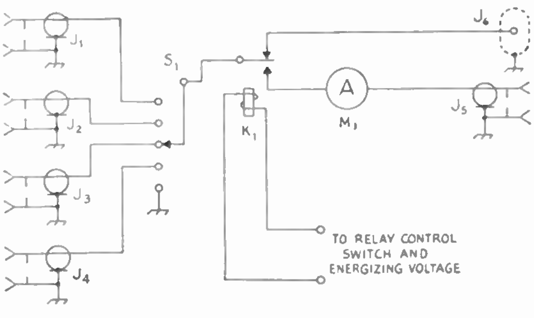

Fig. 8-26—Circuit of the simple antenna-switching accessory used by W2EEJ.

J_1-J_4, J_5—Coaxial receptacle (SO-239).
J_6—Phono jack.
K_1—S.p.s.t. normally-open antenna relay.
M_1—R.f. ammeter; see text.

circuit (connect the relay directly to J_5 if the meter is not used), but it is well worth including.

An ordinary type of selector switch, preferably ceramic, may be used in the circuit for handling the output of low- and medium-power transmitters. If the transmitter used with the accessory is a high-power affair, it is advisable to use a heavy-duty switch such as that found in a surplus BC-365 tuning unit.

Any available metal box large enough to accommodate the jacks, meter, relay and switch may be used as a housing for the circuit. J_1 through J_6 may be mounted on the rear wall of the box and the other components should be arranged to provide for the shortest possible leads throughout the circuit. Use fairly stiff wire for all connections and avoid loops or wire *dress* that will increase stray capacitance or result in shorting. To prevent inadvertent connection of the transmitter to the normally-closed contacts of K_1, use a phono jack (J_6) for the connections to the receiver.

If a low-pass filter for TVI suppression is to be used, it should be installed between the transmitter and the antenna switch in normal fashion. It is advisable to label or otherwise mark the various feed lines and the jacks with which they mate to avoid confusion or improper connection.

The r.f. ammeter serves as a handy indicator for tuning and as a continuous check of the efficiency of the transmitter, particularly if original readings are noted for future reference. It will probably be observed that maximum output occurs with the final tuned slightly off the plate-current *dip*, and optimum grid drive and plate-loading conditions can be quickly determined by observing the meter. Naturally, the meter range — full-scale reading in amperes — required will be determined by the transmitter power-output level.

In use, an additional convenience is the ability to change antennas while receiving, resulting in a modified diversity type of reception which often helps to overcome fading. *Caution:* Remember to reset the switch before transmitting to avoid operating the final without a load.

— *Herbert Greenberg, W2EEJ*

TRANSFORMERLESS VERSION OF W3DM'S T.R. SWITCH

Enthusiasm about installing the electronic transmit-receive switch (*QST*, June, 1957) in a portable transmitter was temporarily dampened by the improbability of being able to secure one of the broad-band output transformers in time for Field Day. However, after some reflection, the problem was solved by modifying the circuit to eliminate need for T_1 of the original layout.

As shown in the circuit, Fig. 8-27, low-impedance output for coupling to the receiver is obtained by operating the type 6AH6 as a cathode follower. Naturally, the gain in a circuit such as this is less than unity. However, this factor does not offset the advantage afforded by using

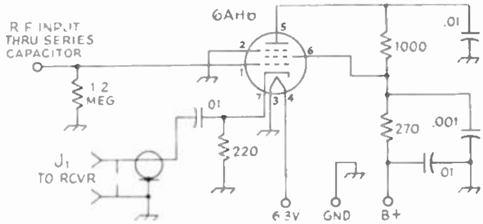

Fig. 8-27—Circuit diagram of the cathode-follower t.r. switch used by W3NF. Resistances are in ohms, resistors are ½-watt composition; capacitors disk ceramic. Capacitances are in µf. The connection to the transmitter tank should be through a series capacitor whose value is computed as $C(\mu\mu f.) = \dfrac{2500}{\text{d.c. plate volts}}$.

the extra tuned circuit ahead of the receiver input, and the ability to conveniently use a good transmitting antenna for receiving purposes.

— *Edward Hart, W3NF, W2ZVW*

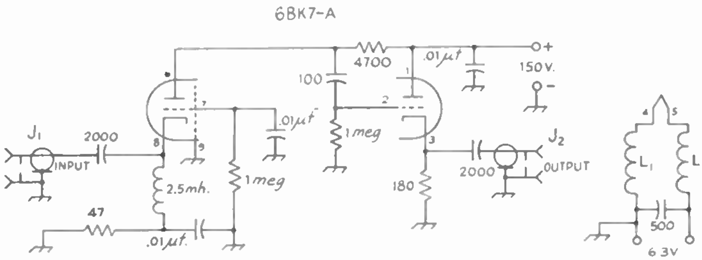

Fig. 8-28—Circuit diagram of W8EUJ's t.r. switch. Unless otherwise indicated, capacitances are in μμf. Resistances are in ohms, resistors are ½ watt. L_1 and L_2 are each wound with 30 turns No. 24 wire to a diameter of 3/16 inch.

T.R. SWITCHES

Modification of my 100-watt station for fast break-in brought up the antenna switching problem. A t.r. switch seemed to be the best answer, so one was designed.

The simplicity of the unit built is shown by the circuit diagram, Fig. 8-28. Since it could be added to existing control units, some other "120-watt table-top rig" amateur may be interested in the circuit.

A grounded-grid input stage (switched by grid rectification) *R-C* coupled to a cathode-follower output stage, provides a broad-band low-impedance t.r. switch suitable for use with coaxial cable. The unit has some gain as shown. If needed, for long lines or to make up for resistive isolation, more gain can be had by increasing the plate resistance of the first stage to 6800 ohms or more.

The 6BK7A tube is a good choice for this application. Designed for cascode operation, it has a good heater-to-cathode voltage rating. More important is an internal shield connected to Pin 9 which very effectively isolates the two triode sections. With no power to the t.r. switch the receiver sounds dead.

My model is a separate unit with its own booster-type transformer, selenium rectifier and other power supply components built on a 3½ × 5-inch aluminum sheet chassis and housed in a 4 × 4 × 5-inch sheet-metal can. Construction is similar to B & W t.r. switch. I have no way of checking power-handling capabilities, but from the tube ratings this switch should handle as much power as the other units I have seen. A phono jack in the transmitter end of the low-pass filter provides a convenient point for connection to the r.f. line.

After installing this t.r. switch several interesting developments were noted. Hash from the final amplifier (parallel 807s) had to be eliminated. A clamp tube circuit was added to help the fixed bias cut plate current completely off. Zero-beating is a little more tricky, requiring less r.f. gain in the receiver. And finally, it is quite a surprise to learn how many hams pick my operating frequency to tune up on. I can hear them now!

— *Charles E. Quick, W8EUJ*

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The t.r. switch shown in Fig. 8-29 is my adaptation of a circuit designed for another purpose and described by ZL4GP on page 48 of *QST* for July, 1955. Although the switch is only slightly more complicated than the simple unit developed by W9LSK (*QST*, May, 1956), it does operate without presenting a constant loss to received signals through the 3.5–30-Mc. range. In fact, the circuit shows some gain at these frequencies.

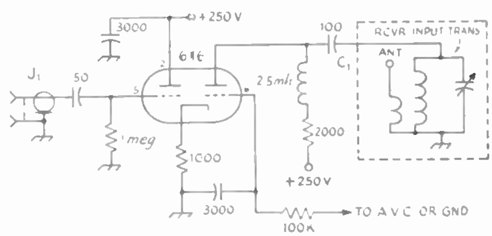

Fig. 8-29—Diagram of 11DAJ's simple t.r. switch. The switch is designed for low-impedance input (coaxial cable) and high-impedance output. Capacitances are in μμf., resistances are in ohms, resistors are ½ watt.

The switch is designed for low-impedance coaxial-cable input and high-impedance output. Because of the latter characteristic, it is important that the switch be built *into* the receiver with its output coupling capacitor connected directly to the secondary of the receiver input transformer.

— *Carlo Winspeare, I1DAJ*

UNBALANCED TO BALANCED FEED FOR LOW-IMPEDANCE MULTIBAND ANTENNAS

In *QST* for June, 1956, W6EBY described a balun-type coupler for use between a coaxial feed-line and a balanced antenna such as a half-wave dipole. Although the system as described makes use of an individual antenna for each band of operation, it is perfectly practical to use the same method for coupling 75-ohm coaxial cable into the center of a balanced multiband trap-type antenna system.

Here at W3BRQ, we run a length of 75-ohm coax from the pi-network output tank to a balun located out on the roof in the general vicinity of the feed point for the multiband antenna. The balun, made from a pair of relatively inexpensive B & W type 3975 coils, provides a match between the long run of coax and a short length of 75-ohm Twin-Lead that connects to the center of the antenna.

— *Tony Gill, W3BRQ*

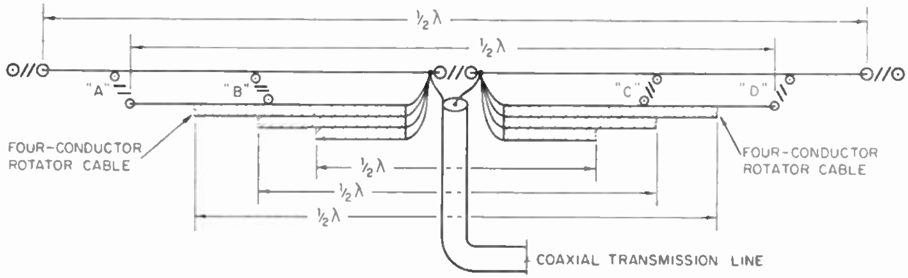

Fig. 8-30—Drawing of W9DOS's multiband antenna for 3.5 through 28 Mc. Individual dipoles for 7, 14, 21 and 28 Mc. are made from lengths of four-conductor rotator control cable. The 3.5-Mc. antenna, made with copper-weld wire, is used to support the dipoles for the higher frequencies. A single length of 73-ohm coaxial cable is used to couple to all five antennas.

USING FOUR-CONDUCTOR ROTATOR CABLE IN PARALLELED DIPOLE ANTENNAS

The easily constructed multiband antenna using several dipoles, each cut for a different band, connected in parallel and fed with a common feedline has been previously described by at least four authors.[1,2,3,4] The latest of these articles described a four-band system using lengths of 300-ohm ribbon transmission line as the dipole elements. Although this idea does lead to simplified construction, it does not carry the easy-to-do-it theme quite as far as does the system used here at W9DOS.

A sketch of a five-band antenna is shown in Fig. 8-30. The point of interest is that the four dipoles for 7 through 28 Mc. are made from two lengths of four-conductor rotator cable. These lightweight elements are supported by a half-wave dipole cut for 3.5 Mc. Copperweld wire is recommended for the 3.5-Mc. radiator because it will stand the strain of supporting the other antennas without breaking or stretching. The 7- through 28-Mc. elements may be attached to the 3.5-Mc. antenna by means of tape or string, or a number of lightweight strain insulators (A, B, C and D in Fig. 8-30) may be used for the purpose.

The two lengths of rotator cable are first trimmed to a length suitable for use as a 7-Mc. dipole. The No. 2, 3 and 4 conductors of each length of cable are then shortened by removing excess wire and insulation to provide elements for the 14-, 21- and 28-Mc. antennas, respectively. The outside ends of the individual dipoles are left floating, and the inside ends are twisted together and soldered to the 3.5-Mc. antenna as shown in the drawing. The common coaxial feedline for the five antennas may be any convenient length.

— *Sigmund J. Wysocki, W9DOS*

[Editor's Note: An antenna of this type will respond readily to harmonics and submultiples of the transmitter output frequency. It is therefore especially important that these frequencies be suppressed *before* they reach the antenna.]

[1] W9YPQ, "Hints & Kinks," *QST*, June, 1937.
[2] W8MOK, Page 91, this volume.
[3] Berg, "Multiband Operation with Paralleled Dipoles," *QST*, July, 1956.
[4] Richard, "Parallel Dipoles of 300-Ohm Ribbon," *QST*, March, 1957.

SAVE CABLE IN MAKING PARALLEL DIPOLE ANTENNAS

The previous Hint describes a multiband antenna using 4-conductor rotator cable. Assuming parallel dipoles are desired for 40, 20, 15 and 10 meters, most hams might purchase a length of multiconductor cable about 70 feet long and trim it equi-distant from the center to the appropriate length of each dipole. However, an original length of only 45 feet, cut as shown in Fig. 8-31, will do the job with a saving of 25 feet of cable.

— *E. R. Hardy, W1HJL*

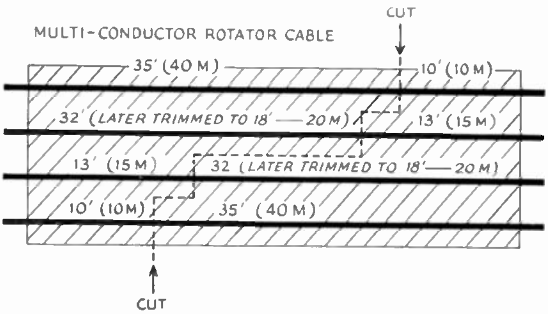

Fig. 8-31—W1HJL's method for saving cable when constructing a multiple dipole from four-conductor cable.

"UMBRELLA FOR TWO;" NOVEL GROUND-PLANE ANTENNA FOR 144 MC.

I had wanted to build a cheap-and-easy ground-plane antenna ever since the two-meter craze hit the Beaver Valley Gang. However, it took some activity on the part of local canines to get me started. After they had torn the XYL's umbrella to shreds, they left me with the prettiest set of ready-made two-meter radials you ever saw!

Paint was scraped from the inside ends of the ribs and these thoroughly cleaned areas were bonded together (soldered) with a length of flexible shield braid. A hole to accommodate the vertical section of the antenna was drilled in the top of the umbrella assembly. A 20-inch length of brazing rod fed with coaxial cable was used as the radiator.

One of the nice features is that I can still open and close the umbrella for convenient installation and transit. Furthermore, you don't have to be a drinking man to get the materials!

— *Rollyn W. McMahan, W3ECQ*

9. Hints and Kinks . . .

for the Mobile Rig

USING 12-VOLT DYNAMOTORS WITH 6-VOLT CHARGING SYSTEMS

RECENTLY a surplus 12-volt dynamotor was acquired at very nominal cost because there is little demand for these units. Immediately, the problem arose as to how the dynamotor could be put to use for mobile operation without extensive and expensive modification of the auto electrical system. The addition of a relay and an auxiliary battery to the existing system provided the solution.

Fig. 9-1 shows how a 6-volt d.p.d.t. relay is wired to permit feeding 12 volts to the dynamotor whenever the push-to-talk switch is activated. With the switch open and the relay in the normally closed position, the two batteries are connected in parallel and both receive charge from the car generator. With the *talk* switch in the on position, the relay connects the batteries in series. Battery No. 1 continues to receive charge when the series circuit is employed.

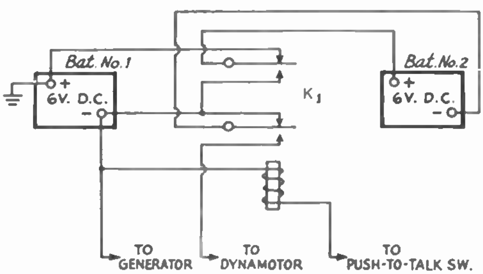

Fig. 9-1—Diagram of the 12-volt electrical system used by W 1ZMZ/8. K_1 has contacts rated at 35 amperes.

Filament and relay voltages are taken from the No. 1 battery to keep the load on No. 2 as light as possible. It has been the writer's experience that the auxiliary battery will stay charged as long as normal periods of receiving, transmitting and driving are involved.

— *Edward Matthews*

CONVENIENT METHOD OF MOUNTING MOBILE GEAR

BY using hinges — the type having removable locking pins — for the support of dash-mounted mobile gear, it is possible to remove and install equipment with a minimum expenditure of time and effort.

Fig. 9-2 shows the hinge-support method of mounting. One half of a hinge is fastened to each side of the mobile unit. The companion sections of the hinges are appropriately located under the dashboard. Use self-tapping screws at the sides of a unit, and machine screws, lock washers and nuts to hold the dash-mounted members in place. On heavy equipment, it may be advisable to provide additional support by means of a brace or bracket located at the rear of the unit.

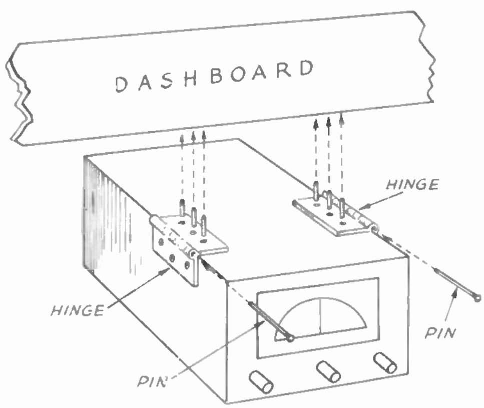

Fig. 9-2—Sketch showing the hinge method of mounting mobile gear.

To remove or install equipment, merely pull the hinge pins. Another feature of the system is that very little space is used by mounting supports, thus permitting several pieces of gear to be mounted in a row without need for wide space-wasting gaps.

— *Myron D. Weisberg*

KEYING THE VIKING MOBILE TRANSMITTER

THE use of c.w. in mobile operation is becoming increasingly popular because it usually assures reliable communication even when the bands are badly crowded. Although several of the commercial transmitters provide keying facilities, the popular Johnson "Viking" was designed solely for phone operation. Fortunately, it is a relatively simple job to revamp this rig for c.w. In my own particular case, the job was speeded up by the assistance of Bill Karsten, K4BUR.

The Viking has a bias supply which delivers about 25 volts negative to the grids of the 6AQ5 buffer/multiplier, frequency multiplier, 807 final and modulator tubes. This bias prevents excessive plate current when excitation is removed from the final and, as a result, the transmitter may be keyed by opening and closing the cathode circuit of the buffer/multiplier. Fig. 9-3A shows how a closed circuit key jack, J_1, may be wired into the cathode circuit of the 6AQ5. The jack must be insulated from ground and should be shunted with a 0.01-μf. disk capacitor.

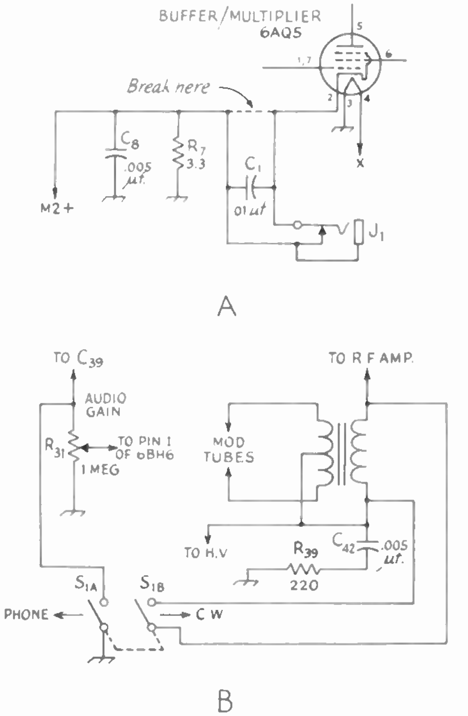

Fig. 9-3—Circuit diagrams showing the connections to a key jack (A) and a phone-c.w. switch (B) for the Viking mobile transmitter. Components other than C_1, J_1 and S_1 are all original parts of the transmitter and are labeled with Johnson identifications (see operating manual for the transmitter).

Fig. 9-3B shows how a d.p.s.t. toggle switch may be connected for use as a phone-c.w. switch. In the c.w. position, the switch grounds the high side of the audio gain control and shorts the secondary of the modulation transformer. In 6-volt models of the transmitter, it is practical to use S_{1A} as a heater on-off control for the audio tubes instead of connecting it across the gain control. However, the wiring arrangement of 12-volt models makes it difficult to install S_{1A} as a heater switch and the circuit of Fig. 9-3B should therefore be used.

J_1 may be mounted on the front panel directly to the right of drive control, and S_1 may be placed just to the left of the coupling control. Drill the necessary mounting holes with care so as not to damage components already mounted in the panel area, and be sure to provide clearance between the new parts and the outer edges of the panel so that the chassis can be slipped back into the cabinet when the modification is completed.

Signal reports received while using c.w. with the Viking have all been T9. There is some feed-through from the oscillator with the key open, but it is noticeable only at extremely close range. Both v.f.o. and crystal control have been used and, even under the most trying road conditions, the stability leaves nothing to be desired.

— *Cdr. Gay E. Milius, jr., W4NJF*

[EDITOR'S NOTE: With improper wire dress, it is conceivable that the installation of J_1 will result in either transmitter instability or decreased output from the buffer/multiplier. Should either of these difficulties occur, it will be advisable to move C8 (original component) directly over to the cathode pin of the 6AQ5, or to install a new disk capacitor between Pin 2 of the socket and ground.]

NOTES ON THE PE-101-C DYNAMOTOR

THE PE-101-C dynamotor has recently been available on the surplus market at very reasonable prices. With the increasing popularity of the new 12-volt automotive electrical systems, the 12-volt primary winding on this dynamotor makes it worth looking into.

Investigation reveals that the PE-101-C dynamotor is equipped with two *identical* high voltage windings. One of these windings gives 400 volts at 135 ma. as stated on the nameplate. Incidentally, the bottom end of this winding is grounded to the dynamotor frame. The second winding is connected in series with the first winding to give the 800 volts at 20 ma. By reconnecting the two windings, a variety of voltages and currents is possible. For example, the two windings may be connected in parallel to give 400 volts at 155 ma., or they can be connected in series and operated at 800 volts and 77 ma. If desired, the two windings may be used separately, giving two separate 400-volt power supplies at 77 ma. each. The current drawn from each winding can be varied as long as the total power drawn from the dynamotor does not exceed 62 watts. Since the above are continuous duty ratings, they may be increased by about 20 per cent for intermittent duty such as normal amateur mobile operation without danger of overloading.

— *L. R. Langley, W8DSX*

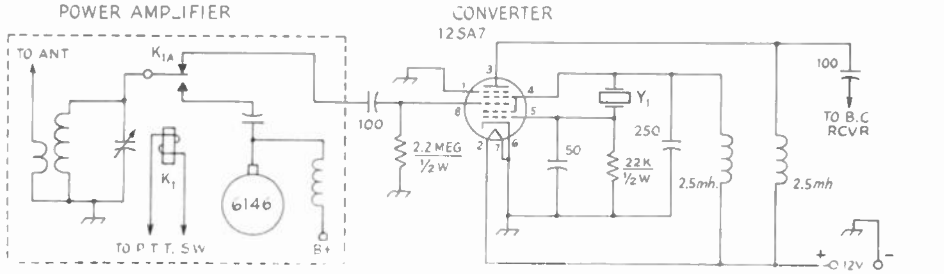

Fig. 9-4—Circuit diagram of W7NPV's simple mobile converter. The dashed lines enclose r.f. amplifier (transmitter components. Resistances are in ohms. Capacitances are in μμf. K_1 is the push-to-talk relay, and Y_1 is a 3000-kc. crystal

SIMPLE 12-VOLT MOBILE CONVERTER FOR 75 AND 40 METERS

After purchasing a new automobile having a 12-volt electrical system, I was faced with the problem of how best to receive 75 and 40 meters for a minimum expenditure. It was necessary that any ham gear added be quite small, and desirable that it use parts from the junk box.

Inspection of the car broadcast receiver revealed that it contained transistors and 12-volt tubes, the latter being the type designed to operate with the plate and screen voltages supplied directly from a 12-volt storage battery. Since there was no vibrator power supply — or no other convenient source of high voltage for a converter — I decided to try the simple 12-volt circuit shown in Fig. 9-4. Performance of the converter compares favorably with some of the more advanced or complicated units.

A type 12SA7 pentagrid converter tube is used in the circuit, but a miniature 12BE6 will work as well. One of the new 12-volt tubes — 12AD6 or equivalent — might be the best choice if the junk box doesn't contain one of the older types.

The tuned input circuit for the converter is the plate tank for the r.f. final in the transmitter. This circuit is switched back and forth between converter and transmitter by contacts K_{1A} of the push-to-talk relay, K_1.

Crystal frequency is 3000 kc. which places the 75-meter phone band between 800 and 1000 on the broadcast receiver dial. When operating on 40 meters, the second harmonic of the crystal is used and the broadcast dial is tuned from 1200 to 1300 kc. If crystal activity appears to be sluggish, the 250-μμf. capacitor may be replaced with one of higher value to strengthen oscillation.

Placement and wiring of components is not especially critical, but the converter is built into the transmitter and is near the final amplifier and the push-to-talk relay. Short lengths of hookup wire are used for leads terminated at contacts K_{1A} and, of course, it's advisable to use coaxial cable between the converter and the broadcast receiver. — *Vernon Phillips, W7NPV*

SUPPRESSION OF AUTO-GAUGE INTERFERENCE

Mobile fans may be interested in my recent experiments with noise suppression in various Ford vehicles.

After reducing ignition and regulator noise to a tolerable level, the remaining interference was quite severe. With the help of a coaxial feed line tied to the antenna terminals of a 50-Mc. receiver, it was determined that most of this noise was coming from the electrical oil-pressure gauge (motor block unit). The electrical temperature and gas gauges were also identified as sources of noise. Interference created by these three instruments was reduced by the installation of 0.01-μf. disk ceramic capacitors between the gauge terminals and ground. Lead length of the disks should be made as short as possible and soldering at the grounded ends is recommended.

After the work on the company vehicles had been completed, the above noise suppression method was tried out on the writer's personal car which carries a 4-Mc. mobile installation. Results obtained were most gratifying. W4MGT also reports favorably on the oil-gauge bypassing stunt. — *Robert A. Thomason, W4SUD*

MOBILE HINT: A PENCIL WHEN YOU NEED IT

Ever hunted for a pencil while mobiling? Keep one on the top surface of the dashboard. A piece of magnet from an old speaker will stick to any convenient location on the dash. And an ordinary wooden pencil with about 3 wide-spaced turns of baling wire or equivalent (not copper) around the shaft will cling to the magnet. For long trips a piece of scratch paper can be placed beneath the magnet, which will hold the paper firmly enough for quick operation notes.

— *Harold A. Thomas, W5HJM*

REDUCING NOISE IN TRANSISTORIZED AUTO RECEIVERS

Some models of the transistorized car broadcast receivers are plagued with motor noise interference. Motorola has recognized this problem and has made availble a high temperature high capacitance electrolytic that connects directly to the ignition coil. The unit bears part number AK-300, has a capacitance of 1000 μf. and nets for less than $2.00.

— *Donald S. Middleton, WØNIT*

TRANSISTORIZED B.F.O. FOR MOBILE USE

The schematic of a compact transistorized b.f.o. for mobile use is shown in Fig. 9-6. The circuit is a variation of that appearing in several issues of *QST*, but the method of obtaining power for the unit is somewhat unique. Although an inexpensive type CK722 transistor is used, the oscillator is adequately stable for use in converting an automobile broadcast receiver for c.w. reception. The b.f.o. may be constructed for use with receivers having either a 262- or a 455-kc. i.f.

When first used, the b.f.o. circuit was installed to take d.c. input power from the hot filament lead in the auto radio. This method of installation resulted in hash modulation of the oscillator signal — by the vibrator — that no amount of filtering would cure. This condition was easily remedied by powering the b.f.o. with the 10 to 15 volts of well-filtered d.c. available across the cathode bias resistor of the audio output stage.

Component values for the circuit are not especially critical, but stability of the oscillator is improved by connecting the base of the transistor to the cathode tap on the b.f.o. transformer rather than to the grid terminal. This results in an improved impedance match as compared to that obtained with normal transformer connections, and also decreased loading on the tuned circuit.

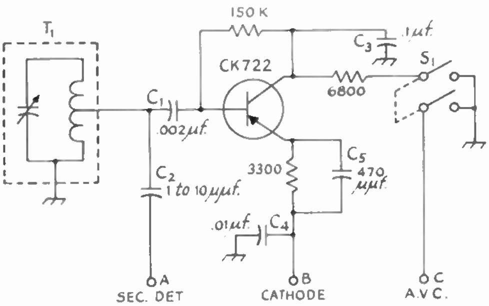

Fig. 9-6—Circuit diagram of the transistorized b.f.o. unit. Resistances are in ohms; resistors are ½ watt. T_1 is a 252- or 455-kc. b.f.o. transformer (see text). S_1, a d.p.s.t. toggle switch, is the oscillator on-off control. Terminals A, B, and C connect to the second detector, audio-amplifier cathode and a.v.c. line, respectively of the broadcast receiver.

Catalogues on hand indicate that 252-kc. b.f.o. transformers may not be too widely available. One homemade substitute for the commercial unit is a good quality 2.5-mh. r.f. choke of the 3- or 4-section variety, tapped between the first and second sections at the ground end (see Fig. 9-6) of the winding. This inductor should be shunted with a fixed "silver mica" of approximately 150 μμf. and a 100-μμf. variable padder.

To avoid complication in the schematic, and because it is difficult to show the several circuits that will be found in various types and makes of b.f.o. transformers, Fig. 9-6 shows only the bare essentials of a typical unit. If the one on hand is

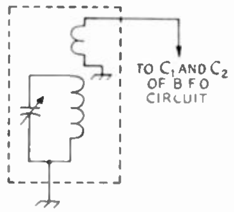

Fig. 9-7—Transformer connections for WØPME's transistorized b.f.o. when T_1 has a feedback winding instead of a cathode tap.

permeability tuned, or if it has fixed capacitors not shown, it may be used in the circuit as long as it tunes to the i.f. frequency. However, some transformers have a feed-back winding instead of a cathode tap and, in this case, the connections shown in Fig. 9-7 should be used in coupling T_1 to the transistor. — *Davis A. Helton, WØPME*

SQUELCH SYSTEM FOR THE GONSET G-66

Mobile fans who wish to add a squelch system to the popular Gonset G-66 receiver should consider using the circuit shown in *The Mobile Manual for Radio Amateurs*, page 84 (also *QST*, October, 1952). This particular job works exceptionally well.

After installing the squelch, taken *as is* from the *Mobile Manual*, it was found necessary to reduce the audio gain of the receiver. This was done by disabling the triode section of the 6AW8 in the receiver. The modification involves the rewiring of a component or two, but does not affect the resale value of the receiver because the original hookup can be put back in place with just a few minutes' work.

Parts involved in the modification are identified as C_{29} and C_{30} in the Gonset schematic. These two capacitors are mounted on a terminal board near the socket for the 6QWS. Fig. 9-8 shows the *before* and *after* wiring of the capacitors. Notice

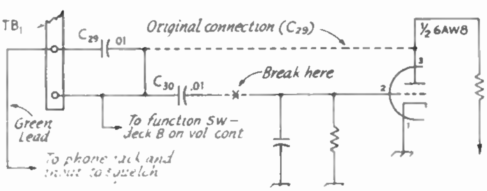

Fig. 9-8—Partial circuit of a G-66 modified to permit installing a squelch system, C_{29}, C_{30} and TB_1 are referred to in the text. Capacitor and resistors not identified are original components that need not be rewired.

that the plate end of C_{39} is disconnected from Pin 3 of the tube and reconnected to the input side of C_{30}. The connection between C_{30} and the grid of the triode is broken at "X" as indicated. TB_1 is the terminal board referred to above.

The squelch circuit may be built in a small box fastened to the side of the receiver. The 8 ma. or so drawn by the squelch tubes may be taken from the receiver power supply.

— *Melvon G. Hart, WØIBZ*

"STACKING" CRYSTALS FOR CONVENIENT SELECTION

Few mobile operators have a convenient storage system which permits rapid selection of crystals for the most frequently used frequencies. One method that has worked out exceptionally well in the W1TNS mobile installation is shown in section A of Fig. 9-9.

Crystals cut for local nets and other popular frequencies are arranged in stacks and then bound together with Scotch tape. Frequencies may be printed on paper tabs attached to the ends of the holders where they are readily visible, and the stacks may accommodate two or more crystals.

The crystal socket must ordinarily be mounted on the outside of the panel when this system is used. Make sure that the socket is at least 7⁄16-inch deep so that prongs of crystals *out* of the socket will not press against the panel and prevent the active crystal from seating firmly in place.

— *Chuck Newton, W1TNS*

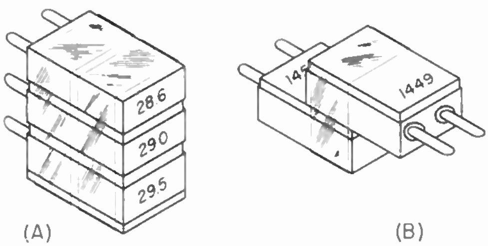

Fig. 9-9—Two methods of "stacking" crystals for rapid selection and ease of identification. (A) Method used by W1TNS. (B) System suggested by W3ZRQ.

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Section B of Fig. 9-9 shows the crystal stacking method used here at W3ZRQ. Scotch tape is used for clamping the holders together and for binding the frequency-identification tabs in place. The crystal socket may be mounted on the rear of the panel because clearance for the prongs of crystals not in use need not be provided.

If you care to, the stack may be made *four* high by adding a crystal to both the top and the bottom of the pile. Orientate the holders in the form of a cross so that the sets of pins are 90 degrees apart. A good grade of plastic cement may be used for bonding the holders together.

— *Allen R. Breiner, W3ZRQ*

WINDSHIELD-WIPER MOTOR FOR TUNING WHIP LOADING COILS

An electric windshield-wiper motor, mounted adjacent to the base of a mobile whip, provides a convenient and inexpensive means of tuning a roller-type base loading coil. It is very easy to arrange for reverse rotation of the motor because the field winding is brought out to a switch. Wiper motors can usually be obtained from an auto junk yard for a dollar or two.

— *Johnny Johnson, W2ZYX*

MOBILE HINT: PRUNING LOADING COILS

A number of laborious mount-the-coil and dismount-the-coil operations associated with pruning a set of mobile antenna loading coils may be eliminated by using the following procedure.

After the first coil has been resonated with the aid of a grid-dip meter, carefully observe the setting of the meter and then remove the coil from the antenna. Next, connect the coil in parallel with a 50-$\mu\mu$f. variable capacitor and, by tuning the latter, adjust the circuit to resonance at the exact frequency measured when the coil was mounted in the whip. The value of capacitance so arrived at is not of major importance, but it is equivalent to that effectively imposed across the coil by the antenna. Therefore, this external or test capacitance may be used to simulate antenna capacitance when other loading coils are being trimmed for resonance. In other words, coil adjustments may be made *on the bench* without involving repeated mounting tasks. The following precautions should be observed when using the system.

Couple the meter through a single-turn loop to the base of the antenna when grid-dipping a mounted coil. Couple the meter as loosely as possible when measuring an unmounted coil shunted with the test capacitor. Do not depend on meter dial calibration in either case because the oscillator frequency will probably pull some during measurements. G.d.o. frequency may be accurately checked by listening to the signal with a receiver of established calibration.

Hand-capacitance effects should be minimized while bench-testing an *LC* circuit by using a reasonably long insulated control shaft or tuning tool. A plastic housing over the capacitor will prevent accidental detuning after initial adjustment. Short leads between capacitor and coil are desirable and, of course, the *LC* circuit should rest on an insulated surface — not a metal work bench — while being adjusted.

— *Art Fenster, W2EXH*

NOVEL VENTILATING SYSTEM FOR MOBILE UNITS

Adequate cooling for some of those compact under-the-dash units can be provided for — without blower — simply by running wiper hose to the wiper line or to the manifold. Frequently, enough air will be drawn in through crevices around the cover, shaft openings, etc., of a unit to make unnecessary the drilling or punching of any special ventilation holes or louvers.

— *Harry E. Adams, W9JX*

MORE ABOUT THE NOVEL VENTILATING SYSTEM FOR MOBILE UNITS

When using the ventilating suggested by W9JX, above, it is advisable to avoid connection to the vacuum line from the intake system. Otherwise, you may run into valve trouble caused by an improper air-gas mixture from the carburetor.

— *Bill Norman, W5TXM*

CLEANING VIBRATOR CONTACTS

An article published in *Bell System Practices* (American Tel. & Tel. Co.) contains information on cleaning of vibrator contacts that should interest amateurs who use these units in mobile and portable gear. The purpose of the procedure is to free the contacts of the film that develops after the vibrators have been through a period of inactivity. This film can accumulate on the contacts of new vibrators as well as on those which have seen service. The film can generally be broken down and the vibrator rendered operative by the contact cleaning described below.

Connect 115 volts a.c., a 40-watt lamp and the vibrator in series in accordance with Fig. 9-10.

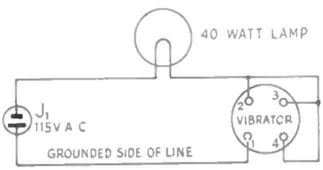


Fig. 9-10—Diagram of the vibrator-contact cleaning circuit submitted by W7OUS. J_1 should preferably be a polarized type connector.

If a polarized plug is used it is preferable that the identified blade (the wide blade of a parallel-blade type) be connected directly to the vibrator socket and the other blade to the lamp socket. Vibrator connections are:

Pin No.	*Internal Connection*
1	Reed and one end of winding
2	Pull interrupter contact
3	Inertia interrupter contact
4	Free end of winding.

Apply 117 volts a.c. to the vibrator through the 40-watt lamp for one minute. The a.c. will drive the vibrator to good amplitude regardless of the condition of the contact surfaces. The mechanical beating and the voltage applied to the contacts (limited by the 40-watt lamp) will generally break down any film in one minute of operation. The vibrator may be left in this test circuit for as long as 15 minutes without damage. *Safety precautions should be observed at all times.*

— *LeRoy S. Parris, W7OUS*

MOBILE ANTENNA MOUNT

The following method of mobile antenna mounting that I use may be helpful to others. Remove one of the rear bumper guards and cut off the top of it with a hacksaw. This cut is made so that a flat plate welded over the cut will provide sufficient area for mounting the antenna base mount. After the plate is cut and welded in place, the guard should be filed smooth. Drill the mounting holes for the base mount in the plate. The guard is then rechromed (this cost me $3.35) and mounted on the bumper. The modified guard can always be replaced with a standard one whenever desired.

— *Vincent N. Capasso, jr., K6ECV*

MOBILE-TRANSMITTER METERING HINT

The circuit shown in Fig. 9-11 utilizes a simple d.p.d.t. toggle switch to perform several mobile-transmitter switching operations. One half of the switch is used to connect a d.c. milliammeter into either the grid or the cathode circuit of a power-amplifier tube. Simultaneously, the other section selects either the receiver or the transmitter power supply as the source of plate voltage for the oscillator-driver tube.

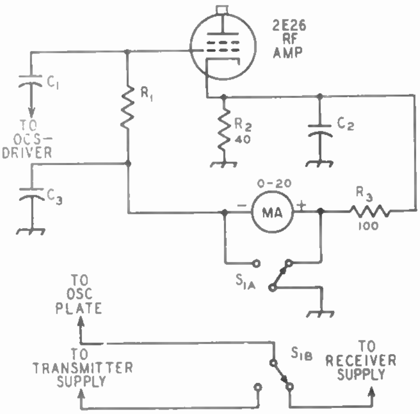


Fig. 9-11—Circuit diagram of the meter switching system suggested by W4DPV.

When S_1 is in the position shown in the diagram, and with the transmitter power supply turned off, the oscillator will take power from the receiver supply and the meter will indicate amplifier grid current. This arrangement is ideal for tune-up or zeroing-in adjustments because it leaves the r.f. amplifier without plate power. In the second position, S_1 connects the meter into the amplifier cathode circuit, and returns the oscillator plate circuit to the transmitter power supply.

The series resistor, R_3, prevents the low-resistance of the milliammeter from shorting out the voltage developed across the amplifier cathode resistor, R_2. Of course, it also divides the cathode current path with the result that the meter registers appreciably less than the total cathode current. However, this presents no problem once the meter has been checked and calibrated against a direct reading. The latter may be made by shorting R_3 and reading total cathode current with an appropriate milliammeter. R_3 has no part in the grid-circuit operation and a direct reading of amplifier grid current is therefore registered by the 0–20-ma. meter.

The component values shown in Fig. 9-11 are used with a 2E26 final. A little arithmetic will show that the effective value of cathode resistance (for the amplifier) is reduced to less than 30 ohms when the meter is switched over to the final and, as a result, the system causes no appreciable drop in amplifier plate voltage. C_1, C_2, C_3 and R_1 are typical amplifier components.

— *Harry Hawkins, W4DPV*

A HOMEMADE BUMPER MOUNT

It is assumed that every amateur has access to an "Armstrong" milling machine (file, that is), one very worn hack-saw blade, and an electric drill. These tools will suffice to build this bumper mount, aside from the welding and brazing.

Make a cardboard template of the bumper contours at the point where you wish to mount the antenna, taking care that the top line is parallel to the ground — unless you want a real rakish job pointing aft! Using the template, refer to Fig. 9-12 and lay out the pieces. Allow an extra half inch in length for the top piece (A) for the hook which goes over the top of the bumper. This hook can be hammered cold with the piece held in a vise. Clamp the two side pieces (B and C) together and drill the holes for the slotted pin (D). Make up the strap-and-bolt piece (E) allowing extra length of strap.

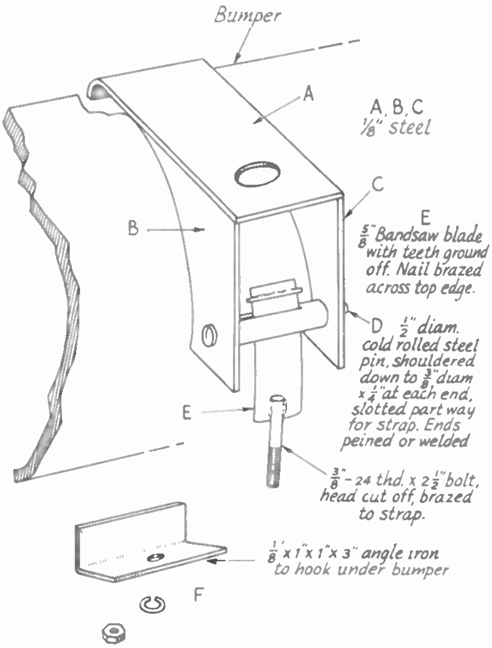


Fig. 9-12—Sketch of the homemade bumper mount used by W8QMI.

At this point it is well to take all the parts out to the car for a trial assembly. If all is well (three hands *would* come in handy here), mark the location for the stop on the strap. Braze the stop to the strap, put the strap in the slotted pin, insert the pin in the side pieces and pein (or weld) in place after making certain the slot is directed so there will not be a kink in the strap. Now the top can be welded to the side pieces and the job is ready for paint. I used a ¾-inch hole in the top plate and made a bushing and two large washers of formica to insulate the antenna.

The mount is locked in place on the bumper by means of the bracket, washer and nut illustrated in section F of Fig. 9-12.

— *E. W. Koch, W8QMI*

5-BAND MOBILE ANTENNA

Here is a center-loaded mobile antenna that will work on 5 bands and there's no need to get out of the car for switching or adjustment when changing bands. I used a Master All-Band Coil, but any type with the correct number of turns may be used. The antenna could be called a multiple-loaded antenna since the proper *LC* sections resonate the antenna for whatever band is being used.

The diagram of the antenna is shown in Fig. 9-13. The capacitors should be mica or ceramic and must have a voltage rating high enough for whatever power is being run. Solder the four capacitors in series and connect the 40-μμf. capacitor to the bottom end of the coil, using a lead of about 6 inches. Now tune the mobile receiver to 10 meters and slide the top end of the top 10-μμf. capacitor along the coil until the signals peak. Do the same on 15 meters with the next 10-μμf. capacitor and so on down the bands until the last tap is peaked for 75 meters. A little readjustment of all the taps may be needed after the first run, due to some interaction between the connections. Solder the connections and the antenna is ready for use.

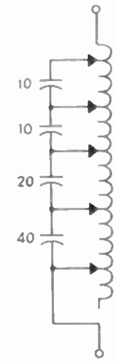


Fig. 9-13—Circuit of the multiple-loaded mobile antenna. The capacitors are in μμf.

— *Rev. Francis A. Peterson, W7RKI*

B.C. BAND HALO

Because I wanted to use my 6-meter halo for broadcast reception I tried connecting the halo to the car b.c. set. Reception was poor and only a few very strong stations were copiable. To remedy the situation, I installed a 400-μμf. ceramic capacitor C_1 between the ground end of the halo and the shield of the coaxial cables a shown in Fig. 9-14. With this arrangement, I am able to receive signals on the b.c. band and still use the antenna for 6-meter operation.

Fig. 9-14—Diagram of the 6-meter b.c.-band halo.

— *Barrie C. Hiern, K5SGP*

CAR BATTERY REMINDERS

Always keep battery terminals clean and tight, because corrosion reduces the charging current supplied to the battery by the charging system.

Periodically check system voltage with a voltmeter to make sure the generator is developing sufficient voltage. Look for excessive voltage drops caused by loose or high-resistance cables.

Check specific gravity with a hydrometer once a month and recharge the battery if necessary. Add distilled water to the battery as required.

Check regulator setting after regulator has come up to operating temperature. Too high a setting of the voltage regulator is damaging to the radio, light bulbs, and ignition contacts. Too low a setting will allow the battery to become discharged

INCREASING VIBRATOR LIFE IN THE ELMAC POWER SUPPLY

Users of the Elmac M-1470 power supply may have noticed excessive sparking in the vibrator. This may be eliminated with a resulting increase in vibrator life by simply changing the buffer capacitors C_{16} and C_{18} from their original value of 0.1 μf. to 0.5 μf. These capacitors should have a 600-volt rating.

— *Harry Stewart, W8PSV*

MODIFYING COMMAND TRANSMITTER RELAYS FOR 6-VOLT OPERATION

When modifying Command transmitters, many hams discarded the seemingly useless antenna relay — the one with two coils and no standard contacts. Fortunately, I saved mine and have since found a good use for the units.

The keying relay for the transmitter is ideally suited for mobile gear because of its compact size and pair of s.p.s.t. contacts, but it won't operate on 6 volts. However, the 300-ohm coil for this relay can be easily replaced with one of the 90-ohm coils from the antenna relay. To complete the transfer, it is necessary to reduce slightly the length of the core for the 90-ohm winding, and this job can be quickly done with a hack saw and file. Removal and relocation of the coils is a simple task because each is held in place with a single flat-head screw.

The modified relay (Fig. 9-15B) really works on 6 volts and draws only 70 ma. or so from the battery. And the compactness involved is enough to catch the eyes of any mobile fan.

— *K. M. Isbell, W6BOQ*

POWER-CONTROL KINK FOR MOBILE OPERATION

In mobile installations using a dynamotor plate supply, the *carry-over* voltage that lasts for a short interval after the dynamotor primary power has been turned off will frequently prevent real rapid break-in operation. This can easily be prevented in installations that employ a d.p.d.t. relay for antenna and plate-supply control by wiring the relay circuit as shown in Fig. 9-16. In this arrangement, R_1 (approximately 100 ohms) is

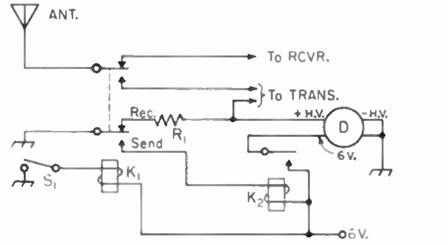


Fig. 9-16—A transmit-receive hook-up that prevents hold-over of the dynamotor output voltage. K_1 and K_2 are the antenna changeover and dynamotor starting relays, respectively. R_1 is the dynamotor grounding resistor (see text) and S_1 is the push-to-talk switch.

connected between the output terminal of the dynamotor and ground whenever the relay is tripped to the *receive* position. This action bleeds the supply output to ground almost immediately.

— *Fred Nazar, W8RNA*

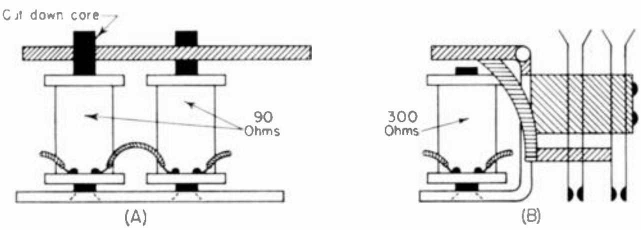
HINT CONCERNING THE KWM-1

Users of the KWM-1 may sometimes have some difficulty when tuning the receiver due to an apparent electrical instability in the tuning mechanism. The trouble usually shows up as an intermittent bubbling sound and requires a rapid back-and-forth movement of the kilocycles control to reduce the trouble.

A small spring contact makes a mechanical connection between the kilocycles control tuning shaft and ground. When this contact becomes dirty or corroded, the above tuning difficulty becomes apparent and seems to be more prevalent when the KWM-1 is used mobile. It is only necessary to clean the contact to cure the trouble. Apply some contact cleaner and lubricant solution such as the General-Cement DE-OX-ID on the connection with an eye dropper or hypodermic needle injector.

— *John Hunt, WØYBE*

Fig. 9-15—Drawings of the Command transmitter relays. The 300-ohm winding of B is replaced with a 90-ohm coil from A in the modification suggested by W6BOQ.



TUBELESS CONVERSION FOR 75-METER MOBILE

Those who have recently acquired a car with 12-volt system may be somewhat staggered at the prospect of acquiring, or modifying, both a receiver and transmitter for 12-volt operation. The following temporary expedient takes care of the receiver and allows one to concentrate his energy and finances on the rig.

Most of the modern auto receivers use an i.f. of 262.5 kc. With the receiver tuned from approximately 1356 to 1606 kc., the second harmonic of the mixer-oscillator beats with 3.5- to 4.0-Mc. signals to provide a 262.5 kc. i.f. All that is needed, then, is an input circuit to match the low impedance of the 75-meter mobile antenna. In the interest of simplicity, it is possible to bypass the r.f. amplifier and to use a fixed tuned, broadly resonant circuit. Sensitivity, as provided by this system, is adequate, and while the selectivity is not all that might be desired, it is not as poor as might be expected.

Parts required are a 100K resistor, a d.p.d.t. wafer switch, and a small coil of approximately 40 microhenries, as shown in Fig. 9-17. The coil

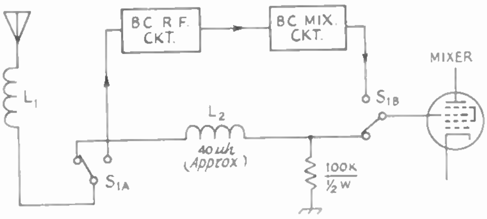


Fig. 9-17—Input circuit for the tubeless 75-meter conversion system suggested by K6YRQ. L_1 is the whip antenna loading coil and S_1 is a d.p.d.t. selector switch. L_2 may be slug tuned, or it may be approximately 85 turns of No. 32 enameled wire close-wound to a length of ¾ inch on a ½-inch diameter form.

should be self-resonant somewhere near 4.5 Mc., as determined with a grid-dip meter. The antenna input terminal of the receiver is fed in series with the coil to the mixer grid, with the 100K resistor for grid leak. This, in effect, forms a pi net, with the input capacity of the mixer tube on the high impedance end, and the capacitance of the coaxial cable from antenna on the low impedance side.

Although many refinements are possible, the system described performs surprisingly well without involving complication or expense.

— *W. S. Skeen, W7EPM*

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Thanks to Don Middleton, WØNIT, for reporting his "150 stations worked" while using a tubeless conversion system. Don coupled his 75-meter mobile antenna *directly* to the *front end* of a Motorola type 75MF (Ford No. FEG 18806-H) receiver. This particular set uses tubes designed to operate with plate and screen voltage supplied directly from a 12-volt storage battery and a transistorized audio section. Tubeless conversion should be of particular interest to amateurs owning this general type of receiver because the sets have no high-voltage plate supply which may be used to power a standard converter.

WØNIT, working along with WØANO and WØCYK, has found out a few other things about tubeless conversion. First, the 75-meter signals may show up at four or five spots on the broadcast receiver dial because of the relationship between the harmonics of the receiver oscillator and the signal frequency. Tuning at the high-frequency end of the dial gives the most band spread.

Secondly, a low-*Q* parallel-tuned trap, tuned to approximately 1560 kc. and connected in series with the antenna lead (inside the receiver), will suppress broadcast signals that otherwise feed through in the 1506.25 to 1606.25 range — the receiver range used to tune the 75-meter signals.

And last but not least is the desirability of using a whip antenna that has been resonated right on frequency. Performance of the tubeless conversion arrangement falls off considerably when the antenna loading coil is only a turn or two off resonance.

— *Ed.*

FORMED PLASTIC WASHERS FOR MOUNTING MOBILE ANTENNAS

It is sometimes desirable to mount a mobile antenna on the fender or rear deck of a car where the body is not flat. Each such installation presents a problem of obtaining specially shaped washers to go between the car body and the antenna mounting surfaces which are always flat. The following method will provide a close-fitting and professional-looking job.

Two thermoplastic (Plexiglas or Lucite) washers about a quarter inch thick and the same diameter as the antenna base are first roughed out with a hack or jig saw. They must then be trued up in a lathe so that the outside rim and the hole are round and concentric. The plastic washers are then placed in a pan of boiling water for a few minutes until they are soft enough to bend. One of the washers is then fished out of the water and immediately placed on the exact spot where the antenna is to be mounted and bent to fit the curvature of the car body at that point. The plastic ring can be handled either by wearing gloves or simply holding it with a dry rag. In a few minutes the washer will cool and set to the shape of the car body. If the underside is the same shape as the top surface, both washers may be shaped from the outside, which is easier.

The washers are then centered in a three- or four-jaw lathe chuck. They are easily centered by trial and error as extreme accuracy is not required here. The convex face of one washer is then turned flat and the concave face of the other one is made flat.

These two washers will now fit against the car body, one inside and one outside, with both external surfaces flat and parallel. The antenna can be mounted on them with a neat fit that would be very difficult to obtain any other way.

— *C. A. Thunen, W6ACT*

MOBILE ANTENNA MOUNTS FOR 144 MC.

The antenna mounting bracket shown in Fig. 9-18 is made from a piece of 0.064-inch aluminum strip. It permits vertical mounting of a quarter-wave 144-Mc. whip and can be easily fastened to the rain trough, above a car door, by self-tapping screws.

The ⅞-inch mounting hole at the top of the bracket will accommodate the base of a Master Mobile 2-meter whip. On the other hand, the bracket may be fitted with a Type 83-1J coax

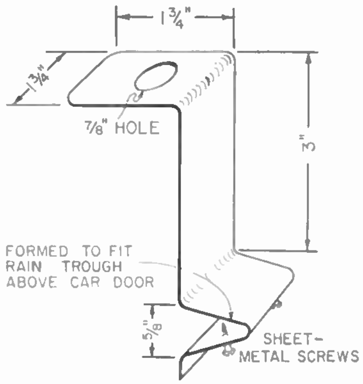

Fig. 9-18—This simple homemade bracket mounts on the rain trough of a car and supports a 144-Mc. vertical whip.

adapter so that a homemade whip, based with a Type 83-1SP connector, can be quickly fastened to the assembly.

Fig. 9-19 shows a more complex but more efficient antenna mount. The base for the assembly, a rubber suction cup such as is used with car-top carriers, is fitted with a brass adapter (homemade) that mates with a Type 83-1T coax "Tee" adapter. The suction cup and the brass insert are fastened together with a flat-head machine screw.

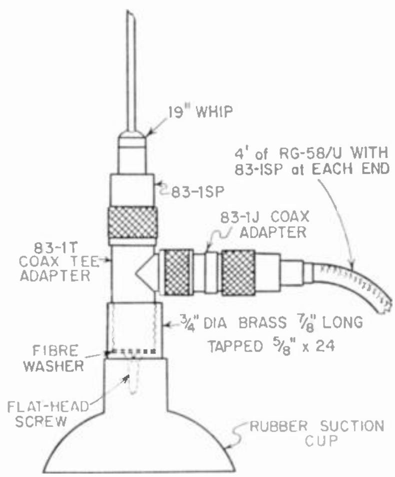

Fig. 9-19—A simple but efficient method of mounting a 144-Mc. whip at the center of a car roof.

The head of the screw is covered with a fiber washer to prevent contact between the screw and the inner conductor of the Tee adapter. If the inner conductor of the Tee is drilled out at the bottom end, it will not be necessary to use the fiber washer.

R.f. power is fed to the center tap of the Tee adapter via a length of RG-58/U cable, a Type 83-1P plug and a Type 83-1J "straight" adapter. The 19-inch whip, equipped with a 83-1SP connector, mates with the top end of the Tee adapter.

Both of the installations are neat in appearance, can be easily mounted on the car, and permit rapid removal of the antenna. When mounting the system shown in Fig. 9-19, it is advisable to apply a thin film of glycerine to the inside of the cup before the latter is fastened to the roof of the car.

Incidentally, a gain in signal strength is evident when changing over from the rain trough to the roof-center mounted antenna.

— Gerald Bagdy, K5KHP

SIMPLIFYING THE "HIDDEN GEM"

The "hidden gem" described in *QST* for March, 1955, is one of those simple but valuable gadgets that will interest all mobileers. Perhaps some of the gang will be interested in a simplified version that I used while touring.

My installation consisted of a 0–1 milliammeter, a crystal diode, a pair of shielded leads and a small r.f. pick-up coil. The meter was mounted on the side of the converter by means of angle brackets and the crystal was supported by a meter terminal. The shielded wires traveled via an out-of-sight route to the trunk of the car and there terminated at a pick-up coil. Fig. 9-20 is a circuit diagram of the set-up.

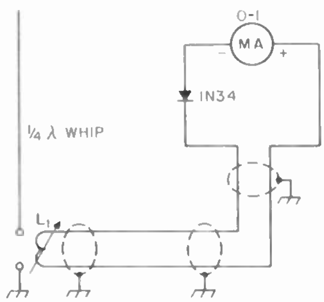

Fig. 9-20—Circuit diagram of the simple field-strength meter used by VE7ASL.

The r.f. pick-up coil, L_1 of Fig. 9-20, should be made with a few turns of stiff wire so that it will be self-supporting. The amount of r.f. picked up by the coil may be adjusted by altering the proximity of the coil with relation to the base of the whip, or by spreading the turns physically. In any event, the adjustment should be one providing about ½-scale reading on the meter when the carrier is unmodulated. A ½-scale reading without modulation allows the meter to deflect still further without pinning when modulation is applied.

— Chas. H. Freeman, VE7ASL

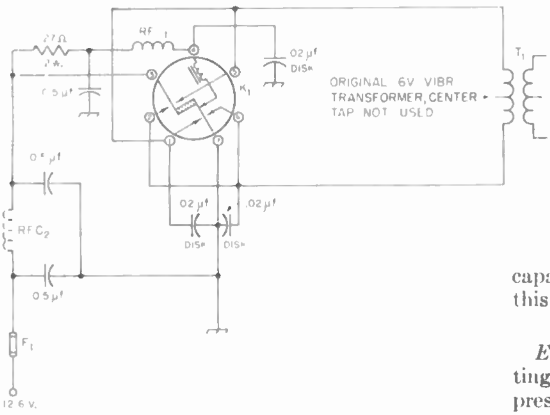

Fig. 9-21—Diagram of a split-reed vibrator as connected into the primary circuit of a 6-volt vibrator supply.

F_1—Fuse rated to suit current drain.
K_1—Split reed vibrator; see text.
RFC_1—7-µh. r.f. choke (Ohmite Z-50).
RFC_2—Approximately 14 µh.: 55 turns No. 12 wire, close-wound on 1-inch diam. form. (Mallory type RF583 has higher inductance and may therefore be more effective.)

USING 6-VOLT VIBRATOR TRANSFORMERS WITH 12-VOLT AUTOMOTIVE SYSTEMS

Now that the 12-volt automotive electrical system has become almost standard equipment, many 6-volt vibrator transformers have become surplus. The following describes a means of using these transformers with 12-volt installations.

It should be understood that the 6-volt transformer has a primary that is actually a 12-volt center-tapped winding. Normally, 6 volts is connected to the tap and the outside ends of the winding are grounded alternately (by the vibrator) to excite first one half and then the opposite half with a pulse of 6 volts d.c. Now, if 12 volts is connected across the entire winding (no connection to the center tap) and the polarity reversed every half cycle, we have essentially the same thing as before. This method of operating the transformer is made possible by the use of the recently designed split-reed vibrator.

The split-reed vibrator is a nonsynchronous type and has a 6-volt driving coil so that universal 6/12-volt units can be built using the same transformer. A series resistor can be used to drop the battery voltage or the coil can be placed in the series-parallel filament ladder so as to provide the required 6 volts. In the average ham installation, the use of a series dropping resistor seems to be the practical solution and a value of 27 ohms (2 watts) will be about the correct value. Fig. 9-21 is the diagram of the primary circuit of a supply using one of the split-reed vibrators. Notice that the vibrator has a 7-pin base. As a result, it probably will be necessary to substitute a 7-prong socket for the one already in the supply. Mallory, Cornell-Dubilier and Oak are some of the concerns that manufacture vibrators that will work in the circuit. The one used in this particular instance is the Oak type V6853. This unit has a reed frequency of 100 cycles and is rated for a maximum current of 8 amperes.

The only apparent disadvantage seems to be that this circuit requires more hash suppression than does the conventional type. However, a good ground for the metal vibrator case and some experimentation with the values of bypass capacitance at the vibrator socket will make this circuit as quiet as any.

— *Laurence B. David, W4YEJ/W4WIS*

Editor's Note: Thanks to K4HEZ for submitting vibrator information quite similar to that presented above. K4HEZ also reminds us (1) that a tube or a metallic rectifier must be added during the installation of a split-reed vibrator if the supply undergoing modification is of the synchronous type, (2) that the Motorola type 48C830082 vibrator is well suited to the job.

USING FILM REELS AS CAPACITIVE HATS

Have you ever tried using a 16-mm. movie film reel as the capacitive hat for a mobile whip? These reels are readily modified for simple mounting, and perform effectively as capacitive loading units. You may even be lucky enough to obtain one or more slightly damaged reels at no cost by visiting a film library or concern that rents home-entertainment films.

In the original form, a reel consists of two round disks joined at the centers by the hub on which the film is wound. Only one of the disks is used for capacitive loading purposes and, as a result, the reel should be split into two sections by removing the hub. Enlarge the hole at the center of one of the disks to accommodate a bushing or other suitable hardware, slip the assembly down over the top section of the whip, and you are in business.

This idea was actually suggested by W5YZL. It has worked out so well in practice that I thought it worth passing along.

— *E. V. Blaize, jr., W5TVW*

[Editor's Note: See "Top Loading Capacitance," *The Radio Amateur's Handbook*, Chapter 19, for additional data on capacitive hats and the effects of capacitive loading on loading coil inductance.]

TUNING THE HELIWHIP TO FREQUENCY

Many of us would like to tune the "Heliwhips" to frequency but don't like the idea of unwinding turns to raise the frequency of resonance. Tuning can be done very easily by winding a sleeve of aluminum foil so that it covers a few turns at the bottom of the tightly wound portion of the whip. After the correct number of turns have been covered, wind plastic tape over the foil for protection.

If the desired frequency is lower than the natural resonant frequency, tape containing ferrous material, such as audio recording tape, might be tried. — *Milford W. Noe, W6IMW*

IMPROVED PUSH-TO-TALK CIRCUIT FOR MOBILE OPERATION

Many mobile operators who parallel the receiver-disabling and antenna relays with the push-to-talk control experience trouble with momentary receiver overload each time the transmitter is turned off. This is caused by dynamotor "coasting" which keeps the transmitter energized for a brief period after the receiver has been activated. Although the problem can be licked by using the system described by W8RNA on page 102, there is a somewhat simpler solution that requires no *bleeding* of the dynamotor.

The control circuit used here at W3HXY has the antenna and receiver changeover relays connected in parallel with the *input* terminals of the dynamotor. After the push-to-talk control has removed input voltage from the dynamotor, the "coasting" action causes the generation of approximately 6 volts (12 volts with a 12-volt system) across the input terminals. By wiring the relays — antenna and receiver — directly across the input terminals, the relays remain energized until the dynamotor has coasted to nearly a full stop. Thus, the receiver does not come *alive* until after the transmitter signal has *died* away.

— *Roy W. Shetler, W3HXY*

PUSH-TO-TALK CONTROL OF MOBILE CHARGING RATE

Many of the newer automobiles with automatic transmissions have, coupled to the shift lever, a pair of contacts which prevent operation of the starter solenoid whenever the transmission is in the "drive," "low," or "reverse" condition, but which close when the shift lever is placed in the "park" or "neutral" position. It is convenient to wire a d.c.-operated solenoid through this safety contact and the transmitter push-to-talk relay contacts, with the solenoid arranged to open the throttle lever on the carburator slightly when energized. When parked, this has the effect of allowing the engine to idle normally during the receive condition, and increasing engine speed for charging purposes by any desired amount while the transmitter is on the air, offering an improvement in the automotive system voltage regulation and reducing noise (both electrical and acoustic) over that which would exist if the engine were operated with an open throttle during both transmitting *and* receiving periods. When the car is in motion, the safety contacts on the shift lever disable this control system to prevent interference with the driver's control of engine speed.

— *Richard A. Schomburg, W7WUM*

MORE ABOUT GENERATOR NOISE

Worn and otherwise defective generator bearings have been identified as a source of electrical interference. In a mobile installation here, the receiver was bothered by a raspy type of noise that sounded similar to power-line leakage. It was present on all bands and, at times, seemed to build up and discharge with a sawtooth characteristic. Breaking the field and the armature connections to the generator did not appear to affect the intensity of the noise. However, the replacement of a worn bearing did completely eliminate the interference. A probable explanation is that the generation of static electricity was greatly reduced by the repair.

— *Joseph E. Stuckey, W4HCV*

10. Hints and Kinks . . .

for Test Equipment

IMPROVED R.F. SAMPLER

HERE is an idea that should be of interest to hams who have oscilloscopes and are puzzled about a convenient way to sample the r.f. output of their transmitters for checking modulation or keying characteristics.

The *Handbook* indicates that the r.f. sample may be secured by a pickup coil in the field of the amplifier tank. This is not the most convenient setup, especially for those who have completely shielded transmitters with coax output.

It has been found that five turns of No. 3014 B & W Miniductor can be placed in series with the coax transmission line without materially changing impedance characteristics. Around the Miniductor is a 5-turn link made from the end of a length of small coax. The coil and link are in a 4 × 2¼ × 2¼-inch Minibox with coax fittings. The link coax leaves the box via a grommet.

Shown in Fig. 10-1 is the resonant circuit, a multiband tank circuit in a separate Minibox. Each of the two tank coils is associated with a 4-turn link. The vertical plates of the scope are connected to the multiband tank. The scope is not grounded.

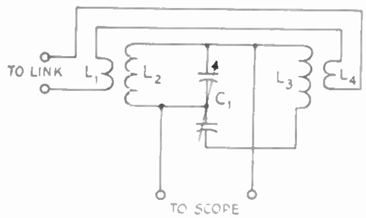

Fig. 10-1—Multiband circuit used with an oscilloscope to observe r.f. wave forms.

C_1—Midget dual variable capacitor 140-μμf.-per-section.
L_1, L_4—4 turns each wound in series over L_2, L_3.
L_2—22 turns No. 18 enam., 1-inch diam., close-wound.
L_3—8 turns No. 18 enam., 1-inch diam., 1 inch long.

Adequate display heights are secured at resonance with power as low as 50 watts and for higher power the tank capacitor can be detuned as necessary.

The Minibox that houses the tank circuit also houses the potentiometer, resistors and capacitor associated with the usual circuit for securing a trapezoid modulation pattern. Thus the setup is convenient for observing modulation patterns and keying characteristics at any time.

Incidentally, connection of r.f. directly to the vertical plates is not recommended for some of the low-priced kit scopes. With these scopes, feed the plates through .005 ceramic capacitors, and connect the plates to the scope circuit through 1-megohm resistors. This can be done at the rear of the scope with a mounted lucite strip, six binding posts and two jumpers.

—*Cecil W. Guyatt, K3ABN*

LINK-COUPLING TO THE GRID-DIP METER

ALTHOUGH this idea may be "old stuff" to many, it was a new and handy stunt here.

In putting some new coils in a bandswitching transmitter, it was found desirable to check their frequency coverage. Unfortunately, there was no way to get at the coils with the meter without disassembling the rig. The solution was link-coupling. I made a flexible link out of a piece of 300-ohm Twin-Lead about 15 inches long with a single-turn loop at each end. The exploring end has a loop about two inches in diameter and the other end has one just big enough to slip over the coil of the grid-dipper. By opening up a small crack in the shielding, it was possible to maneuver the inner end of the link into position against the coil to be measured and the meter then performed just as well as though it were coupled in the usual manner.

Twin-Lead is ideal for this purpose as it is stiff enough to be manipulated readily from the outside but can be bent at any angle necessary to reach the most difficult location. On the lower frequencies, two or more turns at each end of the link may be needed to provide sufficient coupling.

—*Cyrus T. Read, W9AA*

THE GRID-DIP METER AS AN AID TO CRYSTAL GRINDING

Recently, while grinding some war-surplus crystals into the 7-Mc. band, it became obvious that most of the elapsed time had been spent mounting and unmounting the crystals so that activity and frequency checks could be made. In an attempt to do away with as much of this extra work as possible, we devised a practical and time-saving method that involves the use of a grid-dip meter.

When using the grid-dip meter, it is first necessary to unmount the crystal from its holder and then insert it into the coil covering the frequency range under consideration. The grid-dip meter is then tuned for a dip at the crystal frequency and the amount of dip is noted as a criterion for checking crystal activity during the grinding process. The initial steps being concluded, brawn, elbow grease, grinding compound and the other necessary ingredients are brought into play for the actual grinding. Whenever enough grinding has been done to warrant a frequency and activity check it is only necessary to wipe off the crystal, then insert it into the grid-dip meter coil. Depending on which side the crystal frequency is approached from, the meter may either dip gradually or suddenly as the frequency is approached. Most crystals will exhibit a gradual dip from the high-frequency side of resonance. The frequency of maximum dip is the crystal frequency and the amount of dip as compared with the initial standard earlier established determines the relative activity of the crystal. In either case use standard crystal-grinding technique to approach the desired frequency or to improve crystal activity. Most grid-dip meters are not sufficiently well-calibrated for precision accuracy but once the desired frequency is approached more accurate measurements can be made by checking the meter against a communications receiver. In following this practice, the meter is again tuned for maximum dip, the calibrated receiver is tuned to zero beat with the meter and the frequency read directly from the receiver dial.

Conversely, the calibration of a grid-dip meter can be checked with crystals of known frequencies. It is only necessary to insert an unmounted crystal of known frequency within the inductive field of the appropriate coil. Maximum dip of the meter indicates resonance with the crystal. The ham who possesses a number of surplus crystals with odd frequencies which cannot normally be applied to amateur radio practices can make good use of these crystals by mounting them permanently, minus holders, in the appropriate grid-dip meter coils. Two crystals mounted within one coil, with frequencies near the lower and upper limits of the range under consideration, or in close proximity to the most used frequencies, afford a number of check points for determining meter accuracy. If, for instance, we are measuring the resonant frequency of a coil, unless the coil is kept a sufficient distance from the grid-dip meter, it may alter the meter calibration. In such a case, the accuracy of the instrument can rapidly be checked against the crystal and if the calibration has been altered, the amount of deviation can be determined from the crystal check and applied toward the actual measurements being made.

The quartz crystal being of a nonconducting substance will, of itself, have no effect on the calibration of a coil within which it is mounted. Care should be used in determining which is the crystal dip and which is the resonant circuit dip in cases where a circuit whose frequency approaches that of the crystal is being measured. In cases where the circuit under consideration is of the same frequency as the crystal, resonance will be indicated by a further dip of the meter.

Depending on the relative sensitivity of the grid-dip meter being used, the crystal can be placed on either the outside or the inside of the coil. Maximum meter reaction will be had by using the outside method of mounting, while the inside method is more suited for a permanent job. The crystal, minus holder, is attached to the coil with a small amount of Duco or similar cement. The crystal frequency as noted from the holder is marked on the grid-dip meter coil. It may be advisable to adjust the crystal into a position giving the amount of dip desired prior to applying the cement. — *Alvar J. Kent, W1KJO*

USING A TV RECEIVER TO CHECK GRIP-DIP METER CALIBRATION

I recently completed a kit-type grid-dip oscillator and wanted to check oscillations at the high-frequency end. The unit was designed to oscillate up to 250 Mc.

It occurred to me that the home TV set might be used to check frequencies up to 216 Mc. (Channel 13). So I turned on the grid-dip unit and the TV set. The grid-dipper was rested on top of the TV set and Channels 2 through 13 were turned on in succession. For each channel the grid-dip frequency dial was appropriately set, using the correct plug-in inductance.

It was observed that both sound and picture were distorted when the grid-dipper was tuned through the appropriate range of frequencies for each channel. It is not necessary for a station to be operating in order to perform a quick check on any channel. As long as any kind of raster can be seen, the disturbance caused by the grid-dip oscillator will be readily seen.

This simple test actually serves two purposes: first, it shows the presence of oscillation from about 50 to 216 Mc. Second, it indicates the accuracy of dial calibrations of the instrument tested.

This same method can be used to check other types of oscillators operating in to 50- to 216-Mc. range.

— *Paul Goldman, K2GKU*

[Editor's Note: Frequencies of oscillation below 50 Mc. can probably be checked quite accurately by the above method as long as the oscillator output contains harmonics falling in the TV range. The BCI and TV chapter of *The Radio Amateur's Handbook* lists the frequencies of TV Channels 2 through 13 and explains how the frequencies of the picture and the sound carriers may be determined.]

R.F. ISOLATOR FOR D.C. METERS

OCCASIONALLY, fellow amateurs have come to me with d.c. meters that were in need of repair. It appeared that many of these meters were damaged by large overdoses of r.f. The owners reported that the readings weren't always consistent even when the meters were working. The reason for this inconsistency was probably the same — r.f. getting into the instrument.

The device shown in Fig. 10-2 will enable the user to measure safely d.c. voltages in circuits where r.f. voltages are present. It will also minimize the loading effect on the circuit by the meter.

The isolator consists of a series isolating resistance built into a probe and bypassed for r.f. When the probe is used with a sensitive d.c. current meter the series resistance can be calculated by using the following formula:

$$\textit{Resistance}\ (\text{megohms}) = \frac{\textit{full scale voltage desired}}{\textit{full scale current value of the meter}\ (\text{in}\ \mu\text{a.})}$$

Use two or three resistors in series to make up the total resistance; this will provide a longer r.f. leakage path. For good r.f. isolation, ranges which require a series resistance of less than one megohm should be avoided. If a v.o.m. is used, it is easier to choose a scale that is already calibrated so that the voltage may be read directly from the old scale. I use the 0- to 60-μa. range on my v.o.m. so that a 2-megohm resistor gives a 0- to 120-volt d.c. range.

— *Stuart E. Bonney, W8JUV*

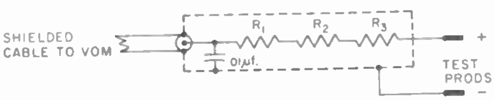

Fig. 10-2—Diagram of the r.f. isolator. Resistors R_1, R_2 and R_3 should total the value found by the formula in the text.

IMPROVISED R.F. SNIFFER

CONVENTIONAL vacuum tube voltmeters can be used for antenna coupling and tuning adjustments simply by switching to the a.c. voltage range and plugging a loop of wire into the a.c. input jacks. The loop acts as an r.f. pick-up and the induced r.f. is rectified by the diode in the a.c. circuit. — *Frank D. Witmer*

AUDIO FREQUENCY TEST SIGNAL WITHOUT AN AUDIO OSCILLATOR

IF AN audio generator is not available when next needed, or should the one on hand deliver inadequate or badly distorted output, try the system used here at W2ZZG.

A good sine wave, as indicated by an oscilloscope, is obtained by feeding the v.f.o. signal into a communications receiver operated with the b.f.o. turned on. Audio output for test purposes is taken from the last stage of the receiver, and the amplitude of the signal is regulated by the audio gain control. Signal frequency is varied by regulating the b.f.o. control.

Naturally, the stability of the v.f.o. and the receiver play an important part in determining the stability of the audio test signal. Furthermore, coupling between v.f.o. and receiver should be tight enough to mask out any noise that leaks into the front end of the receiver, but not so tight as to overload its r.f. amplifier. By experimenting with the input coupling, and by keeping the r.f. gain *down* in the interest of linearity, it is usually possible to end up with an audio output signal that looks quite good on the face of a scope.

Although the equipment used here is not calibrated in terms of audio frequency, the frequency of the test signal can be intelligently estimated. In any event, the signal obtained is a lot more favorable for many jobs than is the frequently interrupted WWV signal used by some as a source of audio. — *Arthur H. Pedley, W2ZZG*

A BAND-EDGE MARKER

A FOOL-PROOF band-edge marker can be made very simply by using quartz crystals and a neon bulb. When the v.f.o. tunes across the frequency of either crystal, the neon bulb will flash, indicating the edge of the band. Crystal Y_1, can be chosen for the low edge and Y_2, for the high edge of the band. However, it is well to remember that if too many crystals are connected in parallel the holder capacity will pass a signal of any frequency.

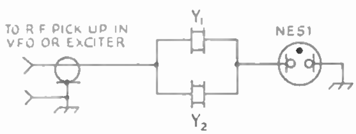

Fig. 10-3—Diagram of the band-edge marker.

The pick-up for the radio frequency voltage can be a short piece of wire placed near a hot tank circuit in the v.f.o. or exciter. Of course, the r.f. field must be strong enough to provide sufficient voltage at the terminals of the neon bulb to light it.

— *John Grindon, W0UVX/9*

SHIELDING DUMMY LOADS

WHILE checking a new rig I connected a dummy load (a 25-watt lamp) to the transmitter. During the checks I heard an out-of-town station calling CQ. I was still using the dummy antenna on the transmitter but since I was tuned up on his frequency I gave him a call just for fun. Not only did I make the contact but I also received a good report!

A later check with a field-strength meter indicated an extremely strong r.f. field around the lamp. I applied several coats of conductive paint (Television Tube Coat, General Cement No. 49-2) to the glass envelope around the lamp, leaving a small ¼-inch circle to allow observation of lamp brilliance. After this coating, the field-strength meter gave only a slight reading a few inches from the dummy load. Now, the lamp makes a good dummy antenna.

— *Harrison A. G. Stone, K2LIF*

TUNED R.F. PICK-UP CIRCUIT FOR OSCILLOSCOPES

This is an idea that should interest those who use an oscilloscope for making modulation checks. The stunt is that of using a simple multiband tuner as the r.f. pickup for the scope. Use of the system requires no *direct* connection to the audio or r.f. stages of the transmitter undergoing test, and provides ready adjustment of the input to the oscilloscope to compensate for changes caused by band changing, power input differences, etc.

A short r.f. probe or antenna is used with the multiband tank as shown in Fig. 10-4. This probe or antenna may have to be inserted an inch or two into the transmitter housing if the power is low and the rig well shielded. Output from the tuner is connected directly to the vertical plates

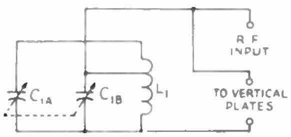

Fig. 10-4—Circuit used by W7KLE for feeding r.f. to the vertical plates of an oscilloscope.

C_1—Receiving-type dual variable, 140-μμf. per section.
L_1—Approximately 13.5 μh.: 25 turns No. 20 tinned, 1⅜-inch diam., 1⁹⁄₁₆ inches long, tapped at 9 turns from end connected to C_{1A}.

of the scope. *Warning — High Voltage* is applied to the vertical plates, so make the connections with the scope turned *off*.

The tuner was made from junk-box parts and covers all frequencies in the 3.5- through 28-Mc. range. When using the circuit, the height of the r.f. envelope on the scope tube may be controlled by adjustment of the position or the length of the pickup antenna, or by tuning C_1 either to exact frequency or slightly off resonance.

As is the case with other multiband tanks, this one will tune 3.5 and 14 Mc. with C_1 set well toward maximum capacitance. Resonance at 7 and 28 Mc. will occur with C_1 adjusted toward minimum capacitance, and 21 Mc. will show up with about one third of the total capacitance in use. — *Floyd X. Passmore, W7KLE*

PROTECTION FOR VOLT-OHM-MILLIAMMETERS

Many of us who make frequent use of a general-purpose test meter will, at one time or another, inadvertently apply voltage to the terminals of an instrument having the function or selector switch set at the *ohms* position. This act of negligence may result in a burnt-out multiplier shunt, a new configuration for the pointer or even more serious damage to the meter movement.

The installation of a fuse as a preventive measure against this mistreatment of a meter is not always desirable or completely effective. The resistance of low-current fuses may not be too uniform and, in some cases, the resistance — whatever it happens to be — is great enough to affect the calibration of the *ohms ranges* of the instrument.

A more positive protection for a meter may be obtained by connecting a No. 14 flashlight lamp in series with the internal shunts. It has been determined that the resistance of these 2.5-volt 0.3-amp. bulbs checks consistently at very close to one ohm. Therefore, once the meter circuit has been modified to include a bulb, it is possible to make replacements in event of failure without concern over variations in calibration.

Fig. 10-5 shows how a No. 14 bulb has been connected into a typical general-purpose test meter.

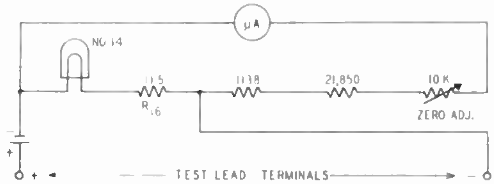

Fig. 10-5—Protective arrangement for volt-ohm-milliammeters suggest by W9AFT.

The circuit and constants shown are for the popular Simpson type 260 meter. The 1-ohm resistance of the bulb is compensated for by removing approximately 2 inches of resistance wire from the 11.5-ohm shunt (R_{16} of the Simpson circuit). Usually, it is possible to find mounting space within the meter case for a socket for the bulb. This method of installation simplifies the changing of a burnt-out lamp.

Any voltage applied to the *ohms* terminals that is lower than the *burn-out* rating of the bulb will not cause damage to the meter shunts. At higher values of voltage, the bulb will burn out even before the pointer can deflect to full scale. It should be pointed out that *all* resistance ranges of a circuit of the type shown are protected by this simple installation.

— *Harlon Wright, W9AFT*

IMPROVED MOUNTING FOR GRID-DIP METER COILS

Grid-dip meters that use a fiber socket for mounting the plug-in coils frequently perform erratically after prolonged use because of socket failure. One method of making a simple repair is to thread a pair of binding posts into the original socket prongs. The Eby-type bakelite binding post having a 6–32 threaded stud is best for the job. The eye in each post can be enlarged with a drill to accommodate the prongs of the coils.

Usually, it is not necessary to take the meter apart while making the modification. If the coils are more difficult to couple to the new mounting position (they will now protrude out at right angle to the meter case), the condition may be remedied by using link coupling as described by W9AA on page 107.

One thing for sure: The new mount will be more rugged than the original so long as the binding posts are threaded securely in place.

— *Warren Smith, KH6WW*

USING THE HEATHKIT AM-2 REFLECTED POWER METER AS A MODULATION MONITOR

This simple modification to the Heathkit Reflected Power Meter makes it possible to use the instrument as a modulation monitor. The only additional part required is a closed-circuit jack. The modification consists of inserting the closed-circuit jack in the lead that comes from the center lug of the potentiometer, as shown in Fig. 10-6. This lead should go to the contact on the

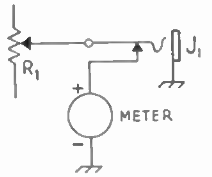

Fig. 10-6—Circuit showing modifications to the power meter. The meter and R_1 are components already existing in the unit. J_1 is a closed-circuit jack.

jack that mates with the tip of the headset plug. The switch terminal of the jack goes to the plus side of the meter. When the headset is removed from the jack, operation of the power meter returns to normal. When the meter is used for a modulation monitor, the potentiometer controls the audio level in the headphones.

— *Emil P. Sulkosky, K1HSR*

V.T.V.M. POWER SUPPLY FOR THE G.D.O.

Here is a possibility of turning the tables that some amateurs may not have thought of.

Since a vacuum-tube voltmeter can be used as the indicator for a homemade grid-dip meter, it is only logical that the power supply for the v.t.v.m. be used to furnish power for the g.d.o. Seems fair enough doesn't it?

— *Luke McCloud, K2DDM*

ADDITIONAL USES FOR THE S METER

Using the S meter of the station receiver with external leads for certain measurements is not new, but the value of the trick is certainly enhanced when the available meter is of the microampere type. While the fact does not seem to be too widely known, several types of Hammarlund receivers carry a 200-microampere unit, including the HQ-129X, SP-100X and military equivalents. A meter of this rating is ideal for g.d.o., v.t.v.m., f.s. measurements, etc. In the case of the SP series, the meter is rather easily removed and replaced.

— *Otto L. Woolley, W0SGG*

USING B. C. SIGNALS FOR HAMBAND CALIBRATION

An old-timer passed his idea on to me and possibly it may help some of the other fellows. The stunt is that of using a broadcast-station signal as a frequency standard for making calibration checks in hambands. Here is how the idea is put into practice.

First determine which b.c. stations would have harmonics — if they were not suppressed because of FCC regulations — that fall in the hambands. For example, here in Indianapolis we have the following combination to work with:

Station	*Fund. Freq. Kc.*	*Harmonic Kc.*
WLW	700	5th — 3500
WLW	700	10th — 7000
WISH	1310	3rd — 3930
WIRE	1430	5th — 7150

Next, using an r.f. signal generator and a receiver with the b.f.o. turned off, zero beat the generator with the b.c. signal. Leave the generator set as it is and tune the receiver — with the b.f.o. turned on — across the ham-band undergoing calibration. When the harmonic of the generator has been found, turn off the b.f.o. and zero beat the v.f.o. (or other r.f. generating device under test) with the generator harmonic.

Since the b.c. stations operate with a very close frequency tolerance, this method should provide a dependable frequency check.

— *Albert Szalay, W9CKD*

POWER-REDUCTION HINTS FOR S.W.R. BRIDGE MEASUREMENTS

One of the problems frequently encountered in making s.w.r. measurements is that of reducing transmitter power output to a level low enough to prevent damage to the bridge. In installations where there is no existing means of controlling output from the amplifier, it is possible to control the power to the bridge by means of the simple system shown in Fig. 10-7. In this arrangement, most of the output from the transmitter is dissipated in the 52-ohm dummy load

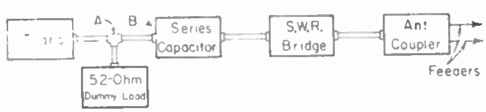

Fig. 10-7—A simple arrangement for reducing power during s.w.r. measurements. A is a "T" coaxial-cable coupler and B is a variable capacitor with a range of approximately 0–100 $\mu\mu$f.

and a portion of the remaining power is fed to the bridge through a variable capacitor.

The dummy load must be capable of dissipating nearly the full output from the transmitter. It should be shielded and equipped for coaxial-cable input. The variable capacitor should also be enclosed in a metal compartment and should be terminated with coax connectors. A standard "T" connector and short lengths of coax may be used for making connection between the transmitter, dummy load and variable capacitor.

When using this method of power reduction, the bridge is inserted in the transmitter output line in the usual manner. Then adjust the variable capacitor for normal reflection of the s.w.r. indicator and proceed as you would with any other set of adjustments or measurements.

— *John W. Stack, W5QQY*

WWV ON THE NATIONAL NC-300 RECEIVER

The 10-Mc. signal transmitted by WWV may be received on the Type NC-300 receiver as follows:

Clip a 330-μμf. capacitor from the stator of the high-frequency oscillator section of the main tuning gang (front section) to the chassis. Set the antenna trimmer to minimum capacitance and tune across the 40-meter band until the 10-Mc. WWC signal is heard.

This is a somewhat unconventional method of using the receiver, but it provides an economical and simple means of beating a crystal calibrator against WWV for insurance of accuracy.

— *Robert J. Murray, W1FSN*

100-KC. MARKERS FROM A 50-KC. SECONDARY FREQUENCY STANDARD

A secondary frequency standard described in *QST* for July, 1954, duplicated for use here at W5RSH, has been modified so that either 50- or 100-kc. harmonics may be selected. Although the 50-kc. markers are extremely helpful for many types of measurements, there are times when an unknown frequency, or a band edge, can be more quickly identified if the standard frequencies are spaced no less than 100 kc. apart. Unless the 100-kc. points can be definitely established, there is a possibility of a measurement being inaccurate by at least 50 kc. or more.

The circuit of the modified standard is shown in Fig. 10-8. Notice that except for the addition of R_1 and S_1, the circuit is identical to the original. Also observe that the resistor and the switch may be added without requiring any alteration to the basic circuit. The functions of the new components are as follows:

With S_{1A} closed, L_1 is shorted and the circuit takes on the appearance of the more familiar 100-kc. standard. With L_1 shorted, crystals cut for 100, 200 and 1000 kc. will oscillate in the circuit, but the activity of the crystals leaves something to be desired. However, crystal activity can be raised to normal by reducing the value of the cathode bias resistor for the 6AK5. This is easily accomplished by means of R_1 and S_{1B} of Fig. 10-8.

If the circuit has been adjusted to zero-beat against WWV for accurate 50-kc. markers, it is probable that the 100-kc. (or higher) harmonics will be slightly *off* frequency when the circuit is switched over. This slight error is of no consequence provided the calibration using 100-kc. markers is rechecked with the aid of the more accurate 50-kc. frequencies.

— *Clark A. Chamberlain, W5RSH*

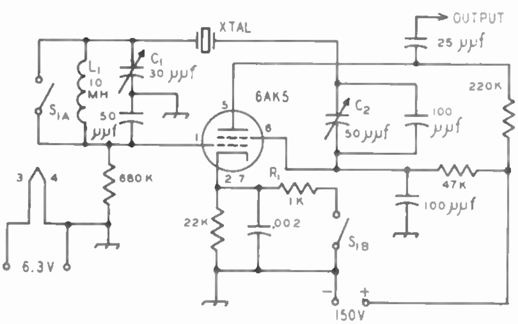

Fig. 10-8—Circuit diagram of the modified 50-kc frequency standard. All resistors ½ watt. All capacitors less than 0.002 μf. are in μμf.

C_1—30-μμf. ceramic trimmer.
C_2—50-μμf. ceramic trimmer.
RFC_1—10-mh. r.f. choke (National R-100S).
S_1—D.p.s.t. switch.

RECORDING OSCILLOSCOPE TRACES WITH A GREASE PENCIL

The grease pencil recording technique won't replace the oscilloscope camera, but it does provide a very satisfactory means of making permanent records of many of the waveforms observed on the ham shack oscilloscope. The procedure is to carefully trace out the waveform, marking on the face of the c.r.t. with a grease pencil (China-Marking Lead). Then place a sheet of paper on the face of the c.r.t. and transfer the grease pencil markings to the paper by briskly rubbing over the traced region with your fingernail. The record obtained will be a mirror image. If a real image is desired, use the same technique to transfer the mirror image to a second sheet of paper.

— *Donald F. Hemenway, W3SQP*

INCREASING AUDIO OSCILLATOR RANGE

Here is a method for extending the range of an audio oscillator to cover the supersonic range between 20 kc. and 120 kc.

As shown in Fig. 10-9, the crystal rectifier produces a half-wave rectified voltage rich in harmonics. No difficulty has been experienced in generating 100 kc. signals (5th harmonic of 20 kc.) from a Hewlett-Packard 205 type oscillator even at levels far below its 5-watt output rating.

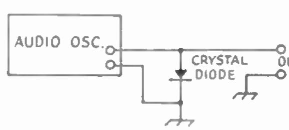

Fig. 10-9—Illustration showing W2LID's method for Increasing the range of an audio oscillator.

One of the most useful functions of this arrangement is the provision of a signal source to aid in the alignment of low frequency i.f. amplifiers.

— *D. J. Gagne, W2LID*

BAND-SPOTTER WAVEMETER

A FREQUENT infraction of the rules governing amateur operation is harmonic radiation outside the amateur bands. The device described here is a series of fixed-tuned absorption wavemeters tuned to the various harmonically related amateur bands. With the transmitter operating, the units are advanced toward the transmitter tank circuit (See Fig. 10-10) until one of the indicating lamps begins to light. If more than one lamp lights up, it indicates that harmonic energy is present and should be suppressed.

Fig. 10-10—Band-spotter wavemeter.

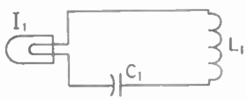

Fig. 10-11—Band-spotter wavemeter. The indicator lamp I_1 is a No. 47 pilot lamp. C_1 is ceramic or mica.

Band	C_1 ($\mu\mu$f.)	L_1	Length
80	100	45 turns No. 28 enam.	5/8 in.
40	47	29½ turns No. 26 enam.	½ in.
20	25	20½ turns No. 24 enam.	½ in.
15	20	18 turns No. 20 enam.	1 1/16 in.
10	10	15 turns No. 22 enam.	½ in.
7.5	10	10 turns No. 22 enam.	½ in.
6	10	9 turns No. 22 enam.	9/16 in.
5	10	6½ turns No. 22 enam.	½ in.
3	5	5½ turns No. 20 enam.	½ in.

Each unit of the wavemeter is built into a plastic tube, such as a pill container, that measures about 9/16 inch o.d. and 2 inches long. A coil is wound on one form and a capacitor is connected

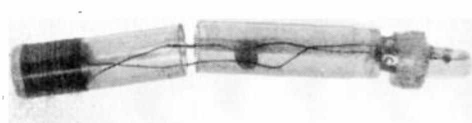

Fig. 10-13—View showing make-up of one of the tuned circuits.

as shown in Fig. 10-11. A second plastic case with its bottom cut off to form a tube is held in position while the two leads from the tuned circuit are soldered to the pilot lamp (See Fig. 10-13). Make the leads as short as possible. Cut the plastic cap that comes with the container so that the pilot lamp will make a tight fit when it is inserted in the cap. After the unit has been checked for resonant frequency, the containers are cemented together and the cap containing the lamp is installed. Each of the individual units are then spot-cemented together to form a single multiple unit.

Remember, these units are harmonic band spotters only, and are not to be used as frequency meters. Be careful when using the wavemeter around high-voltage circuits in the transmitter.

— *Lee F. Worthington, K4HDX*

ANTENNA R.F. INDICATOR

RELATIVE amount of r.f. energy at the antenna can be indicated by a fluorescent lamp taped to the antenna wire at a voltage loop. For a half-wave antenna, this point is at either end of the antenna. Of course, this scheme is only useful to those who can observe the lamp from the shack, although a system of mirrors could be set up for this purpose.

One word of caution: don't be surprised when neighbors report sighting a strange light — the fluorescent lamp can be observed for miles!

— *R. H. Sweeny, W1VEQ*

INCREASING SENSITIVITY OF NEON BULBS

IN the course of tracking down parasitics in a new rig, I had need for a more sensitive indicator than the usual neon bulb. It was remembered that in some radar units a "keep-alive" voltage was used to keep the gas in the "TR" boxes ionized, and the following scheme was evolved to apply a similar voltage to a neon tube.

A half-megohm potentiometer was used to form a voltage divider by connecting the outside terminals of the potentiometer across the 115-volt a.c. line. Then a small neon bulb (NE-2, ¼-watt, resistorless) was connected between the tap on the potentiometer and one side of the line. Thus, by turning the potentiometer, the voltage across the neon bulb can be varied until it is just *below* the point at which the tube glows. In this condition, very little additional voltage is needed to cause the bulb to glow, and a very sensitive indicator results.

The neon bulb can be mounted at the end of a 4- or 5-inch length of bakelite tubing, which then serves as a probe with which to dig into out-of-the-way places inside your rig. The leads to the bulb can be run inside of the tubing.

In addition to being a simple gadget to construct, this little indicator has the advantage of being very sensitive to r.f. fields, yet it is discriminative enough to enable one to pick out the "hot" lead in a crowded chassis.

— *Robert A. Brown, W8COS*

FEED-LINE CONTINUITY AND SHORT-CIRCUIT CHECKER

When installing a beam of the split driven-element variety I always connect a 100,000-ohm, ½-watt resistor across the element at the antenna as shown in Fig. 10-14. Installation of this inexpensive component enables me to check continuity or shorts in the feed line at any time by measuring the resistance of the feed line with an ohmmeter. Any value over 100,000 ohms means a break somewhere in the feed line or a bad connection at the driven element. Any value

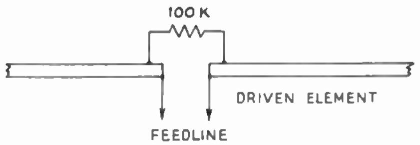

Fig. 10-14—W9DGV's feed-line checker.

less than 100,000 ohms indicates a short. Insertion of the resistor does not affect the performance of the antenna system.

—John E. Greve, W9DGV

MEASURING-CUP BAND SPOTTER

It is not necessary to build or buy an elaborate frequency meter for most amateur purposes, especially when the transmitter is crystal-controlled. Much simpler means can serve the purpose just as well. For example, you could hardly want a simpler circuit than that shown in Fig. 10-15. And as the photographs show, the construction is equally simple. Assembled in a 15-cent measuring cup, this gadget will go a long way toward filling the initial frequency-measuring needs of the Novice licensee. It will also serve the

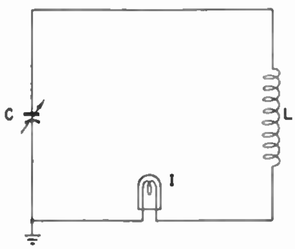

Fig. 10-15—Circuit diagram of an absorption wave-meter covering the 3.4- to 15-Mc. range

C—300-$\mu\mu$fd. variable (National ST-300).
L—22 turns No. 20 wire, 1-inch diam., 1⅜ inches long (B & W Miniductor No. 3015).
—60-ma. dial lamp (pink bead) mounted in bayonet-type bracket (Johnson 147–630).

old-timer in many ways when he builds or adjusts transmitters in any ham band from 3.5 to 14 Mc. The cost of the entire unit is less than five dollars, and this figure can be reduced by over fifty per cent if you happen to have a suitable tuning condenser in your junk box.

The measuring-cup wavemeter is nothing more than a tuned circuit covering 3.4 Mc. to 15 Mc.

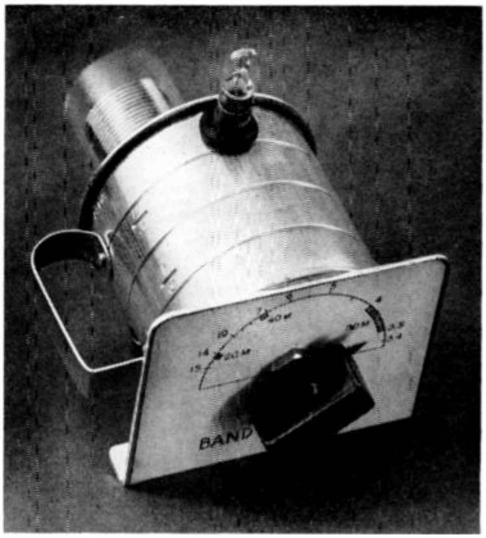

Fig. 10-16—One of the handiest "tools" in ham radio is the absorption wavemeter. This unit, built around an aluminum measuring cup, is designed to fit the requirements of the Novice licensee or old-timer. Construction is simple—the entire assembly is held together with one nut.

with a flashlight bulb in series with it to serve as a resonance indicator. When the coil in the wavemeter is coupled to a transmitter delivering anything from a few watts of r.f. up to a kilowatt and the capacitor is tuned so that the wavemeter is resonant at the frequency of operation, the lamp will light. The unit is calibrated so that the frequency at which the power is being generated is read directly from the dial.

Construction of the wavemeter is extremely easy. The measuring cup is used to provide support for the tuning capacitor and the calibrated dial, incidentally providing a mounting for the indicator lamp and a handle for the entire unit. The lamp is insulated from the cup by mounting it in a grommet-lined ½-inch hole drilled at the top where it will not interfere with the rotation of the plates of the tuning capacitor. The calibration scale is pasted to the face of an aluminum bracket measuring 3½ inches wide and 2⅝ inches high, with a ½-inch lip bent under the cup to form a mounting "foot." This prevents the gadget from rolling off the desk or shelf when stored.

The coil is cemented inside a Quartz-Q coil form 1⅝ inches in diameter and 1⅞ inches deep (Millen 46100). Thus the coil is protected from damage and the operator is protected from the high voltage in the transmitter. The form is mounted ½ inch behind the rear rotor bracket of the tuning capacitor by a machine screw and a spacer. The 6-32 screw fits one of the tapped holes that bolt the ceramic spacer bar to the bracket. An insulated tie-point is slipped under one of the rear stator connectors of the capacitor to serve as the junction point between the tuned circuit and the indicator lamp. One wire from the lamp goes directly to the rotor terminal on the

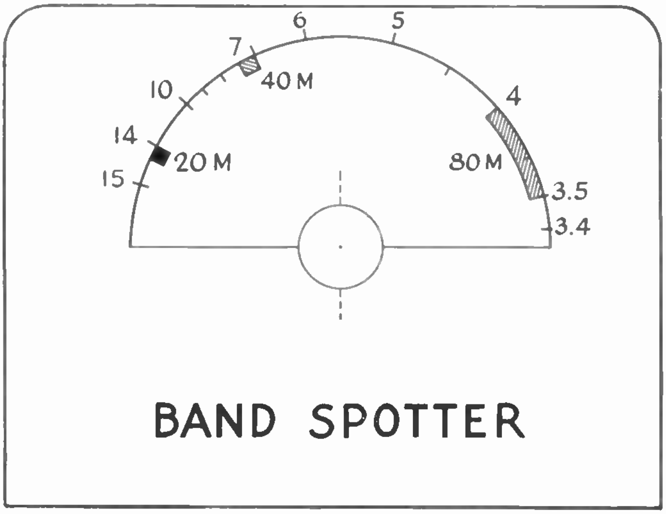

Fig. 10-17 — Actual calibration of the wavemeter. This drawing may be cut out or traced and pasted to the face of the aluminum bracket provided the parts listed below Fig. 10-15 are used in the construction.

rear of the capacitor, the other to the insulated tie-point. The coil is connected from the stator terminal of the capacitor to the lamp at the insulated tie-point.

If you use the same parts we specify below Fig. 10-15, and wire the unit with approximately the same lead lengths shown in the photographs, you will be able to use the calibrated dial scale reproduced in Fig. 10-17. It can be cut out and pasted on the aluminum bracket, or traced onto another sheet of paper. If other parts are used, the wavemeter can be calibrated by using a grid-dip meter in conjunction with a calibrated receiver.

Using the meter is also easy. Assume for a minute that you have tuned up your transmitter, but are not sure that its output frequency is in the desired band. With the transmitter turned on, hold the wavemeter so that the coil is within a few inches of the plate tank coil of your output stage. Turn the tuning dial slowly until the indicator lamp lights, showing that the wavemeter circuit is tuned to the same frequency as the transmitter output. Don't get too close to the tank circuit or you may burn out the indicator lamp.

The same procedure may be followed for any tuned circuit in which power is flowing. Whenever the wavemeter is tuned to the same frequency as the power in the tuned circuit, it will absorb some of that power and then dissipate it in the form of light in the indicator. If the stage you are checking has a plate milliammeter, you can observe the effect of the wavemeter on the tuned circuit to which it is coupled. As the wavemeter is resonated, the plate-meter reading will increase slightly as the wavemeter loads the circuit and takes power from it to light the indicator lamp.

This little gadget cannot be expected to be without its limitations. There are some things that it cannot tell you. For example, its calibration is not accurate enough to permit its use as a frequency meter for close-tolerance reading. It will tell you, however, whether your output is in the 3.5-Mc. range, in the 7-Mc. range (as it would be if you happened to tune up on your second harmonic), or somewhere in between (as it might be if the amplifier was unstable and oscillating by itself). It is for this reason that we call it a *band spotter*, rather than a frequency meter. In the case of a crystal-controlled transmitter, you can be reasonably certain of avoiding off-frequency notices if your crystal is actually in the band, provided that you are sure the output is in the band you think it is. This gadget enables you to be sure.

— *Richard M. Smith, W1FTX*

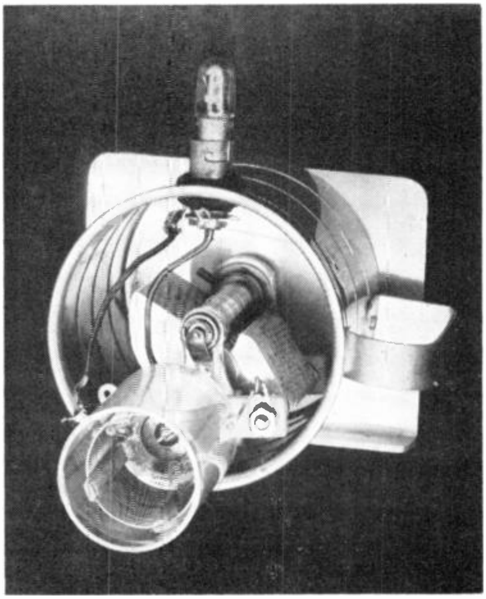

Fig. 10-18—Rear view of the measuring-cup wavemeter. The coil is mounted on the rear of the tuning capacitor inside a protective Quartz-Q form. Also shown is the method of mounting the resonance-indicating lamp in a grommet-lined hole through the side of the cup.

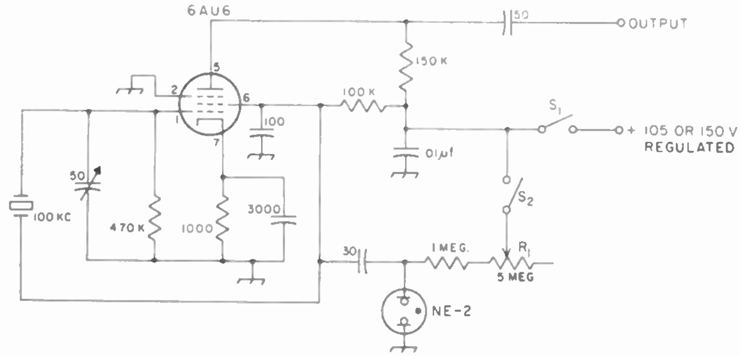

Fig. 10-19— Diagram of the 100-kc. oscillator with 10-kc. markers. Unless otherwise indicated, capacitances are in μμf. resistances are in ohms, resistors are ½ watt.

100-KC. CALIBRATOR WITH 10-KC. MARKERS

THE versatile neon-bulb sawtooth oscillator can be used to modulate a 100-kc. crystal calibrator and obtain 10-kc. marker intervals. The circuit shown in Fig. 10-19 uses a version of a 100-kc. oscillator found in *The Radio Amateur's Handbook*. However, the circuit may be adapted to fit almost any calibrator.

The neon-bulb oscillator is adjusted to oscillate at 10 kc. by the potentiometer R_1, and its output is coupled to the screen grid of the 6AU6 oscillator by a 30-μμf. capacitor. The resultant beats of the 10-kc. and 100-kc. frequencies produce 10-kc. markers between the stronger 100-kc. points. The neon-bulb oscillator will synchronize or lock in with the 100-kc. crystal-controlled oscillator, making this circuit easy to adjust. The oscillator is set by adjusting R_1 and listening to the calibrator signals on the station receiver. The 10-kc. oscillator may lock in with the 100-kc. oscillator at several settings of R_1, and the setting that gives the optimum signal strength will have to be found experimentally.

—*James Bull, W7EIO*

MODIFYING THE HEATHKIT MMI FOR MOBILE MEASUREMENTS

THE modification described here will enable an amateur possessing a v.o.m. with a 0-1.5 volt scale to change the range to read 0-15 volts. Most volt-ohmmeters seem to have ranges either too high or too low for measuring the 12 to 14 volts in an automobile. A 0-15 volt range makes mobile voltage measurements more convenient and accurate. A.c. ranges are included in this modification since some generators, such as those manufactured by Leece Neville, have a.c. outputs.

First, subtract the scale to be changed (in this case 1.5) from the scale desired (15 volts, giving 13.5). Multiply this figure by the sensitivity of the basic movement of the meter. In the case of the Heathkit MM1, the sensitivity figure is 20,000 ohms/volt d.c. and 5000 ohms/volt a.c. Multiplication by these factors gives 270,000 for d.c. and 67,500 for a.c. These figures represent the resistance in ohms to be placed in series with one of the leads. It is desirable that these be 1-percent tolerance resistors.

Two methods can be used to insert the resistors in the proper circuit. The easiest and most economical method is to make two external probes, one for d.c. measurements and one for a.c. One end of the resistor is connected to a banana plug that will fit the 1.5-volt meter jack and the other end is connected to the probing wire or lead. A second method is to connect the resistors to a miniature 4-position rotary switch. This switch is mounted on the instrument in the space between the "ohms-adjusting" potentiometer and the −15-amp jack. The wiring diagram is shown in Fig. 10-20.

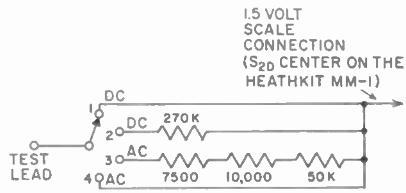

Fig. 10-20—Diagram of the meter circuit. All resistors are ½ watt.

Positions 1 and 4 switch out the resistors so that the meter reads normal. Position 2 allows measurement of 15 volts d.c. and position 3, 15 volts a.c. The resistor for the d.c. scale is a standard value but the 67,500-ohm a.c. unit is not. A combination of resistors can be connected in series to obtain the proper value.

—*Maurice I. Sasson, M.D., W2JAJ*

11. Hints and Kinks . . .

for Sideband

T.R. SWITCH ARRANGEMENTS FOR 10B AND 20A S.S.B. EXCITERS

Two simple t.r. switch arrangements that should interest those who use Central Electronics s.s.b. exciters are shown in Fig. 11-1. Both of the systems permit automatic break-in with a single antenna by making use of the voice-control relay already included as a part of the type 10B and 20A exciters. Two short lengths of RG-58/U coaxial cable complete the installation shown as section A of the block diagram. Three pieces of coax and a T connector are all that is

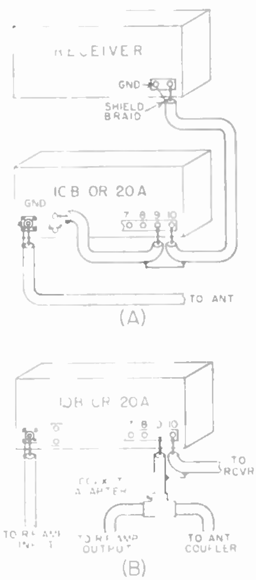

Fig. 11-1—Block diagram of the t.r. switch systems. A is installed when the s.s.b. exciter is worked directly into an antenna. B may be used when the exciter is followed by a power amplifier.

needed for the system shown in section B. Of course, in either case it is assumed that the antenna (or its tuner) is designed for 50-ohm input.

Arrangement A is for use when the s.s.b. exciter is employed as the *complete* transmitter. The cable between exciter and receiver may be any convenient length, but the jumper cable between terminal strips of the exciter should be as short as possible. Notice that the inner conductor of the jumper and the receiver lead are terminated at positions No. 9 and 10, respectively, of the 10-terminal strip located at the rear right-hand corner of the exciters. The outer braid of the two coax leads should be bonded together — but not necessarily grounded — at this point. Terminals No. 9 and 10 of the 10B and 20A units are connected to the internal voice-control relay.

The system shown as section B of Fig. 11-1 may be used when the exciter is followed by a 200-300-watt amplifier. As before, the lead from the receiver is connected to terminal No. 10 of the exciter. Terminal No. 9 of the 10B or 20A is connected through the *shortest* possible length of RG-58/U to the center socket of a standard T connector. Lengths of coax run from the T connector to the output and the input jacks of the r.f. amplifier and the antenna coupler, respectively. Naturally, the load lead may go directly to the antenna if the latter is a 50-ohm affair. Output from the exciter is fed through RG-58/U to the grid circuit of the final.

When installing this t.r. circuit, make sure that the cable between the exciter and T is as short as possible. This does bring the r.f. output lead from the final very close to the exciter unit, but actual operation of the system has resulted in no instability of the r.f. lineup. It is also important that the line between power amplifier and antenna tuner (or antenna) be free of standing waves.

The system shown in section B is used here at W5DLA with the 805 final amplifier running at 225 watts input. It provides voice-controlled break-in without introducing unpleasant plops or other undesirable racket in the output of the receiver.

— J. C. Wallis, W5DLA

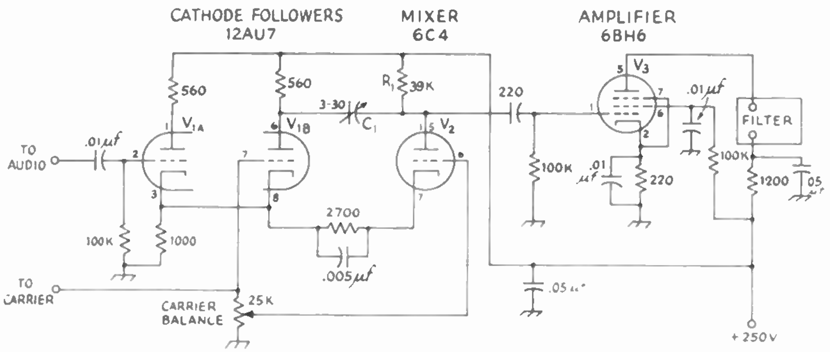

Fig. 11-2—Diagram of the balanced modulator W9WIO used with the "Edmunds exciter." Unless otherwise indicated, capacitances are in μμf., resistances are in ohms, resistors are ½ watt.

A BALANCED MODULATOR FOR THE W1JEO EXCITER

For the last five years I've been using a W1JEO exciter (*QST*, November 1950) with very good results. Reports were always excellent but I sometimes received comments on a trace of carrier. After being reminded many times about the carrier I decided to install a balanced modulator. I was interested in something simple that could be installed without too much difficulty.

I went back to a technical topic by Byron Goodman, W1DX, in *QST*, February 1957, in which the operation of the Crosby balanced modulator was explained. An article by Dan Healey, W3HEC, in *QST* December, 1957, was also consulted.

After studying the above material I came up with the circuit shown in Fig. 11-2. A conventional amplifier (V_3) was added to the Crosby circuit to boost the output to a higher level. Also, a 39,000 ohm resistor, R_1, was used as a plate load for the mixer instead of an r.f. choke. C_1 is a neutralizing capacitor that compensate for capacitive feedthrough between V_{1B} and V_2.

— *James Zvolanek, W9WIO*

SIMPLE GRID CURRENT INDICATOR FOR CLASS AB LINEAR AMPLIFIERS

The 4-400A Class AB_1 s.s.b. linear amplifier here at W7ETK includes an old but perhaps generally-forgotten method of indicating control-grid current flow. Although the method does not prevent the grids from drawing current, it does provide an immediate visual indication of intermittent current excursions that cannot be followed by a meter. With this system in use, I find it unnecessary to provide especially well-regulated bias voltage for the amplifier.

The circuit consists of a sensitive 8000-ohm relay connected in series with the bias lead to the tubes and a 3.2-volt pilot lamp (No. 1490) controlled by the relay contacts. Voltage for the lamp is furnished by the 5-volt filament transformer for the 4-400As. The relay closes whenever grid current is inadvertently allowed to reach one half ma. or so and, of course, the 3.2-volt lamp operating at 5 volts assures a truly "bright" indication that the linear is being overdriven.

— *W. L. King, W7ETK*

"QUIK-DIP" CRYSTAL CLEANING

In the process of using surplus crystals in Type FT-241 holders, the crystals were checked for oscillating activity in a Pierce circuit. I reasoned that a crystal that would oscillate would serve in the lattice filters. Several, however, did not oscillate. When these were opened, all showed heavy tarnish on the silver plate. These were dipped, as assembled, into "Quik-Dip" (a liquid silverware cleaner) for several seconds, rinsed under running water, and then *very* carefully, so as not to break the fine wires, swabbed to remove the loosened black deposit. Of 8 inactive crystals dipped, 6 were reactivated by this method. Some silver is no doubt removed, so it is best to dunk them no longer than necessary; I used 7 to 12 seconds.

The average frequency of the batch of 6 was measured 330 cycles higher than the average frequency of 7 that were not dipped. "Quik-Dip" is a drugstore item as is the "Q-Tip" medicinal cotton swabs used.

— *W. A. Monahan, W6GTR*

SIMPLIFYING CARRIER NULL ADJUSTMENTS

I was not completely satisfied with the carrier null control on my Central Electronics 20A s.s.b. exciter, since it was rather difficult to adjust.

To obtain greater over-all resolution, I replaced the 1000-ohm carrier null potentiometers with 250-ohm linear potentiometers. I compensated the loss in resistance by adding sufficient resistance to the potentiometers. The resistance values added were obtained by measuring the resistance of the original potentiometers from the slider to each outside terminal (with carrier nulled) and then subtracting 125 ohms (half the resistance of the new potentiometer). I then used the nearest standard value resistor. In my case, this was two 390-ohm resistors on one potentiometer and a 470-ohm and 270-ohm resistor on the other.

This modification resulted in four times the resolution as compared with the original circuit. By using 100-ohm potentiometers, still greater "spread" should be possible.

— *Joe Heumphreus, K6DXW*

CRYSTAL-CONTROLLED 28-MC. OPERATION WITH THE 10A, 10B AND 20A SSB EXCITERS

THE simple circuit shown in Fig. 11-3 provides crystal control for the 28-Mc. output of Central Electronics sideband exciters. The circuit can be built into the v.f.o. cabinet and coupled to the v.f.o. input terminal of the exciter via coaxial cable.

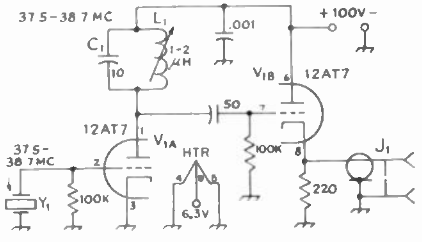

Fig. 11-3—Circuit of W5QMI's crystal-controlled s.s.b. unit. All capacitors less than 0.001 μμf. are in μf. All resistors are ½ watt.

J_1—Coaxial receptacle.

L_1—1–2 μh. slug-tuned (North Hills 120-A or CTC 10-Mc. type. Turns removed experimentally from either type).

Y_1—Overtone crystal. See text.

One half of a type 12AT7, V_{1A}, is used in a conventional triode oscillator circuit. The crystal used with the oscillator is a relatively inexpensive third overtone type manufactured by International Crystal Mfg. Co., Inc. The frequency of the crystal should be in the 37.5- to 38.7-Mc. range, and the tuned plate tank for the circuit, C_1L_1, must resonate at the crystal frequency. A small trimmer capacitor and a 1-μh. inductor may be used in place of the fixed capacitor and the slug-tuned coil.

Output from the oscillator is capacitance coupled to the grid of V_{1B}. This half of the tube works in a cathode follower circuit and provides low-impedance output for feeding directly into the coaxial cable. J_1 is the output connector.

To determine the frequency of a crystal for the oscillator, first select the 28-Mc. frequency that will be used. The crystal frequency will be found by adding the 28-Mc. frequency to 9 Mc., the latter being the frequency supplied by the s.s.b. generator. —*Jim Freund, W5QMI*

MORE ABOUT THE W5QMI S.S.B. UNIT

HERE ARE two suggestions pertaining to the crystal-controlled s.s.b. unit described above.

1) This same oscillator may be used for 21-Mc. operation by installing a 12-Mc. tank in the plate circuit and by using a 12-Mc. crystal. A 47-μμf. mica capacitor in parallel with a North Hills type 120-B (3–5 μh.) inductor should make a suitable tank and, of course, a good ceramic switch should be used for activating either the 12- or the 37.5-Mc. circuits at will.

2) Mount a 50-μμf. variable capacitor on the panel and then connect it across the terminals of the crystal socket. This control will give the operator a little "v.f.o. action" so that he can *zero in* on s.s.b. QSOs near the crystal frequency. —*Jim Freund, W5QMI*

TUBELESS V.F.O. FOR THE 20A S.S.B. EXCITER

A TU-6-B tuning unit from a surplus type BC-191 or BC-375 transmitter may be easily converted into a tubeless v.f.o. for a Central Electronics model 20A s.s.b. exciter. The tuning unit contains all of the parts needed for the v.f.o. and the only expense involved in the entire project is the cost of a few feet of coaxial cable and an output plug.

Section A of Fig. 11-4 shows the tuning-unit circuit before modification. Components labeled C_1, C_2, C_3 and L_1 are the only ones used in the v.f.o. If you happen to have an instruction book for the BC-375 you will find these four components identified with the numbers 601 (L_1), 607 (variable capacitor), 609 and 610 (400-μμf. mica). These parts are located in the left-hand compartment as seen from a front view of the tuner.

The circuit for the v.f.o. is shown in section B of Fig. 11-4. It is quite similar to the circuit described in *QST* for June, 1954. The connection between the oscillator circuit and the exciter is made through two lengths of RG-59/U. These cables add about 20 μμf. per foot across C_2 and C_3, respectively, so the length employed should be no greater than necessary. The inner conductors may be terminated in a 300-ohm plug that will fit the crystal socket. The outer conductors of the cables should be bonded together and grounded at the exciter end.

The only difficulty encountered in the conversion was in unsoldering and resoldering connections due to the mass of metal involved in the large wire, etc. This problem was solved by using two irons simultaneously.

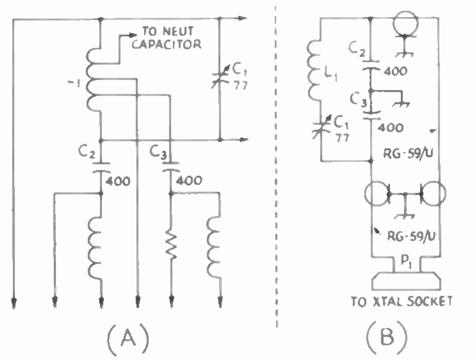

Fig. 11-4—Circuit showing the "before" and "after" wiring of the TU-B-6 tuning unit. W8ZVC uses B as a tubeless v.f.o. for a type 20A s.s.b. exciter. Capacitance values are in μμf.

Stability of the tubeless v.f.o. is excellent and bandspread is adequate. My unit works out to have 496 dial divisions in covering the 5- to 5.5-Mc. range. —*Carl Enix, W8ZVC*

CARRIER INJECTOR FOR PHASING TYPE S.S.B. EXCITER

When using an s.s.b. phasing exciter it is sometimes desirable to inject some carrier without upsetting the carrier balance potentiometers in the balanced modulator. The diagram in Fig. 11-6 shows how this can be accomplished with a minimum of parts.

When the slider of potentiometer R_1 is at the ground end, there will be no carrier injection. However, when the arm is advanced toward the

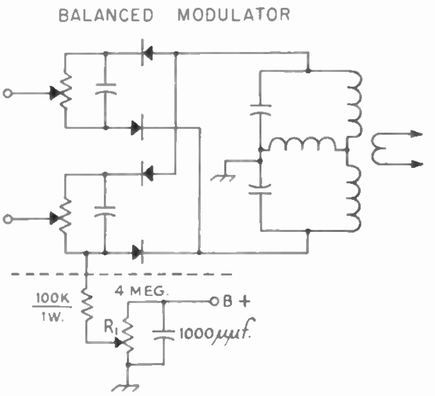

Fig. 11-6—Diagram of the carrier injector.

B-plus end, the circuit will become unbalanced due to positive voltage applied.

Since the 100,000-ohm resistor is in the circuit at all times, a slight carrier unbalance will occur, but this can be overcome by a slight readjustment of the carrier balance potentiometers.

— *W. Lane Tufts, K6JIV*

21-MC. S.S.B. OPERATION WITH THE "W2EWL SPECIAL"

The 14-Mc. version of the "W2EWL Special" can be used for 21-Mc. work after making a simple and inexpensive modification to the rig. This excellent s.s.b. job performs just as well after modification as it did at 14 Mc. The following explains the conversion made here at W5-DYK.

The Type 1626 used originally as the v.f.o. tube (V_{10}, Fig. 1, page 18, *QST*, March, 1956) was replaced with a Type 12SN7GT. One half of the dual triode is used as the oscillator tube without any other changes in the oscillator circuit. The second section of the 12SN7GT is wired and used as a frequency doubler. Tuning the oscillator to 6225 kc. gives output from the doubler at 12.45 Mc. The latter mixes with the 9-Mc. s.s.b. signal for output at the high end of the 21-Mc. phone band.

The doubler stage is completely conventional and those interested in making the change will find a suitable circuit in *The Radio Amateur's Handbook.* The plate circuit of the doubler may be slug-tuned.

— *Howard D. Woertendyke, K4QPT*

MODIFIED RECEIVER TUNING RATE FOR S.S.B. RECEPTION

In converting conventional receivers for improved s.s.b. operation, it is desirable to effectively reduce the bandspread tuning range. This is often done by substituting a large diameter knob for the original bandspread control knob. However, in receivers such as the S-40 series, a neat and superior job will result if the bandspread shaft is removed from the set, and the central portion in which the dial cord rides is further reduced in diameter to about 1/16 inch. This is best done on a lathe, or (with care) by placing the shaft in the chuck of an electric drill and using a small flat file, with the drill running. The reduction of shaft diameter decreases the contact area between the shaft and the dial cord, so it may be necessary to wrap the cord around a few extra turns to prevent slippage.

— *Richard A. Schomburg, W7WUM*

BC-221 AS A CARRIER INJECTION GENERATOR FOR S.S.B.

Although already appreciated by many amateurs, newcomers to the ranks of s.s.b. operation may not realize that a surplus BC-221 frequency meter makes an excellent single-frequency carrier generator for reception of single-sideband suppressed-carrier phone signals.

Frequency stability and adequate bandspread, essential requirements of an s.s.b. injection generator, are already built into the various models of the BC-221. Output amplitude control over a wide range, another requisite of a good generator, can be provided for by replacing R_{38} (in Model 221-N) with a 500K potentiometer.

— *Marlin R. King, KP4RC*

12. Hints and Kinks . . .

for the Shack

AN AUTOMATIC "TIMER" FOR THE 10-MINUTE STATION BREAK

SECTION 12.82 of the FCC rules governing amateur radio is quite specific about the need for identifying an amateur radio station by the transmission of its call sign at least every ten minutes or as soon thereafter as possible. Unfortunately, even the most conscientious operator may inadvertently violate this regulation if he gets tied up in an interesting QSO or a lively moving round-table such as takes place in the s.s.b. circles.

One obvious solution of the problem is the use of an automatic operating aid that either "sounds off" or "flashes" at ten-minute intervals. Recently, both W5JPM and W5MAW figured out a way of building a simple *ten-minute timer* around an electric alarm clock.

Several models of the General Electric and Telechron "boudoir" electric alarm clocks have a time-setting knurled brass knob that makes six revolutions in each hour. In other words, the knob makes one complete revolution every ten minutes. It is no trick at all to solder a lug or arm to the knob and then use this projection to actuate a Microswitch. The switch may be mounted on the rear of the clock and can be wired to control either a ten-minute flasher, a bell or a buzzer.

It is suggested the mechanical layout provide for warning *on-the-hour* and at ten-minute intervals thereafter. Then, if we all synchronize our clocks with the aid of WWV, we won't all be identifying at different times in the same QSO.

Nice thing about the modification is that it does not affect the clock value and the alarm feature is still usable.

— *Jack E. Cox, W5JPM*
John S. Jinkins, jr., W5MAW

Editor's Note: It doesn't take much imagination to realize that W5JPM and W5MAW have come up with an idea that may solve the "conelrad" problem for some of the gang. After all, as long as you *remember* to check the broadcast band every ten minutes you're *in business* as far as conelrad compliance is concerned.

ILLUMINATED CALL LETTER BOX

HERE'S an evening's project that will put some life in your shack and also give a few hours of enjoyable construction time. The gimmick shown in Fig. 12-1 is constructed in a 2¼ × 2¼ × 4-inch Minibox. The desired opening on the front panel is first scribed; four corners of the proposed cutout are drilled with a ⅜-inch bit to produce round corners and the front panel

Fig. 12-1—K8MME's illuminated call letter box.

is then cut out with a small metal saw or hacksaw blade.

Letter and numeral decals, obtainable from most dime stores, are transferred to a sheet of white plastic or translucent material. This sheet is cut to fit snugly behind the opening in the front panel. When the Minibox is reassembled, it will automatically hold the plastic tight. Two felt strips are cemented inside the back section of the box to prevent light leaks.

A pilot lamp and matching socket are mounted inside the box. Power feed wires are fed through a grommeted hole in the back. Power leads can be connected to the receiver heater circuit so that the panel will be illuminated whenever the receiver is turned on. Another scheme would be to control the light with the station send-receive switch. The box would be illuminated during transmitting, giving a visual "on-the-air" indication.

— *John Howard, K8MME*

SIMPLIFIED VERSION OF W6CHB'S TRANSISTORIZED CODE-PRACTICE OSCILLATOR

The circuit shown in Fig. 12-2 is a simplified version of the transistorized code-practice oscillator described in *QST* for June, 1954. Comparison of the original and the new circuits will show that the principal change is the substitution of a pair of headphones for the tank inductance used by W6CHB.

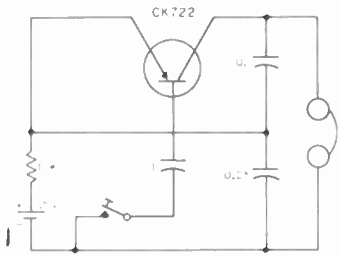

Fig. 12-2—WØJV's version of the transistorized code-practice oscillator. High-impedance phones (4000 ohms) should be used with the circuit.

The circuit of Fig. 12-2 requires no resistor across the capacitor in the base lead of the CK722. Current drain is not in excess of 500 microamperes with a 1.5-volt battery in use. Additional volume may be obtained by employing a 3-volt battery. Incidentally, the original circuit can be used with the phones replacing L_1.

— *George S. Carson, WØJV*

A TWO-STATION TRANSISTORIZED CODE-PRACTICE OSCILLATOR

This code-practice oscillator embodies such features as compactness, economy, simplicity, tone control and dual-position operation. The unit can be built for approximately $7.00, takes up no more space than that occupied by a pair of surplus keys and may be keyed and monitored at both the "main station" and "remote" operating positions.

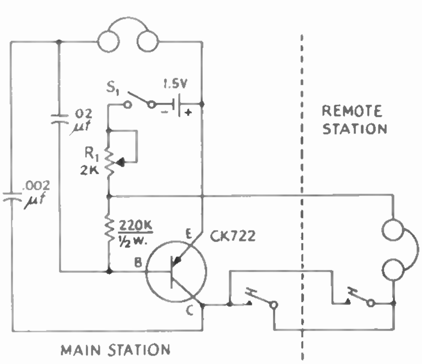

Fig. 12-3—Circuit of the two-station transistorized code-practice oscillator.

The circuit of the oscillator is shown in Fig. 12-3. The parts for the main station may all be mounted on the base of a surplus type J-38 key. R_1 is a 2000-ohm potentiometer (tone control) equipped with a s.p.s.t. switch (S_1). The phones at both positions should have an impedance of 1000 to 2000 ohms. Battery potential may be increased to 3 volts if the 1½-volt source gives less than the desired amount of audio output.

A 3-wire cable connected between stations will permit two operators to work "break-in." The operating positions may be separated by any reasonable distance.

— *William W. Clarke*

MORE ABOUT W1ICP's TRANSISTOR CODE-PRACTICE SET

The circuit shown in Fig. 12-4 is a modified version of the one described by McCoy in *QST* for May, 1956. This arrangement has more audio output than did an exact duplicate of the original model, and it uses a junk-box filament transformer instead of a universal output transformer. C_2 has been added in the interest of increased audio output, and C_3 suppresses key clicks that show up without the capacitor.

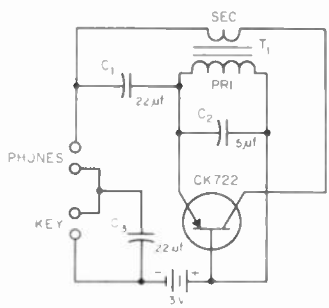

Fig. 12-4—Circuit of the transistor code-practice set described by W8KX. T_1 is a small 6.3-volt filament transformer.

Connecting the 0.5-µf. capacitor across the filament transformer does cause the oscillator to generate a different tone than that emitted by W1ICP's unit. Howevery, the frequency or pitch of the signal can still be varied by increasing or decreasing the capacitance of C_1.

— *Walt Strauss, W8KX*

Fig. 12-5 is the circuit of a transistorized code-practice oscillator that *started out* to be a duplicate of the one described in *QST* for May, 1956. It now has a pair of resistors and a couple of capacitors not used in the original set, but it does use the same transformer and transistor.

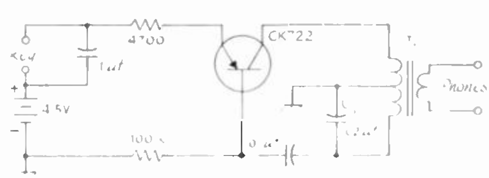

Fig. 12-5—Schematic of W3UYC's transistorized code-practice oscillator. Resistances are in ohms; resistors are ½ watt. Capacitors are paper. T_1 is a Merit type A-2900 universal replacement output transformer.

The alterations can be easily made by anyone who has constructed the 1956 model, and an improvement in tone and the elimination of sharp key clicks will be the reward. The output of the modified unit is nearly a sine wave. The circuit draws only about 0.5 ma. from a 4.5-volt battery, it follows a bug at high speed and it will work with headphones of almost any impedance. The tone can be changed by varying the capacitance of C_1 in steps of 0.01 μf.

— *George Messenger, W3UYC*

SIMPLE SETUP FOR CODE PRACTICE

Some of the newcomers who have need for simple code-practice equipment may solve their problems by hooking a pair of phones, a key and

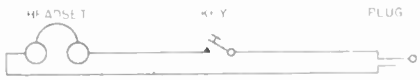

Fig. 12-6—This combination of headphones, key and phone plug, plus a receiver with b.f.o., can be used for code-practice work as suggested by W8CGF.

a phone plug in series as shown in Fig. 12-6. After this combination is plugged into a receiver, close the key, turn on the b.f.o. and then tune to a steady signal, such as WWV or the carrier of a broadcast or Loran station. Naturally, you *key* the signal just as you would the output from a conventional practice oscillator.

— *Frank Fahrlander, W8CGF*

TRAINING AID FOR THEORY INSTRUCTION

In teaching theory to prospective hams, the writer uses a specially prepared schematic of a typical Novice transmitter. The diagram is drawn on a large sheet of oilcloth which can be rolled up for carrying or storage. The circuit is drawn in black on white material because the sharp contrast of this color scheme presents the circuit in a lucid and impressive manner. In labeling the chart, all components are identified by standard circuit symbols.

Those who wish to make one of these chart-type schematics should obtain a large piece of white oilcloth (about 26 by 30 inches) and some black enamel paint. This type of paint is available in small quantities and may be applied to the white background with a small camel's-hair brush.

When drawing the circuit, leave enough room at one end of the chart so that it can be attached, without disfiguring the schematic, to a cardboard tube. The tube serves as a support for hanging the chart and will also protect the oilcloth when it is rolled up. Frequently, a tube can be obtained from the oilcloth dealer. A second tube, one having a diameter large enough to fit over the rolled-up chart, makes an ideal carrying case for the schematic.

The chart-type diagram is really a great aid in presenting simple theory in *black and white* to Novice candidates and most certainly helps in teaching them how to interpret the radio symbols most commonly used.

— *Carolyn J. Hull, W2YCX*

MOUNTING QSL CARDS

A solution to the problem of mounting and displaying QSL cards without damaging or defacing them is shown in Fig. 12-7. The method also permits easy removal or replacement of individual cards.

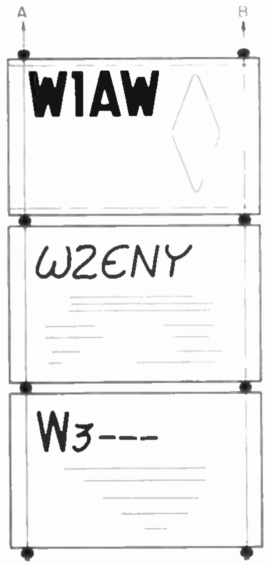

Fig. 12-7—Sketch showing W2ENY's method of displaying QSL cards. Threads shown at the right and left are backed up by threads which run up along the rear side of the cards. Vertical extensions A and B should be long enough to reach the nails, thumbtacks, rod or rings used to support the strip.

The cards are suspended in vertical strips by means of two pairs of fine thread, each about ½ inch in from the edge of the cards. Small glass or plastic beads of the type used by children in making designs are used as separators between each pair of cards. Knot each pair of threads to support the beads at the bottom and clamp the threads extending above the uppermost card with another pair of beads. The supporting strings may be tied to a dowel or curtain rod, or they may be terminated in small rings fastened to the wall or other surface.

— *P. S. Christaldi, W2ENY*

QST ARTICLE INDEXING HINT

If the table of contents is removed from each issue of *QST* and pasted or filed in a loose-leaf binder, it simplifies the task of locating articles or subjects that have been presented in back issues of the magazine. This monthly indexing system is particularly helpful during a current year, prior to the appearance of the annual index in the December issue.

— *Charles Stouth*

ANOTHER QSL CARD DISPLAY METHOD

Mounting QSLs on walls without marring wall paper, paint, or damaging the QSLs is always a problem. One solution is to mount the QSLs with folded stamp hinges, the type used by stamp collectors for mounting stamps. Put a hinge on the back of the corner of each QSL, wet the other half of the hinge and hold in place for a few seconds. After the hinges are dry they will hold the QSL in place indefinitely, and they may be removed when dry without the slightest danger to walls or cards.

— *Mike Kaufman, K6VCI*

SPECIAL INK FOR SMOOTH-SURFACED QSL CARDS

Anyone who has tried writing on the slick side of smooth-surfaced QSL cards with an ordinary fountain pen or ball-point pen has probably experienced considerable annoyance getting the ink to *take* to the surface properly. I have found that Carter's Cloth Marker (a ball-point pen with a heavy jet black ink) is the ideal solution to this problem. This inexpensive pen writes with a slightly heavier line than the ordinary pen and the ink is really indelible.

— *Sam Goldish, W5TVG*

IS YOUR STATION UNDERWRITERS' LAB APPROVED?

The National Electrical Safety Code, Pamphlet 70, Standard of the National Board of Fire Underwriters, deals with electric wiring and apparatus. The Code was set up to protect persons and buildings from the electrical hazards arising from the use of electricity, radio, etc. Article 810 is entitled "Radio Equipment." The scope of this article, Section 8101, says, "The article applies to radio and television receiving equipment and to amateur radio transmitting equipment, but not to the equipment used in carrier-current operation." Without reading further, most amateur stations comply with these safety rules, not because they are required to do so, but because of the inherent nature of the ham to provide great safety factors in most of his equipment. It is to the one in a hundred, where the safety factor is doubtful, that these articles will be helpful. It will be seen later that not only do these articles satisfy the Underwriters' Code but, when fulfilled, some are measures that one would take to TVI-proof his rig. So it's a matter of killing two birds with one stone.

The Board of Fire Underwriters sets up the code as a minimum standard for good practice. Most cities adopt the code, or parts of it, either entirely or with certain amendments which may apply to that particular city. It is up to the city to enforce these rules. When a violation is reported, periodic checks are made by an inspector until a correction is made and to insure against future recurrence.

Antenna Systems Sections 8111–8115

"Antenna-counter-poise and lead-in conductors shall be of hard copper, bronze, aluminum alloy, copper-clad steel, or other high-strength, corrosion-resistant material. Soft-drawn or medium-drawn copper may be used for lead-in conductors where the maximum span between points of support is less than 35 feet. Outdoor antenna, counter-poise and lead-in shall not be attached to poles or similar structures carrying electric light or power wires or trolley wires of more than 250 volts. Insulators shall have sufficient mechanical strength to safely support the conductors.

"Outdoor antenna, counter-poise and lead-in shall not cross over electric light or power circuits and shall be kept away from all such circuits so as to avoid the possibility of accidental contact.

"Where the proximity to electric light and power service conductors of less than 250 volts cannot be avoided, the installation shall be such as to provide a clearance of at least two feet. It is recommended that antenna and counter-poise conductors be so installed as not to pass under electric-light or power conductors.

"Splices and joints in antenna and counter-poise spans shall be made with approved splicing devices or by other means as will not appreciably weaken the conductors. Soldering may ordinarily be expected to weaken the conductor; therefore, soldering should be independent of the mechanical support.

"Metal structures supporting antennas shall be permanently and effectively grounded."

Antenna Systems — Receiving Stations Sections 8121–8124

"Outdoor antenna and counter-poise conductors for receiving stations shall be of a size not less than in the following table:

Material	*Minimum Size of Conductor When Maximum Span is . . .* *Less than 35 feet*	*35–150 feet*	*Over 150 feet*
Aluminum alloy, hard-drawn copper..................	19	14	12
Copper-clad steel, bronze or other high-strength material	20	17	14

"Lead-in conductors from outside antenna . . . shall be of such size as to have a tensile strength at least as great as that of the antenna conductors (as in the table).

"Lead-in conductors attached to buildings shall be so installed that they cannot swing closer than two feet to the conductors of circuits of over 250 volts, or less; or ten feet to the conductors of circuits of more than 250 volts. . . .

"If an electric supply circuit is used in lieu of an antenna, the device by which the radio receiving set is connected to the supply circuit shall be specially approved for the purpose."

Antenna Systems — Transmitting Stations Section 8131–8135

"Antenna and counter-poise conductors for transmitting stations shall be of a size not less than given in the following table:

Material	*Maximum Size of Conductors When Maximum Open Span is . . . Less than 150 feet*	*Over 150 feet*
Hard-drawn copper.......	14	10
Copper-clad steel, bronze or other high-strength material	14	12

Lead-in conductors shall be of a size as specified in the table, for maximum span lengths.

"Antenna and counter-poise conductors for transmitting stations attached to buildings shall be firmly mounted at least three inches clear of the surface of the building on non-absorptive insulating supports such as treated pins or brackets, equipped with insulators having not less than three-inch creepage and air gap distances. . . .

"Entrance to buildings . . . except where protected with a continuous metallic shield which is permanently and effectively grounded, lead-in conductors for transmitting stations shall enter buildings by one of the following methods:

"a. Through a rigid, non-combustible, non-absorptive tube or bushing.

"b. Through an opening provided for the purpose in which the entrance conductors are firmly secured so as to provide a clearance of at least two inches.

"c. Through a drilled windowpane."

Transmitting Stations Section 8192

"Transmitters shall comply with the following:

"a. Enclosing. The transmitter shall be enclosed in a metal frame or grille, or separated from the operating space by a barrier or other equivalent means, all metallic parts of which are effectively connected to ground.

"b. All external metallic handles and controls accessible to the operating personnel shall be effectually grounded. No circuit in excess of 150 volts should have any parts exposed to direct contact. A complete dead-front type of switchboard is preferred.

"c. Interlocks on doors. All access doors shall be provided with interlocks which will disconnect all voltages in excess of 350 volts when any access door is opened.

"d. Audio amplifiers. Audio amplifiers which are located outside the transmitter housing shall be suitably housed and shall be so located as to be readily accessible and adequately ventilated."

How many hams have transmitters unenclosed or without interlocks or both?

The author has purposely visited over a dozen ham shacks and there are some who do not comply with various provisions. Of course, no particular station will be shut down because the antenna lead-in is No. 16 instead of No. 14, or because the speech amplifier is not totally enclosed. The National Electric Code is only a minimum standard, and compliance with its rules will assure less operating failures and hazards, and greater safety.

A copy of the pamphlet is available by writing the National Board of Fire Underwriters in your city, or at 85 John Street, New York 38, New York. Ask for pamphlet No. 70.

Other parts of the Underwriters' Code deal with power wiring and, in addition to the requirement of the use of U.L. approved materials and fittings, have the following to say of direct interest to amateurs:

"All switches shall indicate clearly whether they are open or closed.

"All (switch) handles throughout a system . . . shall have uniform open and closed positions.

". . . supply circuits shall not be designed to use the grounds normally as the sole conductor for *any part* of the circuit."

The latter means that wire conductor should be used for all parts of the power circuit. Dependence should not be placed on water pipes, etc., as one side of a circuit.

— *I. F. Wolk, W6HPV*

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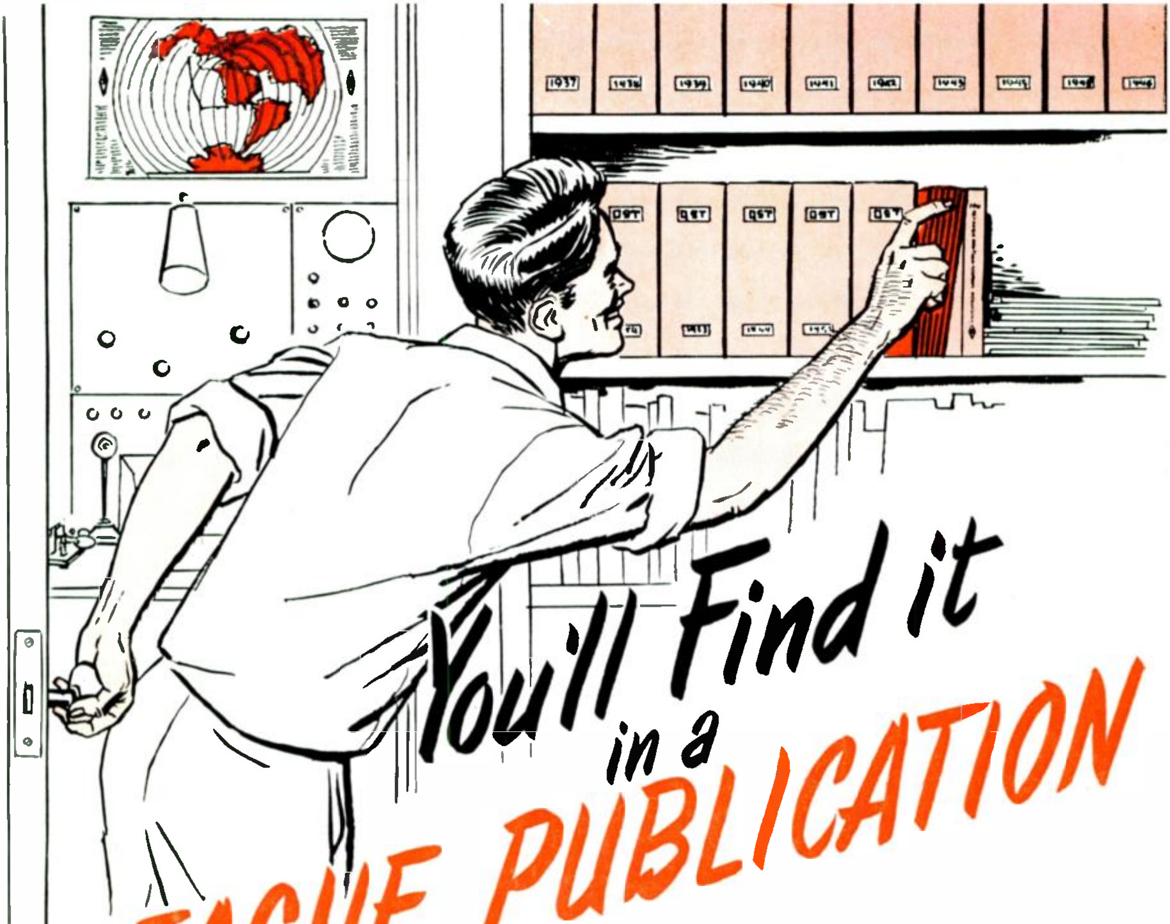

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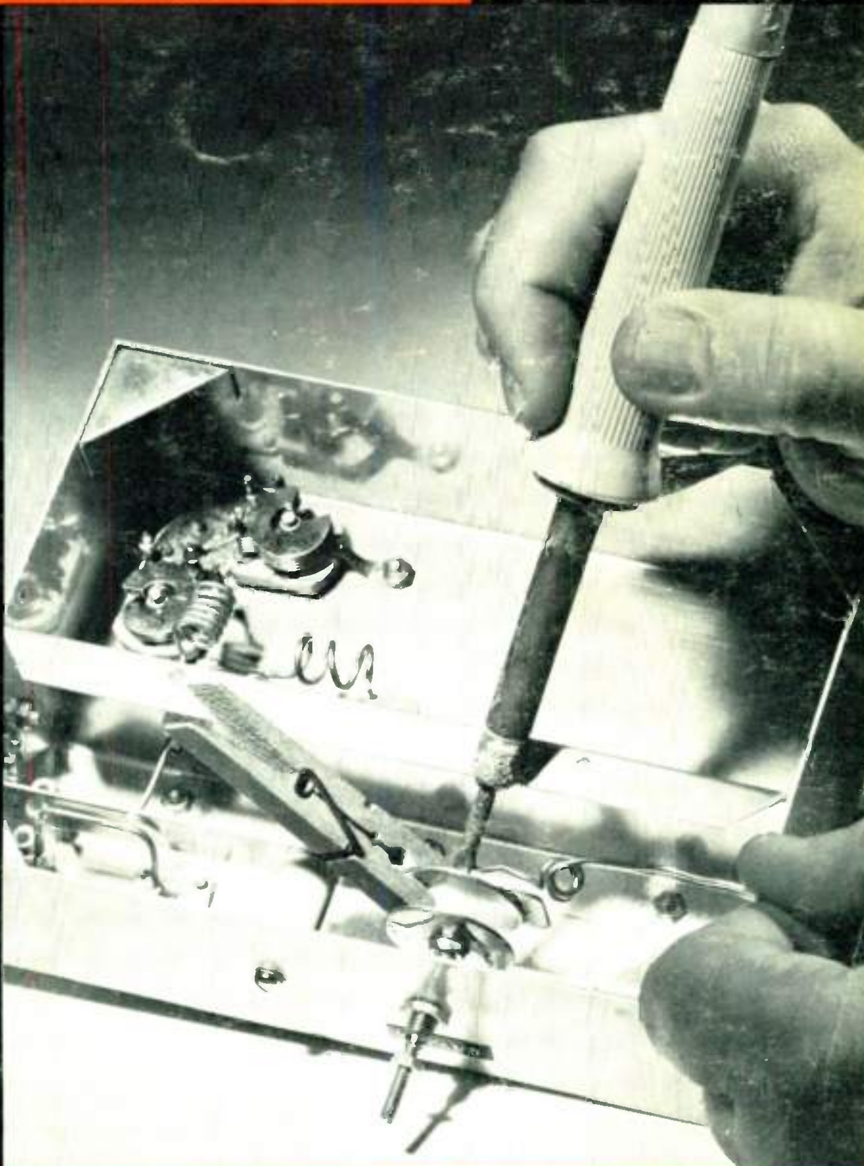

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Foreword

This booklet, the seventh in a series going back to 1933, illustrates two of the outstanding qualities of the radio amateur: his inventiveness in solving the little problems of amateur radio in workshop and station, and his willingness to share his work with his fellow amateurs.

It illustrates in capsule form the American Radio Relay League functioning at its best, for the book has no fewer than 450 authors, each of whom originally contributed his brainchild to *QST*, the League magazine, for publication therein. Gathered here are the best of the ideas presented over a six-year span in the monthly column bearing the same name, "Hints and Kinks."

At least some of the ideas in this volume will be of interest to every active radio amateur—and many of them will be useful to non-amateurs interested in various phases of electronics.

And should you find your own experiments producing a handy answer to a common problem, send it in to *QST;* you'll be among the authors of Volume 8, for which a need will eventually develop as amateurs continue in their public service hobby.

JOHN HUNTOON, W1LVQ
General Manager

Newington, Connecticut

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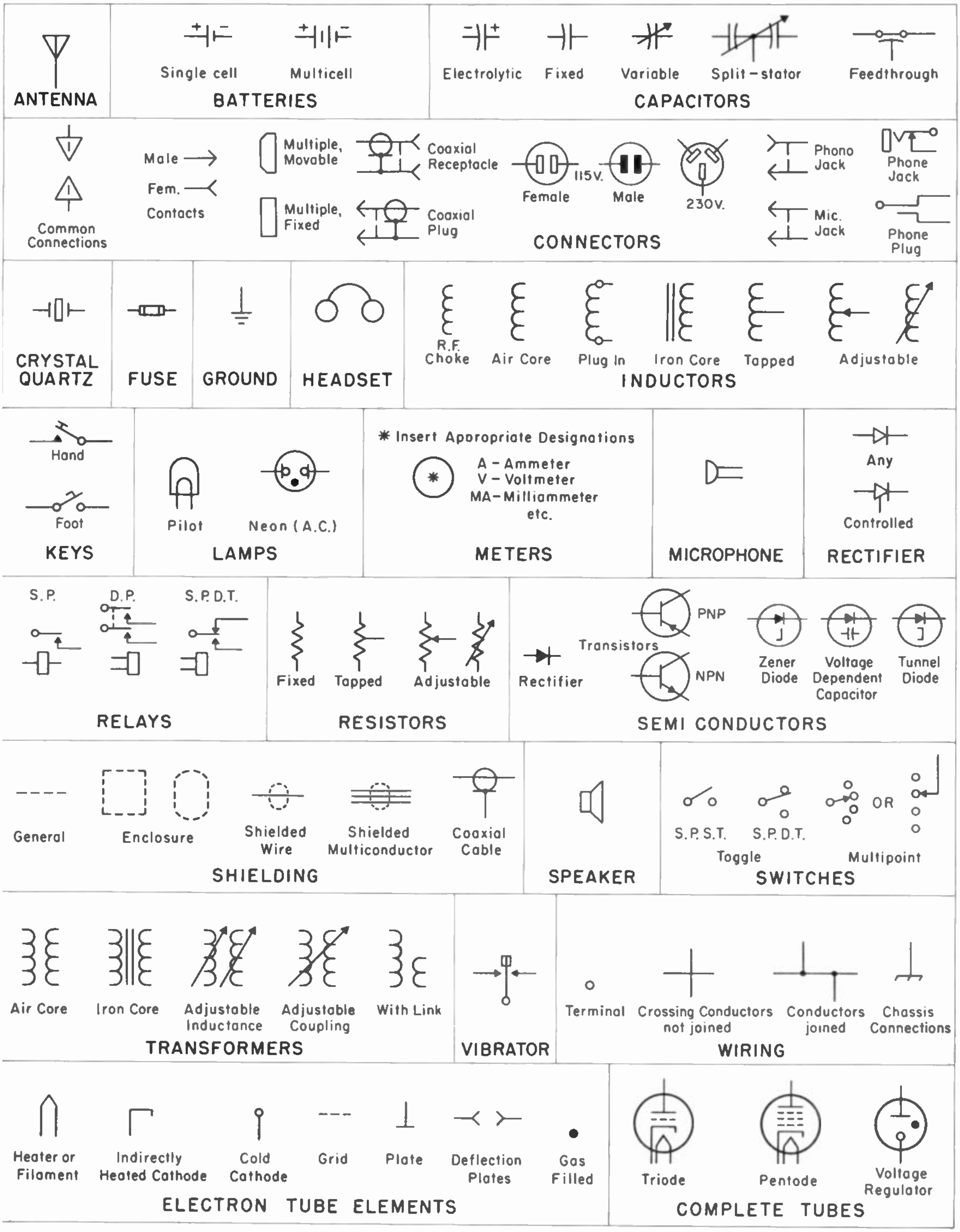
SCHEMATIC SYMBOLS USED IN CIRCUIT DIAGRAMS



Where it is necessary or desirable to identify the electrodes or capacitors, the curved element represents the *outside* electrode (marked "outside foil," "ground," etc.) in fixed paper- and ceramic-dielectric capacitors, and the *negative* electrode in electrolytic capacitors. In the modern symbol, the curved line indicates the moving element (rotor plates) in variable and adjustable air- or mica-dielectric capacitors. In the case of switches, jacks, etc., only the basic combinations are shown. Any combination of these symbols may be assembled as required, following the elementary forms shown.

Hints and Kinks . . .

for the Workshop

REPAIRING SPEAKER CONES

You can repair a torn or damaged speaker cone easily with some fingernail polish and a piece of tissue paper. Saturate a strip of the tissue with fingernail polish and place it over the hole. When the polish has dried, the tissue becomes hard and makes a fine repair to the damaged area of the speaker cone.

—Bruce Zieminski, WA6NOV

HANDY TUBE PULLER

The sponge rubber cup found inside most vibrators makes a nice tight fit over octal tubes and facilitates removal from their sockets. With a little extra squeezing, it can be used for pulling miniature types, too. The cup measures about 1½ inches in diameter and about 2 inches in length. To remove the sponge from the vibrator, simply take off the vibrator base.

—Dave Barquist, K9PAK

VERSATILE MARKER

A small tube of quick drying ink can be used to good advantage around the ham shack. The tube has a felt wick which feeds out the ink and is shaped so that a broad or narrow line can be drawn. The ink, which is available in a variety of colors, adheres to just about any surface and so can be used for writing on chassis, color coding components, wires, etc. More elaborate combinations of ink and pen points are available at the larger office and art supply stores, so that if one has a steady hand the ink tube can be used for panel marking.

—Alex F. Burr, K3NKX

NUT STARTER

Here is an old trick that still works—it might save you a bit of bother. Did you ever try to put a nut into a spot where your fingers or your long-nose pliers wouldn't go? Just take a short length of solder, flatten the end a bit, and force it part way into the nut threads. Bend the solder into the form necessary to get down to that inaccessible bolt, and there you have it. Now all you have to do is to get at the bolt head with a screwdriver! If you can't do that, you had better move the whole works.

—R. O. Deck, Jr., W9JVI

WEATHERPROOF SEALER

General Electric has come out with a new silicone rubber adhesive sealant labeled RTV 102. This material is impervious to the weather and temperature extremes encountered in ham use. It is excellent for sealing antenna connections and connectors that are used outdoors and can be used for potting connections or components. The sealant, which cures without heat, comes in a "toothpaste" tube ready to apply. RTV 102 can be obtained from any G.E. silicone sales office or authorized dealer.

—Bill Hurni, K1SDR

CABLE LACING MATERIAL

The vinyl jacket covering on popular types of coaxial cable can be used for cable lacing. Strip the covering off the coax by cutting a long, straight line down the length of the cable. Open the tube and snap it over the wire or cable you wish to cover.

—Gary Guenther, KØPQW

SIMPLE ALIGNMENT TOOL

A plastic nut starter, such as one of those furnished with some electronic kits, can be converted into an alignment tool by breaking off a piece of razor blade and inserting it into the end of the nut starter. The broken blade should be a little oversized so that it will make a tight fit.

—Tom Rugen, WA2NYQ

SOLDERING IRON CLEANER AND HOLDER

The device shown in Fig. 1-1 has proved so useful to me that I decided to pass the information along to others. Basically, the idea is to use a moist cellulose sponge for removing excess solder and oxidation from soldering-iron tips. The idea works particularly well with pencil-type soldering irons used in small work. The sponge is enclosed in a metal box which anchors down the sponge and provides a cradle for the iron when it is not in use.

Brush the tip of the iron across the sponge before using. This will produce a clean, shiny tip which greatly facilitates soldering operations.

—Frank T. Wyatt, WA6JSA

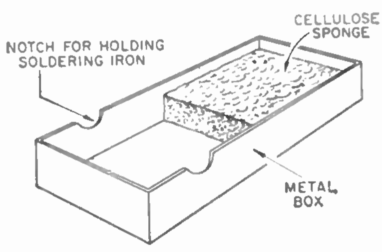


Fig. 1-1—WA6JSA's soldering-iron cleaner and holder.

WORK LIGHT

A small useful work light for lighting up cramped quarters can be made from an old filament transformer, a plastic tube and a flashlight lamp. The sketch in Fig. 1-2 shows the hookup. Although the 117-volt cord may seem a nuisance at first, it solves the problem of flashlight batteries which seem to go dead just when they are most needed. The plastic tube and the isolation transformer insure against shorts when you are on a "live" set.

—Wilfred Tritz, K9DLD

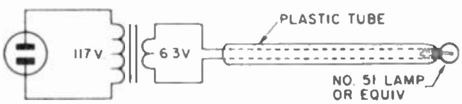


Fig. 1-2—A simple light powered by a filament transformer.

PIN SOLDERING AID

Soldering to pins such as those found on plug-in coils, phono plugs and tube bases is sometimes difficult. Often the solder will adhere to the sides of the pin making it oversized and too large for its socket. I use a lighted match to "smoke up" the outside of the pin before soldering. After this treatment the solder will not stick to the pin and the smoke residue can be easily wiped off when the soldering job has been completed.

—Douglas Dawson, KNØRTW

READING OLD TUBE LABELS

Old tube type numbers are sometimes unreadable due to an accumulation of dirt and grease. Removal of the dirt often obliterates the type number, too. A good way to clean the tubes without erasing the label is to spray the tube envelope with hi-fi record cleaner, then wipe off the dirt with a soft, clean cloth. The type number will stay put and should be readable.

—Terry Welch, K8ZBI

TIN-LEAD SOLDER FOR ALUMINUM

A note to the editor in the December, 1963 issue of the *Journal of the Radio Society of Great Britain* from G3PIT, and a rebuttal from a skeptical reader in the March, 1964 issue of the same publication, have provoked a group of us into some investigation into the soldering of aluminum with conventional solder.

G3PIT contends that ordinary solder will adhere to aluminum if a light oil is used on the aluminum surface first, in order to remove the thin layer of aluminum oxide that forms from the reaction of aluminum and air. He states that this procedure is excellent for soldering feed-through capacitors to a chassis wall, or for any "occasional joint." His critic, however, takes great issue to the use of tin-lead solders on aluminum.

We did some experimenting and have found that steel wire will hold to aluminum fairly well under a "blob" of solder applied in the manner offered by G3PIT. And, surprisingly enough, a 50-50 alloy of tin and lead works better than a 60-40 alloy. This procedure was used successfully to bond aluminum boxes to aluminum chassis for electically-tight compartments. For those who want to try this method, it is suggested that a very hot iron be used and that the aluminum surface under the oil be scraped with a knife just before soldering.

—J. Sparky Summers, W5MVP

SPEAKER REPAIR SOLUTION

"Correction compound," designed to cover mistakes in typed mimeographed stencils, can also be used for repair of small tears and holes in speaker cones. The solution is inexpensive and can be purchased in small quantities from most any of the office-supply houses.

—Bill Whitten, K4KIV/3

WORKSHOP IDEAS

A new 67-page booklet from NASA, called *Reliable Electrical Connections,* contains a lot of Hint & Kink material on handling of wires, components, soldering, shielding, lacing, printed-circuit boards, etc. Helpful information on how to make a good solder joint, the proper way to strip a wire, the correct method of tinning wire, and many other workshop practices are contained in the manual.

The book, which is part of a series to provide technical information, is available from the Office of Technical Services, Department of Commerce, Washington, D.C., 20230, for 70 cents.

—W1CUT

FORMULA AID

Below in Fig. 1-3 is a chart that can be used as an aid in determining formulas for power, voltage, current and resistance. Each quadrant contains formulas for finding the unknown factor which is represented by the large letter in that quadrant.

The triangle at the right is an "Ohm's Law triangle." Place a finger over the unknown factor. The mathematical arrangement of the remaining figures gives the formula for finding the unknown.

—Voe Poston, K9GCE

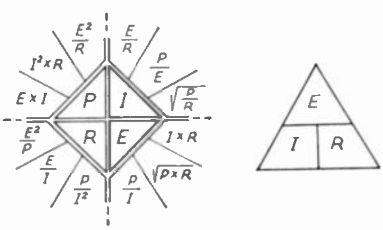


Fig. 1-3—Formula chart for finding power, voltage current and resistance.

SOLDERING RESISTANCE WIRE

SINCE resistance wire contains nickel and chrome, it is difficult to tin the wire with ordinary solder. Silver solder may be used on heavy resistance wire, but most ham work with resistance wire is for meter shunts, etc., and involves the use of delicate resistance wire.

My method of soldering involves first cleaning the wire with the finest Carborundum available. If the wire is covered with fabric, push the fabric back about one inch and hold it there with wax or cement. Next, gold solder is heated on an asbestos or carbon block under a flux, such as borax, until the solder just melts. Be careful not to overheat and use only a small amount of the gold solder; the size of an okra seed (¼ penny weight) will do. Dip the end of the resistance wire into some soldering flux, remove the flame from the melted gold solder and thrust the end of the resistance wire into the molten solder and then remove it. A thin coating of gold should adhere to the end of the resistance wire. The gold-plated wire end is cleaned and can now be tinned easily with conventional solder.

The gold solder can be purchased from a dental-supply house or dental laboratory, and the cost for the amount used here should be no more than half a dollar. Melting point for the gold solder is about 1200 to 1400 degrees F. A gas torch or Bunsen burner will work well for this.

One note about using the completed wire: if a precision shunt is to be made, the tinned sections of the wire should be neglected in the measurement. Only the wire between the plated ends is now resistance wire!

—Dr. Roy R. Campbell, W4DFR

DESOLDERING AID

TO keep lug holes from filling up with solder while unsoldering a wire/lug connection, insert a round wooden toothpick in the lug hole while the solder is still molten. The solder will not stick to the toothpick and the hole filled by the toothpick will be left clean.

—George Simon, W4KRP

CRAYON THERMOMETERS

THE Hint & Kink, "Paper Thermometers", in *QST* for June, 1962, interested many *QST* readers. Another item, called Thermochrom, which does the same job as the paper thermometers, is a crayon whose mark changes color when a calibrated temperature is reached. The crayons are made by the Air Reduction Co., and are probably available from welding supply houses.

—W1CUT

STORING DRILL-CHUCK KEYS

MANY ways have been suggested for keeping track of drill-chuck keys. These have ranged from using a rubber band around the body of the drill to actually welding a magnet to the case of the drill for holding the key.

A more reliable and safer way to do the job, and one that I have used for many years, is to tape the chuck to the power cord near the plug end. This scheme requires that the a.c. plug be removed from the electrical outlet when changing drills, and this reduces the possibility of accidental triggering of the motor switch.

—Harold E. Davis, W8MTI

CRYSTAL DIODE IDENTIFICATION

IDENTIFYING crystal diodes can be difficult if the "code" is not known. If the diode symbol is not printed on the diode, the cathode side of the diode is identified by a band, several bands, dot mark, check or a plug sign. Modern diodes use a color-code system for identifying the type number which was listed in *QST*, July 1960, page 46. In the case of microwave mixer diodes, the base is the anode and the tip is the cathode. R-types of microwave diodes have the opposite polarity.

—Robert H. Kernen, W4MTD

LAZY SUSAN FOR TOOLS

A HOLDER for hand tools can be made by drilling a series of holes in one flange of a large wire spool as shown in Fig. 1-4. A good source of these spools is a radio or TV service shop. Since screwdrivers and similar tools are apt to be top-heavy, small tubes made of tin plate can be made to support them vertically. Form the tube to a diameter to fit the hole in the spool and solder it in place. The entire holder can be picked up by the spindle and carried out for work on mobile or antenna projects.

—E. W. Koch, W8QMI

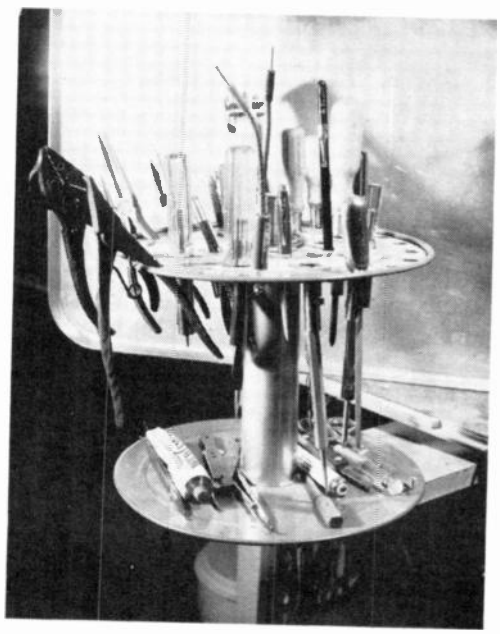


Fig. 1-4—W8QMI's lazy susan tool holder.

ROSIN SOLVENT

AERO GLOSS dope thinner makes a perfect solvent for cleaning rosin from soldered connections. The thinner comes in 4 oz., pint, and quart sizes at moderate prices and may be obtained from most any hobby supply store. Simply brush on the solvent with a small brush. The compound makes a good cleaner, too, and it doesn't seem to harm the finish on components, tube sockets, etc.

—George T. Walczyk, WA2FCC

RESIN CLEANER

QUITE often a good soldering job is left unfinished because of residue from the resin contained in the solder. I found that liquid type-cleaner which contains trichlorethane will dissolve the excess resin very easily. The solution is noninflammable, non-corrosive and dries instantly. A four-ounce bottle can be purchased in almost any office-supply store for less than a dollar. The perfect applicator is a cotton swab, such as a "Q-Tip," usually found in the medicine cabinet.

—Vincent A. Clarida, K4CSI

FIBER GLASS SOURCE

ALMOST any sports shop that repairs fiber glass fishing rods usually is an excellent source for transmission-line feeder spreaders. These shops usually have a large collection of odd lengths of fiber glass rod available at a nominal charge. Fiber glass has excellent electrical characteristics, is easy to cut, notch and drill. You probably can find many other uses for it around the ham shack.

—Leslie L. Sterling, W7GBL

LIQUID TAPE

A CORROSION-RESISTANT liquid plastic distributed by General Electric can be used to protect couplings, fittings, antenna hardware, etc. The compound has the consistency of thick syrup and is dabbed on the object, or if the item is small enough it can be dipped into the substance. In a few hours the compound shrinks to a tight smooth coating and takes on the appearance of black plastic tape. This "Liquid Tape" can probably be obtained from local General Electric distributors.

—Richard W. Kitson, K1GSD

CHASSIS HOLE PUNCH

HOLES for meters, or sockets, CRT bezels, etc. can be made in panels and chassis with a Greenlee Model 740 Electricians Knockout Punch. The tool looks like a cross between the familiar chassis punch and a can opener, and comes with four anvil disks for making holes 2, 2½, 3, and 3½-inches in diameter. The tool has no trouble cutting aluminum up to ⅛ inch in thickness.

ADAPTOR PLUG

THE sketch in Fig. 1-5 shows an exploded view of an adaptor plug which adapts a conventional u.h.f. series connector for mating with a phono jack. To assemble the plug, solder a 1-inch length of No. 12 copper wire to the center conductor of an SO-239 connector. Now, sweat-solder the cap end of a phono plug into the small end of an 83-1H hood. Slip the hood and plug assembly onto the SO-239 connector so that the No. 12 wire inserts in the center conductor of the phono plug. Attach the hood to the connector with machine screws and solder the wire that is in the tip of the phono plug.

—Robert J. Jarnutowski, K9ITS

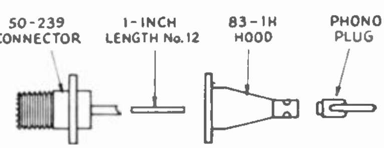


Fig. 1-5—U.h.f. series-to-phone-plug adaptor.

HOLE-DRILLING AID

SOMETIMES, while constructing or revising equipment, it is necessary to drill a hole in the chassis from the bottom since parts already mounted on the top side are in the way of the drill. I have found that a sharp hand awl or ice pick, when pressed down and rotated from the top of the chassis, will easily pierce the aluminum so that the hole can be positioned and drilled from the opposite side. This method is especially useful when a drill press is used and such components as i.f. transformers and tube sockets have already been mounted.

—Mel Hart, W0IBZ

CAN-OPENER SCREWDRIVER

ARE you constantly hunting for a small screwdriver? Try making one: Take an opening key that comes with sardine or coffee cans, file or pound it flat to the desired thickness and width to fit the screw head. The result is a miniature screwdriver.

—Stuart M. Mulne, KN8LEA

SOCKET PUNCH DRIVER

DRIVING the smaller Greenlee and Pioneer socket punches, which are equipped with a hex-head drive screw, is most difficult with the customary Crescent wrench, and becomes nearly impossible with that tool when the new socket hole has to be punched in a crowded chassis.

These and similar socket hole punches can be driven rapidly and conveniently with a tool consisting of an Exelite series 99 No. 14 (7/16") nut driver clamped in a carpeter's bit brace. Punching a ¾-inch socket hole with this tool combination takes only a few seconds as contrasted to about five minutes with a Crescent wrench.

SOLDER REMOVING TIP

A DESOLDERING technique which has appeared recently in several publications involves the use of a syringe bulb and a short length of small diameter spaghetti, or better yet, a short length of Teflon tubing.

The tubing is connected to the syringe and the joint to be cleaned of solder is heated with a soldering iron. The "squeezed" syringe is brought near the connection and then released. The suction will pick up the excess solder and draw it into the tube. In the case of spaghetti, the first ½ inch or so is cut off, since it will now be stopped up with solder. With Teflon tubing, the solder may either be shaken out, or poked out with a piece of wire. In either case, the connection will be left free of solder.

—D. P. Marlow, K7ASY

BOTTLING UP CHEMICAL FUMES

CORROSIVE vapors from chemicals commonly used around the ham workshop can be contained more effectively by storing the liquids in flexible plastic bottles. Fill the bottle about one half to three quarters full, then squeeze the bottle until the liquid almost reaches the top of the bottle. Now screw on the lid. This action creates a region of reduced pressure inside the bottle. If there is a slight leak around the lid, the chemical fumes will be contained inside the bottle since the air outside the container will be sucked into the bottle. The squeezing action will probably have to be repeated periodically, depending upon the size of any leak.

—Robert L. Martin, K1CJX

SHEET-METAL DRILL

THE sketch in Fig. 1-6 shows a modified high-speed twist drill that will make clean round holes even in very thin metal stock. This type of drill, which was brought to my attention by Sgt. L. W. Atkins of the RCAF, can be made from discarded, worn-out drills. First, grind a wedge on the tip of the drill as shown in the sketch at the right in Fig. 1-6. Then rotate the drill 90 degrees and grind the drill to resemble the sketch to the left in Fig. 1-6. Grind a small rake on the cutting edge of the drill to insure clean chip removal. Drills down to ⅛ inch can be modified this way without much trouble.

—R. R. Sopczak, VE3ABL

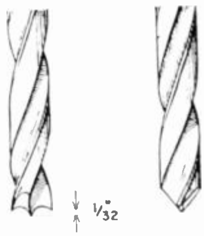


Fig 1-6—Sheet-metal drill.

INSULATING COMPOUND

I HAVE found that the red liquid-plastic substance, which is sold for insulating tool handles, makes an excellent all-around insulator for coating connectors, antenna hardware, etc. Called INSL-X Tool Dip, it is available from most electronic-parts distributors or mail-order houses.

—Roger W. Krass, K1ZSF

HOLE SIZE FOR TAPPING

THE article in June 1961 *QST*, by Deane concerning "Screws, Nuts and Things" failed to mention that one can find the correct drill size for a hole to be tapped by subtracting the turns per inch of the screw as a fraction from the screw size. For example, if a machine screw has a 32 threads per inch, then you would use a drill 1/32 of an inch smaller than the o.d. of the screw. This rule seems to hold true on all American screws because the threads are as wide as they are deep and it makes no difference if the threads are coarse or fine.

—Rev. Lyall Sherred, KØDEU

SOLDER BLOTTER

WHEN cleaning solder from joints or parts use a length of braided wire as a solder blotter. Hold the braid behind and against the unmelted solder. Heat the joint with a soldering iron and the solder will flow into the braid, removing it from the heated area.

—William Horstman, KL7ERC/5

INSULATED TOOL HANDLES

SOME technicians like to have insulated handles on their working tools. This can be accomplished in several ways, including the use of products currently available for this purpose. However, a very simple way to cover tool handles is by using shrinkable tubing, available now from most radio-parts mail-order houses. Just slip the tubing over the handle, snip off at the appropriate point, and apply heat with a soldering iron, hair dryer, hot plate, or match. The tubing will shrink neatly into place to form the desired tight insulated covering. The only precaution to observe is to make sure the final size of the tubing will be small enough. This is generally automatic if the original size of the shrinkable tubing is just sufficient to fit over the tool handle.

—Dwight B. Olson, DL4AGF/W9EAM

THIRD HAND GADGET

A THIRD-HAND device for holding small assemblies, circuit boards, etc. can be made by mounting Vise-Grip pliers on a board with angle brackets. Leather or sponge rubber padding on the jaws will minimize the danger of scoring or damaging the work being gripped. The device is especially useful for soldering operations.

—F. H. Western, VE2QO

GOOD CHASSIS LAYOUT PROCEDURE

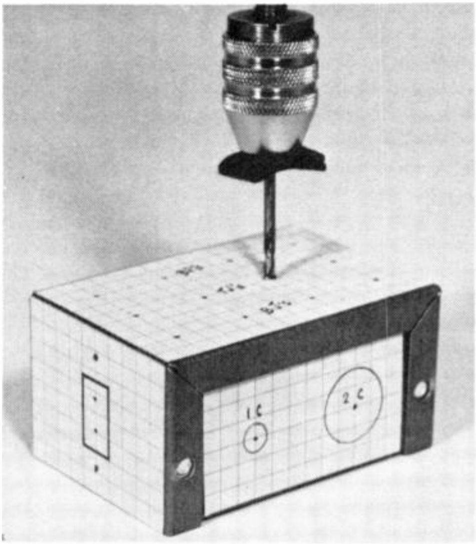
It is good practice to cover a chassis box with paper for layout, drilling, and cutting. Seeing it pictured here should encourage others to adapt this time-and trouble-saving idea.

Quadrille or similar ruled paper should be cut to fit each surface and then be attached with rubber cement. The ruled lines will help your thinking during the layout operation, save measuring with a ruler in many cases, and permit erasures. Dots indicate the centers for drilling. Outlines for large or odd-shaped openings can be drawn and reference notations can be added. Prick-punch all center marks before the drilling operation.

Leave the guide sheets attached while drilling and cutting to protect the bare metal or previously enameled surfaces. The sheets will peel off like adhesive tape when the work is done.

The photograph also illustrates another idea: Push a drill bit through a couple layers of felt so that in case the drill pierces the metal unexpectedly, the felt will prevent the drill chuck from marring the surface.

—*John Howard, K8MME*



SOLDERING TO ALUMINUM

Contrary to popular belief, it is possible to solder to aluminum. The procedure for using ordinary solder is as follows:

1) Heat the aluminum enough to melt 50-50 solder. A blowtorch or a gas range is the best source of heat for large objects. Electric irons rated as high as 200 or 300 watts will not work unless the object to be soldered to is extremely small.

2) Melt a little solder on the part to be tinned.

3) Remove the piece from the flame and scratch the solder into the aluminum with a wire brush; reheat if necessary to keep solder molten.

4) Allow complete cooling before the actual soldering operation is started.

Aluminum is ordinarily hard to solder to because it oxidizes rapidly. However, by brushing molten solder into hot aluminum, the oxide is actually removed and the solder is brought into direct contact with the metal, thus assuring a good electrical and mechanical bond. Once the aluminum is tinned it is very easy to solder.

Obviously, this process cannot be used on delicate parts or hard-to-get-at places. But it is certain that anyone who does much work with aluminum will find the idea useful.

—*Ray Orloski, W9SED*

NEW LIFE FOR WORN SOLDERING-IRON TIPS

Soldering-iron tips that have been subjected to prolonged service usually become poor conductors of heat. This condition may be remedied by cleaning away the oxide that has formed between the tip and the heating compartment of the iron. However, several such treatments ordinarily reduce the diameter of the tip excessively and render it completely useless.

One method of extending the life of a tip that has been cleaned and recleaned to a state of apparent uselessness is to wrap it in a strip of flashing copper. The tip should be thoroughly cleaned before the wrapping is applied, and the fit between tip, copper and the heating barrel should be as tight as possible.

—*W1DF*

QST REFERENCES

Small, self-adhesive labels, the kind stocked by most stationery stores, have the obvious amateur-radio applications of wire markers, control labels, etc. One more use for the labels that I have found is for noting especially interesting articles that appear in *QST*. I merely apply the label to the *QST* cover containing the article with reference on the label to the title, or subject, and the page.

—*F. H. Western, VE2QO*

SOLDER SPONGE

To reclaim used parts or to remove wires from terminals for modifications, make a solder sponge. This is simply a length of braided wire which has been dipped in liquid flux. The outer braid on any small coaxial cable, such as RG-58/U, makes a good sponge. Use Kester liquid resin flux or make your own by dissolving resin in isopropyl alcohol.

Position the sponge on the terminal and apply a hot soldering iron to the other side of the sponge. When the terminal is hot enough to melt the solder, the solder is literally sucked up into the sponge and leaves a clean terminal with no solder splashes on adjoining circuitry. This method is especially good where stranded wire has been wrapped around tube socket terminals.

for the Workshop

MAKING LARGE ROUND CHASSIS HOLES WITHOUT A PUNCH

THERE is no need of holding up work on an aluminum chassis just because punches for cutting large holes are not immediately available. Fig. 1-7 illustrates a set of four operations used here at W6GJZ whenever a large hole for a meter, tube socket, etc., is required. The steps involved in employing the system are as follows:

a) Use a pair of small sharp-pointed tinsmith's calipers to scribe the chassis as shown in Fig. 1-7. Make several *round trips* so as to score the metal deeply.

b) Drill a hole at the center of the circle. The hole must be large enough to accept a hack-saw blade. A pistol-grip saw is recommended for the operation ahead.

c) Make radial cuts—the more the better—from the center hole to the scored line marking the perimeter.

d) Bend each individual tab back and forth until it breaks free. After all of the tabs are removed, finish the job with a half-round file.

An alternative, if a pair of tinsmith's calipers is not available, would be to use an ordinary pencil caliper or a circular template for marking the hole. The saw cuts could then be made to the pencil line and the tabs removed with a small sharp chisel. The metal should be placed on a solid surface as the tabs are removed and the cuts should be made well inside the pencil line. This method worked out satisfactorily on 18-guage aluminum and required about ten minutes' work per hole.

—Dr. Russell R. Crane, W6GJZ

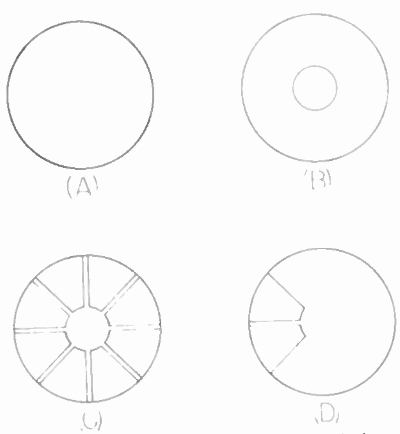


Fig. 1-7—Method of making large chassis holes recommended by W6GJZ. Operations (a) through (d) are listed in the text under the same headings.

COLORED TAPE FOR IDENTIFICATION

COLORED adhesive bandages can be cut into various sizes and shapes and used for identifying such things as cable connectors, cable ends, antennas, etc. Outlets and test-point jacks can also be identified by this method.

The bandages come in several colors—red, yellow, blue and white—and some are even marked with stars and other emblems. Conventional black plastic tape can be used to indicate ground.

—Dr. Maurice I. Sasson, W2JAJ

PLASTIC BAGS FOR THE WORKSHOP

THE problem of how to organize various varieties of parts is not unusual in the workshop. My solution is to package small parts in moisture-proof plastic bags. For small parts, two pieces of plastic are cut to the desired size, held with long-nose pliers near the edges, and held near the flame of a match or candle. Be careful not to ignite the plastic.

When packaging large parts, it usually isn't necessary to make your own bags; simply use sandwich bags available at grocery stores. The fourth side of the package can be sealed with an identifying label and hung on a rack such as shown in Fig. 1-8.

—Craig E. Kershow, KN3ZEE

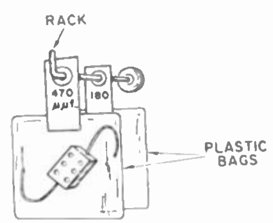


Fig. 1-8—KN3ZEE'S plastic bag parts holder.

FIBER GLASS FOR HAM USE

HERE's a suggestion—that a fiber glass kit used to repair fiber glass boats and automobile bodies be applied to amateur radio use. Here are a couple of ideas: This material can be used to join antenna mast sections. Be sure to wrap the joint first with waxed paper, then apply the fiber glass and you'll get a perfectly fitted coupling. QSL cards can be coated with the substance; carefully arrange the cards on a table and then apply fiber glass over the entire surface to make an attractive and durable operating tabletop.

—Charles F. Broschart, K2VHZ

CUTTING METAL TUBING

SHORT lengths of small, hard metal tubing are sometimes difficult to cut with a tube cutter. An easy way to cut tubing is to insert the tube stock in an electric drill, turn on the drill and hold a hacksaw against the tube at the spot to be cut. After a notch has been cut in the rotating tube, turn off the drill, strike the tube a swift blow, and it will break off at the desired spot. Lengths as short as ¼ inch can be cut with this method.

—James Garrett, K5BTV

ANOTHER NUT STARTER

A TOOL that I have found handy for starting nuts in hard-to-get-at places comes from an Erector set. The gadget is nothing more than a 6-inch aluminum strip about ¼-inch wide with sides of about 1/16-inch. At one end, cut two slits near the edges and depress the center piece as shown in Fig. 1-9. The resulting tong is depressed and the nut is inserted where it is held. Of course, the tool is restricted to only a few different-sized nuts, but other tools can be made for whatever sizes are most used around the shack.

—Jerrold Grochow, WA2PIV

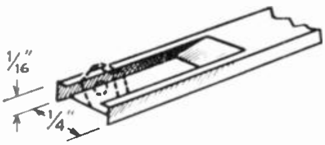


Fig. 1-9—WA2PIV's nut starter

PENCIL IRON CLEANER

OWNERS of pencil soldering irons will find the following technique useful in removing excess solder from the tip. The process is also quite effective for removing the oxide that forms on the tip. Plug in the iron and let it come up to temperature. Plunge the hot tip into a bar of sealing wax, then brush the wax off the tip with a stiff bristle brush. Excess solder and oxide will come off with the wax.

—Richard Bezman, K3NGP

EMERGENCY ALLEN WRENCH

WHEN I was trying to remove the main tuning knob from my receiver I discovered that it had an Allen set screw and that I didn't have an Allen head wrench. I tried a square-point wire nail for a tool and it worked fine! When I replaced the dial, I used a pair of long-nose pliers to tighten the screw via the nail wrench.

—Bill Jacobs, K5WTA

HAIR CURLER HEAT SINK

THE sketch in Fig. 1-10 shows a heat sink for protecting resistors, transistors and diodes during soldering. The device is one of those patented hair-curler gadgets. The one I have was purchased in a local 5 and 10 cent store and is made of aluminum. The fingers of the curler are hinged and spring-loaded and grasp the lead of the component to be protected.

—Edmund B. Redington, W4ZM

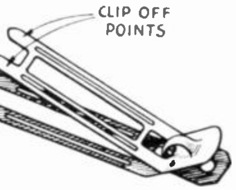


Fig. 1-10—W4ZM's hair curler heat sink

DISTILLED WATER

WHEN your XYL is defrosting the family refrigerator, ask her to save the ice that forms on the surface of the freezing compartment. It is almost pure water when melted and is a convenient source of mineral-free water for use in storage batteries.

—Julian N. Jablin, W2QPQ

INSULATING PAINT

DON'T throw away those old plastic toy models that come in kit form. Dissolve the plastic in a solution of acetone and use it as an anti-corona or insulating paint. When the acetone evaporates it leaves a thin protective plastic film.

—Edward M. Johnson, K6DTC/KR6CGA

COPPER SHEET SOURCE

COPPER sheeting for use in shields or low inductance v.h.f. leads can be obtained inexpensively from an arts and crafts supply store. The sheeting can be cut with scissors, shapes easily and can be soldered with a conventional soldering iron.

—Julian N. Jablin, W2QPQ

NUT STARTER

THE vinyl jacket covering most coaxial cable makes a handy machine-nut starter. Remove six to eight inch lengths of the covering from the cable. Place the nut on a flat surface and push the vinyl tube over the nut. The flexible vinyl material will grasp the nut and hold it until it is started on that inaccessible machine screw. Vinyl from RG59/U will suffice for nuts most commonly used in amateur construction but larger ones can be handled by RG8/U covering.

—Mike Kaufman, K6VCI

DX QSL TIP

INSTEAD of enclosing a self-addressed envelope when QSL-ing a DX station, send along a self-addressed gummed label. It will cost you less for postage and will be less expensive for the DX station, since he can now send you the card instead of a card in an envelope. It probably would be a good idea to place the gummed label between sheets of waxed paper, especially when the DX station is in the tropics!

—Irv Oppenheim, WA2WIJ

ANOTHER CRYSTAL GRINDING COMPOUND

IT is easy to overshoot the desired frequency when grinding crystals for v.h.f. use because the fundamental frequency is multiplied several times. In these cases a slow grinding compound is essential.

I use Sunbeam Shavemaster Self-Sharpening compound for the final grinding of a crystal. This substance is extremely fine in texture and it requires a great deal of elbow grease to move the crystal a few kilocycles.

—Kim A. Boriskin, K2MGS

SAFETY MAT

It's a standard Navy rule that whenever possible one should stand on a rubber mat when working with electronic equipment. Although most ham shacks don't present the same danger as a steel deck, it is still a good idea to use some sort of an insulated mat when the shack is located in a cellar or other location that is sometimes wet or damp. An old discarded bathtub mat can be used for this purpose.

—Jack Nelson, W2FW

LIQUID TAPE

Several years ago mention was made in this column about Liquid Tape. However, the substance was difficult to find since it was not a common stock item. A Liquid Tape is now made by GC Electronics (General Cement) and is distributed nationally by most radio parts dealers. The compound hardens to a strong pliable finish that will not crack, peel or chip. The Liquid Tape can be used as an insulating and waterproof coating for fittings and connectors on antenna systems. It is available in 2 oz. (176-2), 16 oz. (176-16), or 1 gallon (176-G) quantities.

—W1CUT

SOLDERING-IRON-TIP SAVER

The circuit shown in Fig. 1-11 consists of a 150-watt lamp, I_1, a 117-volt receptacle, J_1, and an s.p.s.t. toggle switch, S_1. If a 200-watt soldering iron is plugged into J_1 with the lamps switched in series with the iron, the iron will operate at reduced heat sufficient for small jobs but low enough to prevent the tip from deteriorating due to prolonged heating. When maximum heat is required, switch S_1 is positioned to place the full 117 volts on the iron, which will reach full heat almost immediately. Of course, an iron of any wattage may be used as long as the lamp has a wattage about equal to that of the iron. In addition to this tip-saving feature, the receptacle may be used as a checker for shorts in electrical appliances and equipment. When a unit under test is shorted, lamp I_1 will light up to full brilliance; if it has an open circuit the lamp will fail to light.

—John B. Powell, WA2DCA

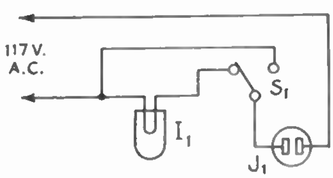


Fig. 1-11—WA2DCA's soldering-iron tip saver.

BASIC TOOL KIT FOR THE BEGINNER

When a newcomer starts out in amateur radio, he soon finds that one of the "must" items around the ham shack is a good set of tools. Whether he is building gear or maintaining his present equipment, there will be special tools, particularly suited to radio work, that he'll be needing in his tool box. He may get by for a while using a pair of scissors for wire cutters, or the family carving knife for wire-stripping, but sooner or later he'll find these make-shift substitutes are inadequate for the job. When that time comes, he is confronted with the problem of exactly what kind of tools he should buy.

The first item on the list should be a soldering iron. The iron to use for general radio work is a 60- or 100-watt job with a ⅜- or ¼-inch tip (such as the Drake model 400 used in the ARRL laboratory). If you buy an iron with a larger tip, you'll find there will be many places around a chassis you won't be able to reach. Larger-sized irons and tips *are* needed when doing sheet-metal work or when it is necessary to transfer a great amount of heat to the work.

When wrapping wires around terminals or when making connections to points that are difficult to reach, long-nose pliers are a radioman's "must." Long-nose pliers are available with or without wire cutters at the base of the jaws. The cutters are of little help in cutting wires close to sockets or the chassis, but often wires will be easy to reach, and having the cutters on the long-nose pliers will save time. The cost difference between pliers with and without cutters is so slight that it is worth while to purchase those with the cutters.

When wrapping wire around terminals and then soldering, many times there are short lengths of wire protruding that must be snipped off. This is done with a pair of diagonal-cutters. With these it is possible to reach into very cramped spaces and cut wires. The three tools listed, a soldering iron, long-nose and side-cutting pliers, together with a screwdriver, are probably the most important that the amateur uses.

A cheap paintbrush makes an excellent clean-up tool for removing bits of loose matter from a chassis or for brushing out dirt.

Small holes in metal and some insulating materials are drilled with twist drills and a hand drill. Most hand drills will only take drills up to ¼-inch diameter and one has to look for other methods if larger holes are involved. For holes up to ½-inch, a common method is to start the hole with a small twist drill and the hand drill, and then finish with the large drill held in a carpenter's brace. Another, and perhaps preferable, method, is to use a reamer held in the carpenter's brace. For still larger holes, such as the ⅝- and ¾-inch holes for miniature sockets and the 1⅛- and 1¼-inch holes for bakelite and ceramic octal sockets, radio chassis punches are recommended. These punch out a clean hole as a bolt is tightened, and they work beautifully in the materials normally used for chassis material.

A hack saw, large coarse flat file, and rat-tail file also are helpful for cutting and enlarging holes on a chassis.

In addition to the tools outlined earlier, Table 1-1 gives the contents of a basic tool kit for the ham. An electric hand drill is a luxury unless one is doing considerable work in iron and steel, as in building an antenna tower, where it becomes a "must." However, the tools described will prove to be adequate for most jobs the newcomer encounters.

—W1ICP

TABLE 1-1

Beginner's Tool Kit

- Electric soldering iron, 60 to 100 watts
- Solder (rosin-core)
- Long-nose pliers, 6-inch
- Diagonal cutting pliers, 6-inch
- Soldering aid (Hytron)
- Screwdriver, 6- to 7-inch, ¼-inch blade
- Screwdriver, 4- to 5-inch, ⅛-inch blade
- Hand drill, ¼-inch chuck or larger
- Drills, ⅛- and ¼-inch, and Nos. 18, 28 and 33
- Pliers (combination)
- Pocketknife
- Two large coarse files, one flat, one rat-tail
- Two small files, one flat, one round
- Keyhole saw (metal-working)
- Hammer
- Center punch
- 1⅛-inch socket punch
- Small paintbrush
- Reamer
- Carpenter's brace

BREADBOARD TRANSISTOR HEAT SINK

A simple and safe method for experimenting with stud mounted transistors without actually mounting them is to place thin flat washers of two different diameters on the mounting stud. Alternate the two sizes of washers as you place them on the stud. A nut of the proper size and thread will secure the washer stack, resulting in a heat sink that will increase the heat dissipation of the transistors during breadboard design.

—Clair E. Kirk, Jr., W6ORS

BENDING COPPER TUBING

It's an old trick but worth repeating: When winding large coils with copper tubing, put ordinary beach sand inside the copper tubing and it will prevent the tubing from "kinking" or flattening during the winding process.

—Jim Carlson, WB6EED

HOMEMADE QSL CARDS

The man who QSLs infrequently or changes his address often, or who wants special cards for contests, portable or mobile operation, can have some fun making his own QSL cards by using custom-made rubber stamps. Most large cities have rubber-stamp dealers; the names of dealers who specialize in this area can usually be found in the classified section of *QST*.

Usually, it's a good idea to use two stamps, one of which has the call in large letters, and another with slightly smaller type for the contact information heads. Actually, I use three stamps for my QSL cards. One has my call in large letters; I also use this stamp on station records and to identify station property. The second stamp contains my name and address. The third is the QSL body which contains such things as band, mode, time, and equipment. This is the largest and most expensive of the three, but it is never outdated and can be used forever.

Routine cards can be made using regular government post cards. However, a little experimentation with colored cards and ink can produce a handsome personalized card.

—Alex. F. Burt, K3NKX

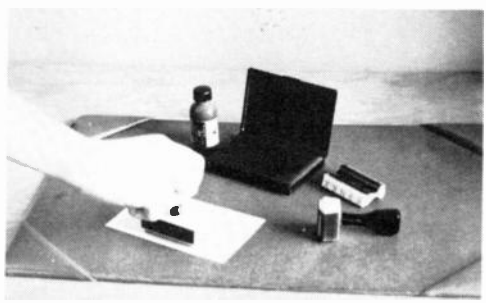


Fig. 1-12—Equipment for making your own QSL cards: stamps, inked pad, paper stock and some imagination! This stamp is freshly inked and then applied with one firm motion to produce a neat, clear impression.

Hints and Kinks . . .

for the Receiver

REMEDY FOR NOISY VOLUME CONTROLS

THE following scheme has been used for several years, to advantage, for quieting noisy volume controls. First make up a cleaning solution using a small dab of plain unmedicated Vaseline and a small amount of lighter fluid, naphtha, or any noncorrosive solvent that is quite volatile under normal conditions. Dissolve the Vaseline in the solvent in a warm place. Make up a batch of it and keep it in a stoppered bottle.

To cure the noisy volume control, remove the volume control knob, dip a pipe cleaner into the cleaning solution, and apply to the control shaft while turning the shaft back and forth with your fingers. A few applications for about one minute should be enough to return the control to normal again. Remember, if you use an inflammable solvent, keep fire and sparks away from it. If used on a plugged in receiver or other equipment connected to the a.c. line, pull the plug out first. The cleaning solution is both a cleaner and a lubricant and is not messy. It will penetrate small spaces, the solvent will evaporate and the lubricant will remain.

—G. Roger Gladding, W1AOS

OUTBOARD B.F.O.

THE circuit shown in Fig. 2-1 is a simple 455-kc. b.f.o. which is easy to build and adjust. Most of the parts can be found in the junk box but if components do have to be purchased they can be obtained with no great damage to the billfold.

The circuit is a basic one and almost any triode may be used. The two coils and their capacitors are the two sections of a common 455-kc. i.f. transformer. If the b.f.o. is mounted near the receiver detector circuit no additional coupling may be required. However, the diagram shows a coupling capacitor C_1 which may be connected to the detector diode plate if additional coupling is required.

—James Lewis, K4SAM

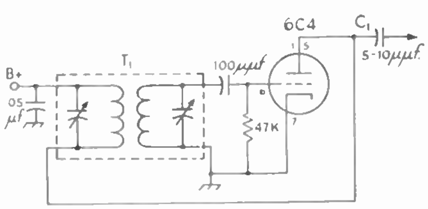


Fig. 2-1—Circuit of the b.f.o. Transformer T_1 is a 455 kc. i.f. transformer.

NOISE CANCELLING SYSTEM

A SYSTEM for noise reduction, which has been around since the "spark days" and which can be used successfully under certain conditions, is shown in the diagram of Fig. 2-2. I am using the system on 80 meters where L_1 consists of about 20 turns of wire on a 1½-inch diameter form. The coil, L_1, is mounted so that the coupling to L_2, the receiver's antenna input coil, can be varied until the phase relationship between the two coils is 180 degrees out of phase and the noise will be canceled out.

—Gordon Crayford, VE6EI

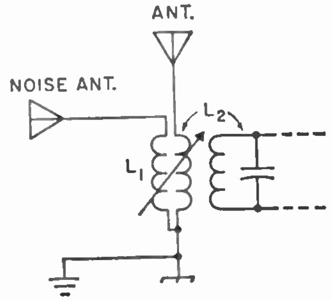


Fig. 2-2

BANDSPREADING THE BC-455

THIS modification to the popular 6-9.1 Mc. Command receiver should appeal to both old hands with surplus equipment and those newcomers who are using this receiver as a mainstay of their stations. The end result of about an hour's work on the BC-455 will double its bandspread so that the 40-meter band covers about 2½ inches of dial circumference compared with the original one inch it occupied.

First, take off the outer dust cover of the receiver and remove the cover over the tuning capacitor. In order to do this it will be necessary to remove two of the i.f. cans and several tubes unless a right angle screwdriver is available. This provides access to the two bolts on the cover of the plate that supports the 12K8 grid cap lead. Now remove all rotor plates from the capacitor except the right-hand three in each section (looking at the capacitor from the rear of the receiver). Replace the dust covers. The dial will now have to be recalibrated. First paint it completely with black enamel. Locate the 40-meter band with a transmitter, signal generator, or the 7.335-Mc. Canadian Observatory signal. The rest of the calibration is best done with a 100-kc. crystal calibrator that has been checked against WWV. The dial can be calibrated by scratching it at 100-kc. intervals. Commercial decal numbers will dress it up and give it a professional appearance.

—Hovey M. Cowles, W3JWZ

IMPROVING GC1-A SELECTIVITY

To obtain more selectivity in the Heath GC1-A receiver, W6TNS suggests placing a 0.005-µf. disk ceramic capacitor, C_1, across the Transfilter, as shown in Fig. 2-3.

—Monty Hart, VE3TA

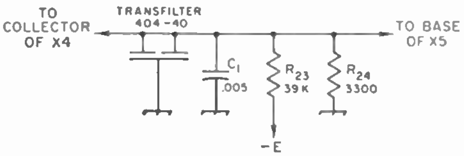


Fig. 2-3—Mohican selectivity is improved by adding capacitor C_1.

SIMPLE CRYSTAL FILTER

The circuit in Fig. 2-4 is an ultrasimple crystal-filter i.f. amplifier for any receiver that has an i.f. of 440 to 470 kc. Crystals Y_1 and Y_2 are FT-241A surplus types matched to 5 cycles at the i.f. With the i.f. of 460 kc., and a crystal-controlled b.f.o. at 461 kc., capacitors C_1 and C_2 were adjusted to reject the other side of zero beat which was down at least 60 db. after adjustment. A bandwidth of about 250 cycles, at 10-db. points, was obtained with the system. A complete i.f. strip, using only one i.f. transformer, can be made by adding an amplifier at point "X" and feeding the output to a product detector.

This circuit is a modification of the one by W6YBR, "An Inexpensive Crystal-Filter I.F. Amplifier", *QST*, February 1958. With an i.f. this low, only two crystals are needed instead of three used by W6YBR.

—Chet Opal, K3CUW

SOURCE OF HUM IN OLD RECEIVERS

My six-year-old receiver, after traveling all over the country without benefit of normal servicing, finally required a complete overhaul. One of the most obvious defects was the strong a.c. hum that appeared consistently in the output of the set.

Although all new capacitors—both paper and electrolytic—were installed in the receiver during the overhauling process, the hum was found to be just as bad as ever when the set was turned on. After much checking, the trouble was traced to defective ground connections.

This particular receiver is one of the type that utilizes the metal mounting rings for the tube sockets as ground tie-points. These rings are in turn fastened to the chassis by means of rivets. During the years of use, the rivets had worked loose, thus allowing a coating of oxidization to form between the rings and the chassis. Naturally, a set of very poor ground contacts was the result. A little solder between the rings and the chassis did the trick as indicated by complete elimination of the hum.

—Lee Dilno, W8DAP

ACCURATE ZERO BEATING

Because the audio frequency response of most receivers drops rapidly below a few hundred cycles per second, it is not possible to zero beat two signals exactly by listening to their audio beat note on a receiver's speaker or earphones. A more accurate indication of zero beat can be obtained by measuring either the receiver's a.v.c. voltage or its second detector output voltage with a vacuum tube voltmeter. When the difference in frequency between the two signals is only a few cycles per second, the voltmeter needle will fluctuate with the beat signal. The fluctuations become slower as the frequency difference becomes smaller and a large dip is obtained when the frequencies are exactly equal. However, this dip is extremely sharp and it sometimes requires a steady hand to zero beat the two signals exactly.

—D. F. Zawada, K8EMS

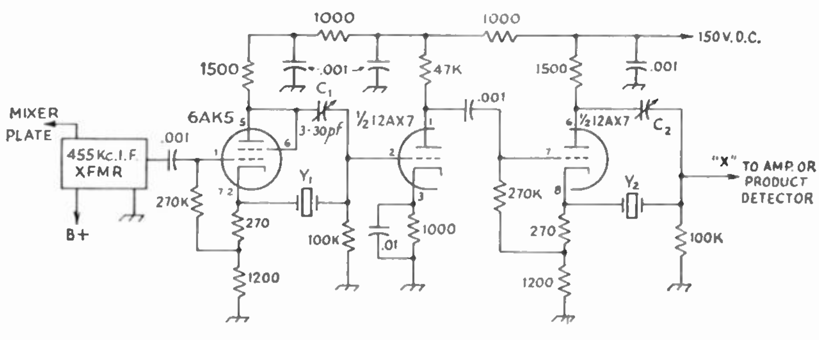


Fig. 2-4—K3CUW's crystal-filter i.f. amplifier circuit. Unless otherwise indicated, capacitances are in µf., resistances are in ohms, resistors are ½-watt.

DUAL TUNING EYE FOR RTTY

Most RTTY terminal units use an oscilloscope or a zero-center meter as a tuning indicator. A less expensive approach is to use a 6AL7 electron ray tube. This "magic eye" tube has two "eyes" so that both the mark and space filter operations can be monitored simultaneously.

The circuit in Fig. 2-5 shows a typical circuit using the 6AL7 tube. The tube is inserted between the limiter and keyer sections of the terminal unit. To use the indicator, tune for equal deflection of both eyes.

—Neil Iverson, W7PVF

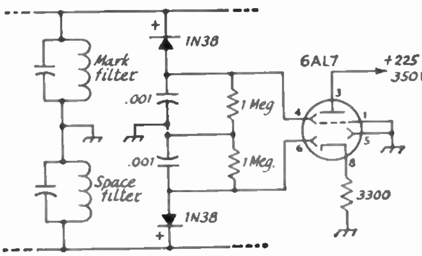


Fig. 2-5—W7PVF's dual tuning-eye circuit.

USING 1N34s TO PREVENT RECEIVER OVERLOAD

After installing a kilowatt final amplifier, I was troubled by very slow recovery of the receiver in going from transmit to receive after the send-receive switch was thrown. It took as long as three seconds for the receiver to return to normal, especially when using sharp crystal selectivity. Putting a neon bulb across the antenna terminals did protect the antenna coil on the receiver, but had no effect on receiver overloading. Attempts to time the relays weren't too successful, since getting the relays to open in the proper sequence would result in the wrong closure sequence.

Installation of two germanium diodes (1N34 crystals) across the antenna terminals of the receiver completely eliminated the slow recovery and effectively prevented receiver overload regardless of relay timing. Apparently, the crystals begin conduction at a fraction of a volt, and bypass anything above this level so that it does not enter the receiver. No effect on the strength of received signals was noted, and there was no TVI as might be possible from the use of nonlinear elements in the antenna circuit.

The crystals were installed directly across the antenna terminals of the HRO-5, with the polarities of the crystals such that one was opposite in polarity to the other. The same system was tried on a BC-779 receiver with equally gratifying results.

The author hopes that this novel idea may be of help to someone who is bothered by slow receiver recovery caused by transmitter energy feeding back through the antenna relay to the receiver.

—Sidney L. Gerber, WØTAI

EXTENDING THE HEATHKIT Q-MULTIPLIER RANGE

By adding an 880-μf. fixed mica capacitor to the tuning capacitor of the Heathkit Q multiplier, the unit will cover the 400-kc. range. I now can use the multiplier on my Navy RBC receiver, which has a 400-kc. i.f.

—Gerald Wyatt, CN8FN/K4UNW

RECEIVER OVERLOAD PROTECTION

Damage to my Collins receiver from r.f. overload prompted me to install two silicon diodes connected back-to-back from the antenna post to ground. The diodes must be silicon, since silicon diodes do not conduct until the voltage across them reaches about 0.5 volts. With two diodes connected as shown in Fig. 2-6, the voltage to the receiver input is limited to about 1 volt peak-to-peak.

I used the 1N1341A diode which is rated at 7 amp., although almost any silicon diode can be used. The 0.5-volt figure holds for all silicon rectifiers regardless of p.i.v. or current rating.

Mount the diodes on a grounded metal shield inside the receiver chassis, as close to the antenna terminal as possible. In order to mount both diodes to the same shield, use one 1N1341RA diode, a reversed polarity type. No change in my receiver's performance can be noticed since installation of the diodes.

—A. W. Moody, W7SV

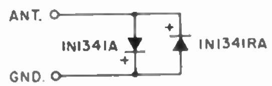


Fig. 2-6—Back-to-back silicon diodes will give receiver overload protection.

NOTE ON SURPLUS TYPE BC-348 RECEIVERS

The dial calibration on BC-348 receivers can be greatly improved by adjusting the inductance of the oscillator coils. To provide this adjustment (except in J, N, & Q series) proceed as follows:

1) Make certain that the i.f. is correctly aligned at 915 kc.

2) Note whether the dial spread is greater or less than the actual frequency band covered.

3) If the dial spread is greater, the inductance is too small.

4) If the dial spread is less, the inductance is too large.

5) Remove the top and bottom covers from the oscillator compartment and drill and tap a 6-32 hole over the center of each coil which re-

quires correction. The covers are thin and best results will be obtained if the holes are punched through with a tapering punch to give more material for threading.

6) In the holes over low inductance coils, insert a small powdered iron slug with 6-32 screw attached.

7) In the holes for the high inductance coils, insert a 1-inch 6-32 brass screw, with the head inside the coil.

8) By alternately adjusting the trimmer capacitor (near the high end of the dial) and the slug (near the low end of the dial) bring the receiver as nearly as possible into calibration. Lock the slug adjustments with a 6-32 nut and cut off any excess screw length to prevent catching on case.

If care is used, the calibration over most of the dial should be off not more than the thickness of one of the heavy calibration marks on the dial.

FLYBACK TO THE PAST

I ENJOYED W3QY's article in October, 1962 *QST* on the NAA receiver, especially since I had built a receiver for the v.l.f. bands. My approach to the honeycomb coil problem was different, however. I used a television horizontal circuit flyback transformer. The primary winding, L_2, serves as the tickler coil in the plate circuit while the secondary winding, L_1, becomes the tuned grid coil. The ferrite core must be removed from the flyback transformer and is discarded.

The diagram in Fig. 5 shows the circuit of my v.l.f. regenerative receiver. The r.f. choke, RFC_1, is made from two or three old i.f. transformer windings connected in series. The regeneration is not at all critical and threshold operation of feedback is unnecessary. However, it is advisable to have some control of regeneration by means of the potentiometer to control the detector plate voltage. The 12AU7 will oscillate with about 11 volts on its plate, but reception is improved with 20 volts and becomes degraded again at 45 volts.

The 500-hy. transformer, T_1, can be any audio interstage transformer with its primary and secondary windings connected in series. Of course, they must be connected in the proper phase.

With a 500-pf. tuning capacitor and my particular antenna, the receiver tunes approximately 15 to 23 kc. The output volume is sufficient for speaker output.

—*Floyd Donbar, W8PA*

USING DYNAMIC SPEAKERS

IF you have an old electrodynamic speaker in your junk box it can be put to good use as a shack speaker. All that's needed is a straightforward half-wave rectifier circuit to power the speaker field coil. Such a circuit is shown in Fig. 2-8. For safety reasons, care should be taken to isolate the circuit from ground and all leads should be insulated.

It is a good idea to check the d.c. resistance of these speakers since some of them were used with automobile broadcast receivers where the field coil was excited with the car's primary voltage. These car speakers will have a low-resistance coil and are not applicable for use with the circuit in Fig. 2-8.

—*John P. Stockes, KN8OIF*

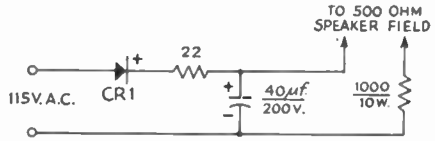


Fig. 2-8—Power supply suitable for use with dynamic speakers.
CR_1—150-ma. rectifier.

NBFM WITH THE NC-300

THE diagram in Fig. 2-9 shows the circuit of the n.b.f.m. adapter built by W7LHL and my-

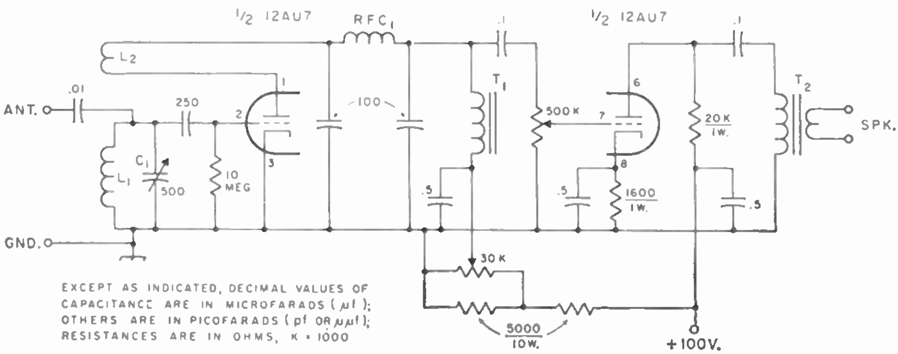


Fig. 2-7—W8PA's regenerative v.l.f. receiver

C_1—500-pf. variable capacitor.
L_1, $_2$—TV flyback transformer.
RFC_1—See text.
T_1—See text.
T_2—Output transformer (Standcor A3328).

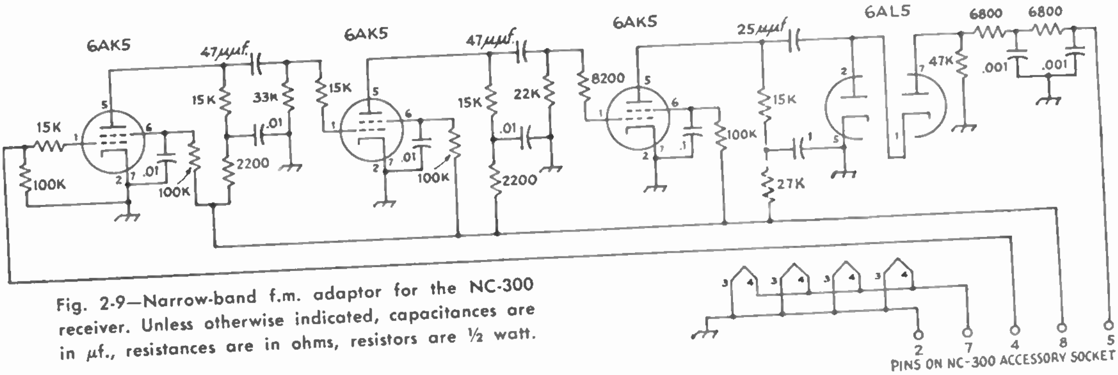


Fig. 2-9—Narrow-band f.m. adaptor for the NC-300 receiver. Unless otherwise indicated, capacitances are in μf., resistances are in ohms, resistors are ½ watt.

self.[1] The unit is built by W7LHL and my- Minibox with an 8-prong octal plug mounted at one end. The unit is inserted into the NC-300 receiver's accessory socket. To receive n.b.f.m., turn the NC-300 mode switch to AGC. Limiting can be controlled by the receiver's r.f. gain control.

—*Len Garrett, W7JIP*

[1] "A new approach to F.M. Reception," *QST*, September, 1946.

SURPLUS 274N RECEIVER NOTE

I have converted several 274N receivers and have found that a large percentage of these receivers have defective capacitors—the large triple section 0.05-μf. jobs. I suggest that anyone who is going to modify this equipment automatically replace these capacitors with disk ceramic units to save headaches later on.

—*Dick Walker, W2MNY*

PLUG-IN MECHANICAL FILTER

The popular Collins mechanical filter, type FA-21, will fit a standard transistor socket. In fact, Collins has even shortened the input and output pins of the filter to 7/32 inch to facilitate this type of mounting. The use of a transistor socket enables rapid replacement of a suspected faulty filter and removes the worry of heating the filter while soldering directly to the input and output pins.

—*W. S. Baker, K2LZF*

REASSEMBLING THE HQ-110 AND HQ-170

Owners of the Hammarlund HQ-110 and HQ-170 no doubt have found it difficult to replace the cabinets on the chassis on models equipped with clocks. The trouble arises because the clock adjustment shaft must pass through a hole in the rear wall of the cabinet. If a 6- to 8-inch piece of spaghetti is placed over the clock adjustment shaft before the cabinet is replaced, the spaghetti can be easily guided through the cabinet hole. After the cabinet is on, remove the spaghetti and install the knob provided for the clock shaft.

—*Clifton H. Falls, K8JIC*

LOW-FREQUENCY PARAMETRIC AMPLIFIER

The circuit shown in Fig. 2-10 is a simple 10-Mc. parametric amplifier that can be made to function with only simple test equipment. I used it to get the feel of parametric amplifiers before jumping in at the deep end with a v.h.f. or u.h.f. model.

A grid-dip oscillator is used to resonate the tuned circuits. Coil L_2 is resonated to the input signal frequency, f_s, and L_3 to the idler frequency, f_i. The pump is coupled into the signal tank by means of a four-turn link, L_1, wound on the cold end of L_2. An r.f. signal generator having a 50-ohm output impedance is used as a pump generator. Output from the device is coupled to the receiver from point "A" or "B". Almost any of the inexpensive capacitor diodes seem to work in this circuit. I used a Vari-Cap with a nominal capacitance of about 47 pf.

Most of the various parametric amplifier effects described in the literature may be observed by using different combinations of signal, pump, and idler frequencies. Some interesting frequency combinations in Mc. are:

f_s	f_p	f_i
10	14	4
10	14	24
10	20	10

—*Richard F. Burns, W9NVC*

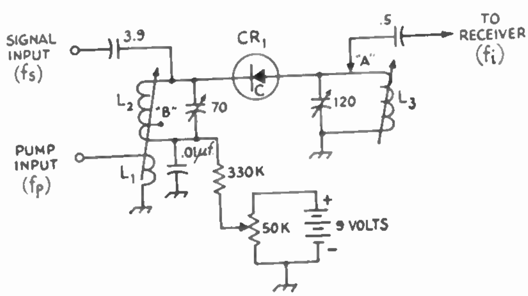


Fig. 2-10—"Educational" low-frequency parametric amplifier. Unless otherwise indicated, capacitances are in pf. CR1—Semiconductor capacitor diode (see text).

NOISE LIMITER FOR HYBRID RECEIVERS

PRACTICALLY all of the automobile b.c. sets today are of the hybrid variety which require a plate voltage of only 12 volts. The dark lines in Fig. 2-11 show the circuit of a self-adjusting series limiter that can be used in hybrid circuits. It is important that the diode CR_1 be silicon and of the high-back resistance type. Some silicon diodes give only fair results and germanium diodes will not work at all. The 1N658 computer diode works well in this application and its performance can be compared to that of a vacuum tube. The limiter can be switched out of the circuit by shorting the diode CR_1, but the leads to the switch should be as short as possible and must be shielded.

—Samuel M. Bases, K2IUV

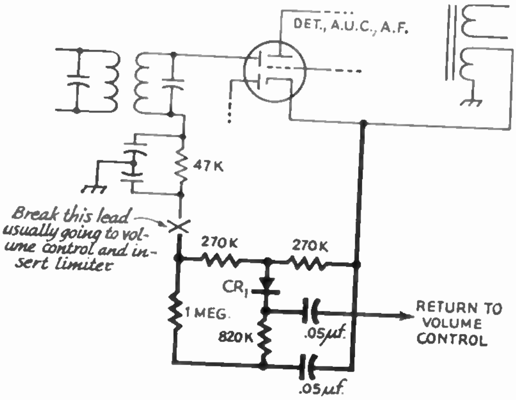


Fig. 2-11—A semiconductor diode noise limiter for hybird receivers. Diode CR1 is a 1N658 computer diode.

EMERGENCY EARPHONES

IF the metal diaphragms in your earphone are damaged cut two disks the size of the original diaphragm from a piece of cardboard. Next, cut two smaller disks, about the size of a dime, from a tin can and stick them to the center of the cardboard disks with a strip of masking tape. The new diaphragms are inserted in the phones with the cardboard sides toward the magnets. The earphones will have an entirely new sound which, in my opinion, is better than the original. I'm still using mine after three months and gone is the tiring, rasping, "tinney" sound usually associated with even high-priced earphones.

—Bob Sparks, W5YWD

REDUCING THE NOISE FIGURE OF PENTODE AMPLIFIERS

RECENTLY I ran across a method of reducing the noise figure of a pentode v.h.f. amplifier. It involves the use of feedback in the screen circuit of the tube and reduces the effect of partition noise. On a 6AK5 amplifier operating on 6 meters, I was able to reduce the noise figure about one db. by connecting a ten-turn coil, ⅛ inch in diameter between the 6AK5 screen and the screen by pass capacitor. Those interested in pursuing this technique further can find information on the subject in the book *Noise*, by Van Der Ziel, published by Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

—Robert F. Schuetz, W2BDG

A PANADAPTER CONNECTION FOR THE 75A-4

I FOUND an easy way to connect a BC-1031C panadapter to my 75A-4 without the need for much more than lifting the cabinet lid. Connect the hot wire from the panadapter cable to the tube shield of the 6BA7 second mixer and ground the outer shield of the cable to the receiver chassis. When replacing the tube shield, push it down to within 1/32 of an inch from the tube base shield, but don't let it touch! This forms a concentric capacitor around the tube and provides sufficient coupling between the receiver and panadapter.

—Robert W. Westcott, W3DNY

STILL ANOTHER NAA RECEIVER

THE diagram in Fig. 2-12 shows the circuit of my transistorized NAA receiver which was inspired by the converters described by W9BNW/8 ("Hints & Kinks," *QST*, July, 1959) and WØOMN ("Hints and Kinks," *QST*, February, 1961). I use a 2N414 transistor, although almost any kind of transistor will work. A 2370-kc. marine-band crystal, Y_1, was used for the oscillator simply because I'm feeding the converter into a 1937 vintage receiver with stability best around this frequency.

The 15-kc. input circuit is a 0.001-µf. fixed capacitor and a 60- to 130-mh. horizontal oscillator inductor, L_1. A capacitive divider, C_1 and C_2, is shunted across the input circuit to tap down the transistor input. All of the capacitors marked "M" in Fig. 2-12 are mica.

I used an audio signal generator to resonate the input circuit and, after the antenna was connected, only a slight readjustment was necessary. My antenna is approximately 50 feet of wire running around the edge of the basement. Although NAA roars in at my location, a more sophisticated antenna will probably be necessary for those farther removed from Maine!

—Ben Warriner, K1PNK

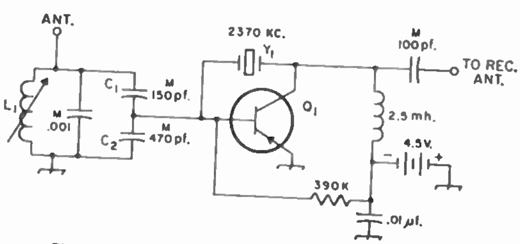


Fig. 2-12—K1NK's transistor NAA receiver.
L₁—60–130 mh. (Thordarson HS-6).
Q₁—2N414 or equivalent.

REPLACEMENT R.F. AMPLIFIER

Some time ago, while working on the development of a v.h.f. multiplexing amplifier, I came across a tube which seemed well suited for receiver front-end work. This tube is the 6EH7 and is readily available from most radio parts distributors.

What makes this tube attractive to the amateur is that it is a high-gain, low-noise, remote cutoff pentode, ideal for receiver front-end use, and that its voltages are near enough to those of the 6BA6 to allow direct electrical replacement. It is only necessary to construct a small 7 to 9 pin adapter plug.

The adapter plug was built as follows: obtain 7- and 9-pin tube sockets similar to Cinch-Jones types TS102P03 and TS103P03 respectively, and about two feet of reasonably hard, tinned, 18-20 wire. Remove the mounting rings from both sockets and the pin connectors and center lug from the 7-pin socket. Drill through the pin holes in the 7-pin socket with a drill sufficiently large to just pass the selected wire. Connect 7 three-inch pieces of wire to the pins of the 9-pin socket as shown in the table. Slide ½-inch long pieces of spaghetti tubing over each lead to prevent shorting. Form each lead so that it will fit through the proper hole in the 7-pin socket and slide the two sockets as close together as possible. The sockets may be held together by electrical tape or other methods. Cut the protruding leads to a uniform length of approximately ¼ inch and form so the completed assembly will insert into a seven-pin socket. The completed assembly will be approximately 1½ inches high. Being in the receiver front end, the over-all lead length should be kept as short as possible. A further, but not essential refinement, would be to use a small bypass capacitor for the 6EH7 screen connection at the 9-pin socket. The only variation in characteristics which requires compensation is the input grid capacitance. In most instances, the antenna trimmer capacitor will easily compensate for this variation, since there is only a 4-pf. difference.

Pin connections for 9-pin to 7-pin conversion.

9-pin socket	*7-pin socket*
1 and 3	7
2	1
4	3
5	4
6	NC
7	5
8	6
9	2

In the writer's case this substitution was made in a National NC-183D. At 28 Mc., the noise figure, as measured with a Polytechnic Noise Figure Meter, was 13-15 db. with the 6BA6 and 7-9 db. with the 6EH7. Two 6EH7s, for the first and second r.f. amplifiers, were also tried; however, the increase in gain caused a tendency toward oscillation and very little additional improvement in noise figure.

—Eugene B. Fuller, W2FZI

ONE-CRYSTAL MULTIBAND CONVERTER-OSCILLATOR

The oscillator circuit by Murray in "Technical Correspondence," *QST*, May 1960, page 51, reminded me of one I used in a crystal-controlled converter which tuned all the amateur bands 80 through 10 meters and used only one crystal. A suggested oscillator circuit is shown in Fig. 2-13. It uses a 6-Mc. crystal, is used in conjunction with a conventional bandswitching converter, and is fed into a BC-454 Command set receiver. The frequency relationship of the crystal-controlled oscillator and the receiver tuning range is as follows:

Band meters	*Oscillator Output Freq. (Mc.)*	*Receiver Tuning Range (Mc.)*
40	12	5.0–5.3
20	18	4.0–4.35
15	18	3.0–3.45
10	24	4.0–5.70

Inductors L_1, L_2 and L_3 along with C_1 should be resonant at the indicated frequencies.

—Jackson L. Cox, WØKMV

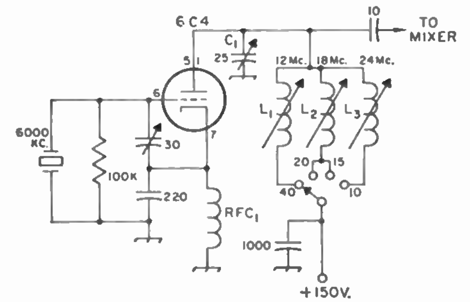


Fig. 2-13—Single-crystal oscillator for miltiband converter Capacitances are in μμf.

L_1—9 μh. slug-tuned coil (Miller 40A826CB1).
L_2—4 μh. slug-tuned coil (Miller 40A336CB1).
L_3—2 μh. slug-tuned coil (Miller 40A226CB1).
RFC_1—2.5 mh. r.f. choke.

RACK PANEL SPEAKER ENCLOSURE

Installing a speaker in a cabinet panel or rack can sometimes be a problem. An easy solution is to drill several ¾-inch holes in a circular pattern for the sound waves to come through. After removing the burrs, cement a plastic picture frame to the panel. Instead of a picture, insert a piece of speaker grill cloth to cover the holes. The frames are available at most five-and-dime stores for only a few cents.

—Chuck Utz, K1QNF

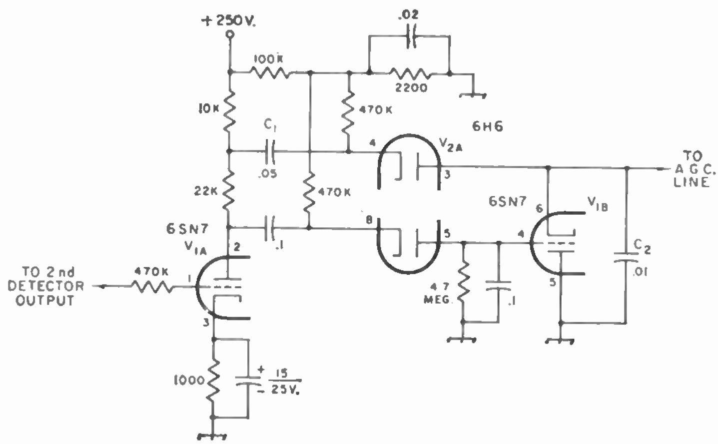


Fig. 2-14—K7UUC's hang a.g.c. system. Capacitances are in microfarads, resistances are in ohms, resistors are ½-watt.

HANG A.G.C. CIRCUIT

The circuit shown in Fig. 2-14 is a modification of the audio-hang system described by WØBFL, *QST*, October 1957, and has helped to give a new lease on life to my 17-year-old HQ-129-X receiver.

A comparison of the circuit in Fig. 2-14 with WØBFL's will show that this one is somewhat simpler. That is, only two diodes are required and no audio transformer is needed. Capacitors C_1 and C_2 were determined by experiment to give a suitably fast attack. The resistor in the grid lead of V_{1A} reduces audio distortion that would otherwise occur because of grid-circuit clipping on strong signals.

Although my application required the use of a 6SN7GTB and a 6H6, more modern types such as the 12AU7 and the 6AL5 can be substituted with no other changes.

—*Frank E. Stuart, K7UUC*

EARPHONE COVER PADS

Old-fashioned uncomfortable headphones can be modernized by outfitting them with a set of vinyl plastic doorknob covers available from most hardware or five-and-dime stores. Cut a small hole in the center of each cover and slip the covers over the phones. The earphones can then be worn much longer without discomfort.

—*Les Collum, KØRHI*

SIMPLE HIGH-PASS FILTER FOR 28-MC. CONVERTERS

The simple high-pass filter circuit shown in Fig. 2-15 has a cut-off frequency of approximately 10 Mc. It is used to suppress b.c. signal feedthrough that frequently occurs when a 28-Mc. converter is worked into a low-frequency tunable i.f. such as a broadcast receiver. In one particular installation—c.d. layout described in *QST* for September, 1955—the filter completely eliminates "birdies" which were encountered when using a ground-plane antenna and a long feed line. The filter was inserted between the antenna relay and the converter.

The housing for the filter may be made from either aluminum or flashing copper and should measure 2 by 2 by 4 inches. A box of this size allows inductors to be spaced apart enough to prevent coupling between coils.

Component values shown in Fig. 2-15 are for use with a 50-ohm antenna feed system. Values for a 75-ohm filter, or one having a cut-off frequency other than 10 Mc., may be quickly determined by employing the following formulas:

$$C_K = \frac{1}{4\pi fc}$$

$$L_K = \frac{1}{4\pi fcR_G}$$

where C_K = Capacitance in microfarads (μf.)
f = Cut-off frequency in megacycles (Mc.)
L_K = Inductance in microhenrys (μh.)
R_G = Termination resistance in ohms.

—*P. W. Rand, W1DBM*

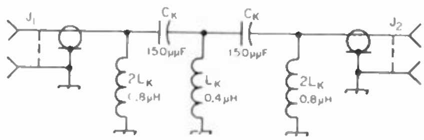


Fig. 2-15—Circuit diagram of the high-pass filter suggested by W1DBM.

L_K—0.4 μh.: 6 turns No. 20 enam. wire, ⅜-inch diam., 3/16 inch long.

$2L_K$—0.8 μh.: 11 turns No. 20 enam. wire, ⅜-inch diam., ⅜ inch long.

Note: Coils are self-supporting.

FLY-WHEEL TUNING

I have incorporated fly-wheel tuning in my Knight R100 receiver without even removing the cabinet. The idea could probably be adapted for almost any receiver. Remove the large main tuning knob. Fill this hollow (cup shaped) knob with lead shot, glue the shot in place and add a plastic back. With this arrangement, the "feel" of the tuning is much improved.

—*Henry L. Wyatt, K4YCR*

ZENER-LIMITED "HANG" A.G.C.

A MODIFIED version of Goodman's "hang" a.g.c. system[1] used by William L. Hale, K8JIX, is shown in Fig. 2-16. The modification is simple and might well be a desirable addition to any receiver employing "hang" a.g.c.

In order to obtain selectable "hang" durations, three separate, switched resistors were substituted for R_{1A} in the original circuit. The values chosen were 4.7 megohms for long "hang," 1.5 megohms for medium, and 0.47 megohms for fast recovery. In addition, K8JIX shunted the 0.47 megohm resistor with a 14-volt Zener diode, CR_1. When fast recovery is selected the diode prevents C_1 from charging to more than the Zener voltage when a strong signal appears. This limits the "hang" duration to a fixed maximum regardless of signal strength and is useful for c.w. break-in operation. The instantaneous attack of the a.g.c. system reduces receiver gain to a reasonable level when the key is closed yet the gain recovers between letters to allow a breaking station to be heard.

K8JIX found the diode unnecessary in the medium and slow-recovery switch positions, which he normally uses only for s.s.b. In this mode a negative bias from his transmitter disables the a.g.c. amplifier, as well as the audio in his receiver, so the a.g.c. line is inoperative when his s.s.b. transmitter is turned on and recovery time is of no consequence. In other situations, however, the diode could be shunted directly across C_1 and perform its limiting function at all times.

The resistor values and Zener voltage were chosen by K8JIX to suit his particular requirements. Other values may be employed to obtain different "hang" characteristics.

[1] Goodman, "Better A.V.C. for S.S.B. and Code Reception," *QST*, Jan. 1957.

[1] Arnold and Allen, "Some New Ideas in a Ham-Band Receiver," *QST*, May 1960.

10 MC. WWV WITH THE COLLINS RECEIVER

COLLINS 75S-1 and 75S-3 owners have had fun permuting the high-frequency crystals to see what additional band coverage can be obtained. There is one particular variation that is quite useful these days at locations where WWV on 15 Mc. fades out early in the evening.

Take the 6.555-Mc. crystal and plug it into one of the 14-Mc. positions—in other words, in place of either the 8577.5-, the 8677.5-, or 8977.5-kc. crystal. Next, tune the preselector to about 6 Mc. on the dial. WWV at 10 Mc. will come banging in loud and clear at "45" on the main tuning dial.

If you are interested in the frequency combinations that give the above results, here is the rundown. The second harmonic of 6555 kc. is 13,110 kc. Subtracting 10 Mc. (WWV) from this gives 3110 kc. Subtract the i.f., 455 kc., giving 2655 kc. as the p.t.o. frequency. The dial reading is 2700 minus 2655, or 45 as indicated on the dial.

When the band-selector switch is at one of the 14-Mc. positions, and the preselector is set to read about 6 Mc., the tuned circuits will tune to the proper frequencies.

—D. W. R. McKinley, VE3AU

Q MULTIPLIER FOR BC-312 OR BC-342

HERE is a hint for users of the BC-312 or BC-342 who wish to use these receivers with the Heathkit Model QF-1 Q Multiplier. The QF-1 will not tune to the BC-312 i.f. of 470 kc. To make the conversion refer to the QF-1 schematic and you will see a 3300-µµf. silver-mica capacitor in the tank circuit. Replace this capacitor with one with a value between 2800 and 3000 µµf., and retune the inductor to 470 kc. by adjusting the tuning slug.

Using a 2800-µµf. ceramic capacitor, the cir-

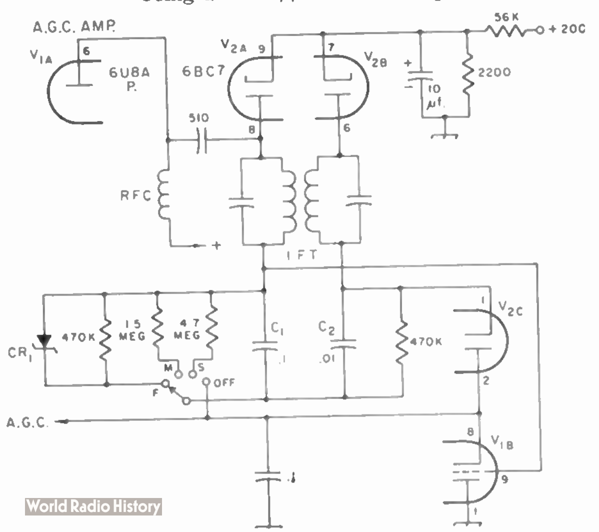


Fig. 2-16—Hang-a.g.c. circuit with diode limiting for fast recovery in break-in operation. CR_1 is a 14-volt Zener diode.

cuit came to resonance with the slug almost all the way in; so, if normal tolerances will not permit tuning to resonance at 450 kc., try a capacitor of 3000 $\mu\mu$f. Although I used an available ceramic capacitor which works very well, it is possible that the recommended silver-mica unit would improve the selectivity and Q. As it is, with the BC-312 series having such broad selectivity, the Q multiplier is a welcome addition when the going gets rough.

—*Harry K. Long, W7CQK*

HEADPHONE BALANCER

When the sensitivity of one phone in a headset is a little higher than the other, place a piece of tissue paper between the diaphram and the coils of the sensitive phone. This dampens the vibrations but doesn't introduce any noticeable distortion.

—*William Lise, WV2AUC*

HEADPHONE ADJUSTER SPRINGS

Many headsets available nowadays don't have the spring loading device which holds the receiver units in their preset position on the headband vertical slide bar. I have found that springs from the retracting mechanism of defunct ball point pens may be curled on between the headband brackets to overcome this omission. My Trimm headset now stays in this adjusted position.

—*Alan Parsons, K7UYJ*

SEMICONDUCTOR I.F. NOISE SILENCER

Today the problem of noise in amplitude-sensitive receivers is obvious, and most of this noise has been effectively eliminated in the receivers at the expense of the quality of the detected audio signals. But amateur radio is not high fidelity. Therefore, a combination of filters and limiters in the r.f., i.f., or a.f. stages of an amplitude-sensitive radio receiver will do the job of reducing noise strikingly well.

The Bishop circuit described by Stiles [1] is an excellent guide along these lines, and the one suggested in the ARRL *Handbook*[2] will prove useful. But with the unlimited numbers of receiver-accessory gadgets—Q multipliers, beat-frequency oscillators, S-meter amplifiers, crystal calibrators, product detectors, and squelch circuits—there is hardly any room left on the receiver chassis for other gadgets. This is primarily why the author chose semiconductors for this particular device, an i.f. noise silencer.

The schematic diagram of the silencer is shown in Fig. 2-17. A 100-pf. capacitor couples some of the i.f. energy from the grid of the second i.f. amplifier into the network L_1 and C_1, which should have values corresponding to the i.f. frequency in use in the radio receiver. A 1N34 diode, CR_1, rectifies all the i.f. noise pulses and injects these rectified pulses into the screen circuit of the 6BE6. Components L_2 and C_2 are tuned to the i.f. frequency of the receiver. A second 1N34 diode, CR_2, acts as a clamp. A 470,000-ohm potentiometer, the THRESHOLD control, is used to adjust the operating point of the silencer. The second i.f. amplifier in the radio receiver should be changed to a type 6BE6.[3] With this done, the net output from the threshold control is applied to Pin 7 of the 6BE6 i.f. amplifier.

The author has found this circuit to be most useful in that it will work when amplitude modulation and sideband transmissions are used. But for those who, at times, desire to switch back to hi-fi "unmuffled" reception, switch S_1 can be turned to the OFF position. However, with the silencer operating, the author has been able to decipher many messages which could not have been received without this limiter.

—*Alex S. Labounsky, WA2MTB*

[1] Stiles, "I.F. Noise Limiter," *QST*, June 1960.
[2] *The Radio Amateur's Handbook*, 37th ed., p. 105.
[3] Some loss of gain can be expected when using the 6BE6; a 6DT6, with the signal fed back to No. 3 grid, would still have full gain when substituted in this circuit. —*Editor*

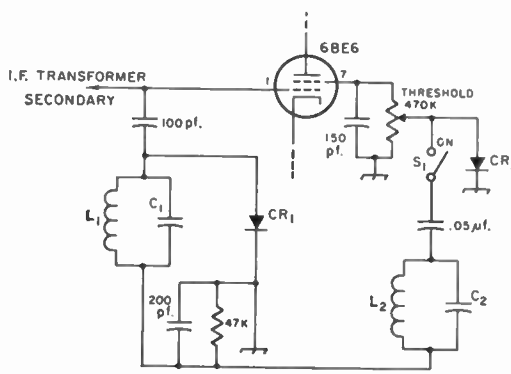


Fig. 2-17—WA2MTB's i.f. noise silencer. L_1, C_1, and L_2, C_2 should resonate at the receiver's i.f. CR_1 and CR_2 are IN34A semiconductor diodes.

DUAL-PURPOSE PRODUCT DETECTOR

The circuit in Fig. 2-18 shows a novel approach to switching between a.m. and s.s.b. detection. Although I worked out the scheme for my own homebuilt receiver, it should be of value to someone converting a commercial receiver or designing his own.

Tube V_1 in Fig. 2-18 is the last i.f. amplifier of a conventional arrangement. A basic characteristic of a product detector is that when no b.f.o. voltage is injected into it, it operates linearly; thus, it can also operate as a good audio amplifier. The idea in this circuit is to use the product detector as a mixer while in the s.s.b. mode, and as an audio amplifier on a.m. V_2 is an added triode, connected as an infinite impedance a.m. detector. Audio from V_2 is fed through T_3 to the product detector. I.f. is switched via links from T_2 to T_3 for either s.s.b. or a.m. modes.

When used on a.m., T_3 acts as an i.f. choke in series with the product detector trapping out the i.f. component. When used on s.s.b., i.f. is injected directly into T_3 by way of the link, and b.f.o. is switched on.

Transformers T_1, T_2, and T_3 are conventional i.f. transformers, separated from each other and, if possible, individually shielded. The links are hand wound over the windings with about 10 turns or so over the cold ends of the coils.

T_1 and T_2 are best tuned up in the a.m. position and adjusted for maximum signal. While still in the a.m. position, jump the switch S_{1C} temporarily to turn on the b.f.o. Now adjust T_3 for the minimum beat note, which indicates the best trapping action of T_3.

—Eugene A. Anthony, W2GOO

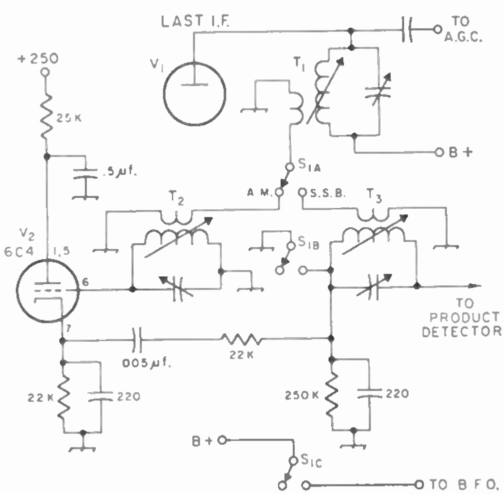


Fig. 2-18—W2GOO's system for making a product detector do double duty. Unless otherwise indicated, capacitances are in pf., resistances are in ohms, resistors are ½ watt. T_1, T_2, T_3—See text.

USING THE GONSET SUPER-SIX AHEAD OF A COMMAND RECEIVER

An excellent, low-cost communications receiver can be assembled by adapting the BC-453 Command receiver (190-550 kc.) for use with the Gonset Super-Six converter. This combination has been used at this station for s.s.b., c.w. and a.m., and has outperformed several amateur receivers costing many times more.

The simple modification necessary to the Command receiver is accomplished by removing approximately 180 turns from one end of L_1, L_3 and L_5, the antenna, r.f. and oscillator coils, respectively, in addition to the removal of the powdered-iron slugs. The tap on L_1 is unimportant in this instance and may be neglected if desired by connecting the grid coupling capacitor directly to the hot end of the coil. The trimmers can be adjusted for optimum gain at 1430 kc., the output frequency of the converter, by using a broadcast signal as a source. Modification of the coils does not prevent the use of the BC-453 for other purposes at a later date since the coils come as a plug-in set and can be easily replaced with the original type.

If desired, the usual Command receiver modifications for phone jack, r.f. gain control, b.f.o. and a.v.c. switch, noise limiter, etc., can be made at the same time. The construction of a small 200-250 volt a.c. power supply with a separate inexpensive 26-volt filament transformer (Stancor P-6469) completes the unit. Voltages for the converter are obtained from the same power supply, of course, and B-plus should be dropped to 130-180 volts through a suitable resistor for optimum operation.

No special precautions need be observed in connecting the converter to the BC-453. In the interests of safety, however, it should be pointed out that at least one variety of commercially available "plug-in" power supply for Command receivers should be used with extreme care since if the line cord is plugged in backwards the receiver cabinet will become hot to ground. Severe shock or death might result if a grounded lead and the receiver cabinet is touched at the same time!

—Ronald E. Delp, W6DAW

CORRECTION AND IMPROVEMENT FOR HANG A.G.C.

The "Zener-Limited 'Hang' A.G.C." circuit by K8JIX in the "Hints & Kinks" column of *QST* for November 1963, should be shown with the 4-position rotary switch grounded. Better yet, the switch can be bypassed to ground with a large-value paper capacitor and returned to the arm of an r.f. gain control, which is connected across a negative bias source.[1] This method of r.f. gain control is very convenient. The variable negative bias selected by the control does two things: it feeds through the attack gate diode to the a.g.c. line and controls the r.f. gain. It also acts as additional delay bias on the a.g.c. rectifiers. For example, if the receiver's S meter is monitoring the a.g.c. bias in the normal manner, and the r.f. gain control is set to give an S-6 reading on the meter, any signal weaker than S-6 will not operate the a.g.c., whereas a signal stronger than S-6 will produce full normal a.g.c. action. This action is ideally suited to s.s.b. round tables, where signals may range from S-6, say, to S-9 or over. During any pause, the gain rises to the proper level for the weakest signal in the group (set by the r.f. gain control), rather than rising to full blast and forcing the operator to listen to weaker signals and hash below S-6.

—Craig R. Allen, WB6IAQ

[1] Arnold and Allen, "Some New Ideas in a Ham-Band Receiver," *QST*, May 1960.

HOMEMADE HONEYCOMBS

The NAA receiver article in October *QST* brought back fond memories. In fact, it inspired me to dig out one of my early log books in which I found, along with stations worked, how-to-make-it instructions for honeycomb coils. For those who would like to wind their own, here are the original instructions:

Procure a circular block of wood, 2 inches in diameter. Drive 1¾-inch wire brads into the wood at equal distances, about 20 on each side. Space the two rows about ¾ of an inch apart as shown in Fig. 2-19. Now wind with d.c.c., No. 22 or 24, after putting a strip of cardboard or stiff paper around the disk between the row of nails. Wind until sufficient number of turns is secured, and then soak thoroughly with shellac or coil dope. The number of turns needed when used in shunt with a variable 0.001 μf. condenser[1] are as follows:

Turns	*Wavelength in Meters*
25	120 to 375
35	180 to 515
50	240 to 730
100	450 to 1460
250	1300 to 4000
400	2050 to 6300
500	3000 to 8500
1500	15,000 to 24,000

Other values can be found readily by interpolation.

Allow to dry and then remove the nails. Wind tape around the outside and then remove gently from the disk. Fasten the coil to a blown-out fuse cartridge by wrapping with tape. The coil is now ready and can be plugged into the fuse clip socket. If the coil coupling is to be made adjustable, the fuse mounting needn't be used. Coils can be mounted on wooden doweling and slid back and forth.

With so many local b.c. stations on the air now it will probably be necessary to use three coils with some arrangement for loosening the coupling between the antenna-ground coil and the tuned grid coil. If there is only one local b.c. station, either a series- or shunt-type wave trap can be easily constructed to eliminate it.

—*Hartwell M. Hughes, WA6VXN* (ex-1BIP)

[1] Editor's Note: Capacitor.

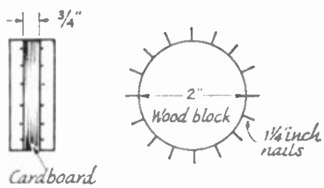


Fig. 2-19—The honeycomb coil is wound on a 2-inch wooden disk.

PERMAKAY FILTER FOR IMPROVED RECEIVER SENSITIVITY

The selectivity of many receivers having an i.f. of 455 kc. can be improved by adding a remodeled Motorola Permakay filter unit. These units were removed from Motorola f.m. communication equipment in large numbers when conversion to split-channel or narrow-band f.m. was made. Discarded filter units are often obtainable from mobile communication service organizations.

The Permakay unit contains 12 copper cups potted in a 4 × 2 × 1½-inch metal box. Potted coil which has a Q of about 150 at 455 kc. Figure 2 shows the original circuit with the exception of the coupling capacitors, which are added in this modification and are shown outside the dotted lines. The bandpass curves, after modification, are shown in Fig. 2-20 for two different coupling capacitor values.

To remodel the unit, pry the lid off along with the brittle potting compound, with a sharp screwdriver and hammer. This job must be done with care to avoid damage to components, and may take an hour or two. This exposes the coupling capacitors, slug-tuning screws, and wire connections to one side of each resonant circuit. Each resonant circuit remains potted in its copper cup, but the tuning-slug screw pro-

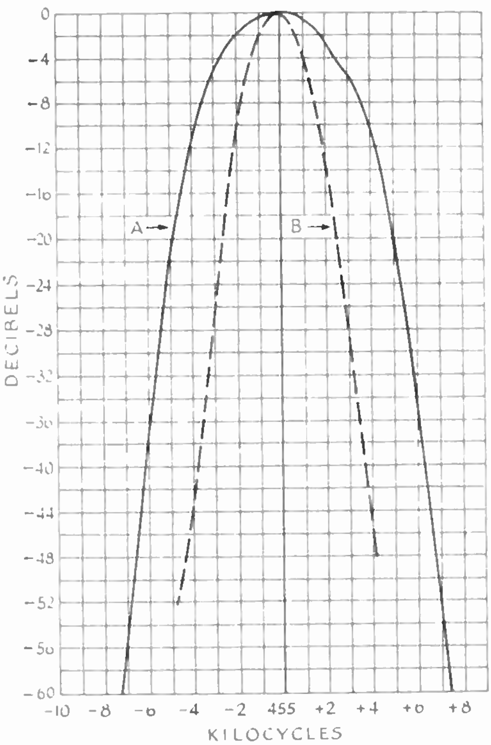


Fig. 2-20—Selectivity curve for the Permakay filter. Curve A is the 6-kc. bandwidth (at 6 db.), curve B is the 3-kc. bandwidth (at 6 db.).

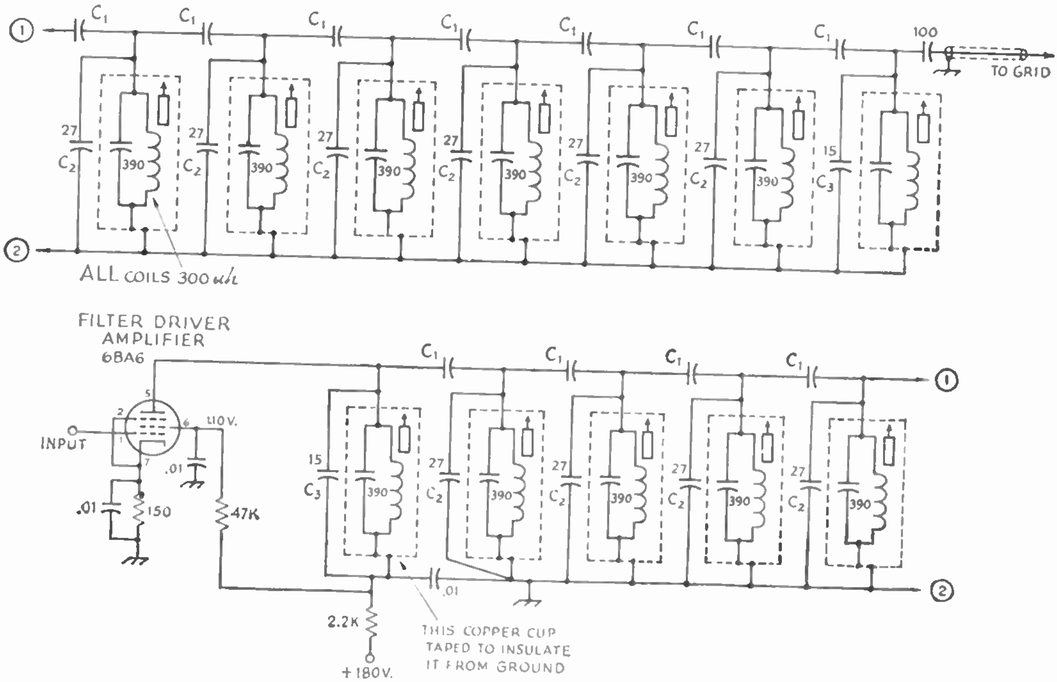


Fig. 2-21—Schematic diagram of the Permakay filter. In the original circuit, C_1 was 19 pf.

	3-Kc. Bandwidth	5-Kc. Bandwidth
C_1	3 pf.	5 pf.
C_2	27 pf.	27 pf.
C_3	15 pf.	15 pf.

trudes and is now adjustable. Remove the original coupling capacitors, C_1, and replace them with the values shown in Fig. 2-21. With 5-pf. coupling capacitors, the filter has a 6-db. bandwidth of 6 kc., and with 3-pf capacitors, a bandwidth of 3 kc. Since the original coupling capacitors formed part of each resonant circuit, small shunting capacitor. C_2 and C_3 are added to the circuit to maintain the center frequency at 455 kc.

To compensate for filter insertion loss, an additional stage of i.f. amplification is added as shown in Fig. 2. Since the resonant circuits are internally grounded to the copper cups, the input cup is insulated with tape and bypassed to ground to allow B-plus to be fed through the coil and to the driver plate. After modification, the slug-tuning screws are adjusted for maximum gain.

The filters by themselves exhibit rather high insertion loss. The 3-kc. filter loss measured 62 db., and that for 6-kc. 31 db. However, the filters have a high input impedance of about 60,000 ohms, and this allows the pentode amplifier to achieve enough gain to compensate approximately for the insertion loss. The gain from the 6BA6 grid to the filter output is five for the 6-kc. filter and one sixth for the 3-kc. model.

Since the loss of the 3-kc. filter is high, caution must be used in inserting this unit into an existing receiver which has little a.g.c. ahead of the filter. Dynamic range is limited by the fact that weak signals must be kept above the noise at the grid of the tube following the filter, and strong signals must not overdrive and distort in the tube which drives the filter. An additional amplifier inserted in the center of the filter might be helpful.

The filters described here are marked TU-145 and were obtained when kit SK-9443A was installed, but similar modifications should be possible with other Permakay models.

—G. L. Roberts and J. D. Gooch, W9YRV

Chapter 3

Hints and Kinks . . .

for the Transmitter

APACHE TRANSMITTER MODIFICATION

SOME time ago I acquired one of the Heathkit Apache TX-1 Transmitters. I had a kilowatt final and wanted to use the Apache as a driver (both audio and r.f.) while still retaining its original status as a self-contained medium-power transmitter. The diagram in Fig. 3-1 shows my modification.

In order to have a simple yet compact switching arrangement, I selected a Centralab index assembly type P-273 and two of their ceramic wafers type RRD. These were chosen instead of the preassembled-type switch since the assembled type has a metal shaft. Phenolic material is used in the "do-it-yourself" switch and is preferable in order to withstand the high audio voltages developed.

Prior to assembly, the wafers must be modified to prevent arcing between rotary pole sections. This is a simple operation, easily completed in a few minutes. The end of each semicircular rotor strip opposite the contact tab is bent back on itself at the edge of the mounting rivet. A small screwdriver or knife edge will serve to lift the contact end slightly, allowing it to be readily grasped with a pair of needle-nose pliers. This gives another sixteenth of an inch clearance at each end, once all four contacts are so bent. With the contact ends bent, the switch should not be rotated to its extremes, since it will force the bent portion up against the pole contacts with possible damage resulting. Although the switch has five positions available, only two are required for this purpose.

Remove the jumper between *JW-2* and *JS-5* as well as between *JW-1* and lug 1 of the h.v. filter capacitor *JY*. Now wire the switch into the circuit as shown in Fig. 1. Use sufficiently well-insulated wire with leads long enough to permit positioning the switch in a hole drilled in the chassis to the right side of the coax antenna receptacle. It is recommended that several strips of plastic insulating tape be spread along the side of the chassis nearest the switch contacts to prevent accidental shorting.

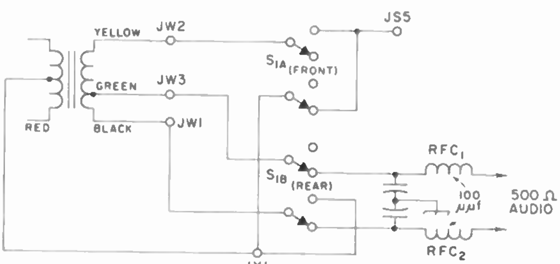


Fig. 3-1—(left) W2ITD's Apache transmitter modification.

The 500-ohm audio output is brought out via a dual-connection female microphone receptacle mounted in a hole drilled directly above the coax antenna receptacle. Two small v.h.f. chokes and a couple of small bypass capacitors are used for TVI suppression.

Prior to operation of the transmitter it is advisable to check the wiring. Before replacing the cabinet, it will be necessary to drill and file or ream two holes to allow the protrusion of the switch shaft and audio connector. With this modification r.f. and audio excitation can be obtained when high power is desired without affecting the original circuit in any way.

—Stephen C. Taber, W2ITD

FOURTEEN MARS FREQUENCIES WITH THE HEATHKIT V.F.O.

HERE is a simple modification to the Heathkit v.f.o. which makes possible fourteen MARS frequencies, plus the usual 80- through 10-meter frequencies. A 3-position rotary switch, two capacitors and a few miscellaneous parts are the only items required. Fig. 3-2A shows the unmodified low-frequency circuit of the v.f.o., and Fig. 3-2B shows the finished modified circuit.

To make the conversion first drill a hole large enough to receive a panel shaft bearing in the upper right-hand corner of the panel. When mounting the bearing, be sure to place it so that it clears the v.f.o. calibration disk and green plastic shade. From a piece of scrap aluminum, form a bracket to support the rotary switch S_1 and position it directly behind the low-frequency trimmer capacitor. Attach the rotary switch S_1 to the bracket so that its shaft is in line and faces the panel shaft bearing. Connect the switch shaft to the panel bearing with a flexible shaft. Referring to Pictorial 2 in the Heathkit v.f.o. manual, place a solder lug on the screw holding the panel light "K." Connect a heavy tinned lead from the ungrounded terminal of the low-frequency trimmer capacitor to the "arm" of switch S_1 and solder. Now disconnect the 10-pf. capacitor (see Heathkit manual, Pictorial 1) leaving the 47-pf. capacitor intact. Connect the 10-pf. capacitor and a 5-pf. capacitor, C_1, as shown in Fig. 3-2B. Now connect a 15-pf. capacitor, C_2, from the switch to ground. Use the solder lug on panel light "K" as a tie point for the above ground connections. Disconnect the wire going from the 11-meter padder to S_4 (Heathkit manual, Pictorial 3) and connect a lead from the padder to the rotary switch S_1 as shown in Fig. 3-2B. Run this lead from the capacitor through grommet E_1 (Heathkit manual, Pictorial 3) up to the switch. This completes the wiring.

Place switch S_1 in the "normal" position, and turn on the v.f.o. Go through the calibration procedure described in the Heathkit manual for the 160- and 80-meter bands. Now switch to the "low-frequency" position and set the v.f.o. dial at 4 Mc. Tune the station receiver to 1.76 Mc., and adjust the old 11-meter capacitor (C_3 in Fig. 3-2B), to zero beat the v.f.o. with the receiver. Turn the switch S_1 to the high-frequency position. The v.f.o. should tune 3.6 to 4.1 Mc. in this position.

The v.f.o. now covers a fundamental range of 1.6 to 2.05 Mc. in three steps: Low frequency 1.6 to 1.76 Mc., normal 1.75 to 2.0 Mc., and high frequency 1.78 to 2.05 Mc. The second harmonic of the low-frequency range covers the MARS frequencies 3237, 3245, 3275, 3289 and 3347 kc. The second harmonic of the high-frequency range covers 4020 and 4025 kc. The third harmonic of the low-frequency range covers 4820 kc. The third harmonic of the normal range gives 5302.5 and 5760 kc., while 6997.5, 14,405, 20,994 and 27,994 kc. can all be covered with the v.f.o. in the 40-meter position.

—William Holliday, W4DKL

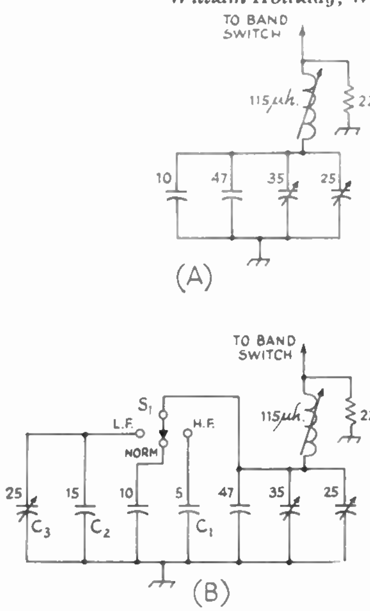


Fig. 3-2—Diagram of the low-frequency circuit of the Healthkit v.f.o. before modification (A) and after modification (B).

C_1—5-pf. silver mica capacitor.
C_2—15-pf. silver mica capacitor.
C_3—11-meter trimmer.
S_1—One-pole three-position rotary switch.

ONE-TUBE CRYSTAL-V.F.O. INPUT CIRCUIT

There are several types of oscillator circuits which make good crystal oscillators, but when these circuits are used following a v.f.o., they become temperamental and sometimes unstable. The circuit shown in Fig. 3-3 is a crystal-oscillator, grounded-grid amplifier which, with the flick of a switch, becomes a cathode-follower, grounded-grid amplifier for v.f.o. operation.

—Patrick E. Hamel, K8DJK

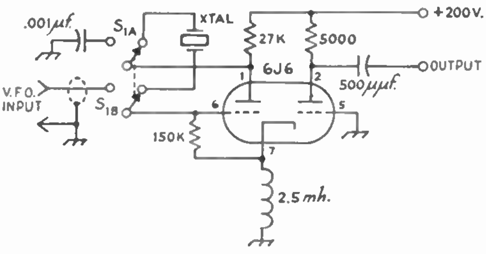


Fig. 3-3—Diagram of the crystal-v.f.o. circuit. Switch S_1 should be a low-loss type. Leads to the switch and crystal should be kept as short as possible.

DX-100 AUDIO CIRCUIT CHANGE

After receiving several reports of insufficient audio on my DX-100 transmitter, I enlisted the aid of a fellow ham who had modulation-percentage measuring equipment. His scope showed that the DX-100 was modulating less than 60 per cent. Increasing the gain or raising my voice beyond comfortable level only caused distortion and splatter.

To rectify the situation, I merely replaced the two 510-pf. coupling capacitors in the preamplifier stages of the modulator with .05-μf. units.[1] Since the chassis is fairly crowded in this section of the transmitter, it was easier to insert the .05 μf. capacitors in parallel with the 510-pf. units. One of the 510-pf. capacitors is connected between Pins 6 and 2 of the 12AX7 speech preamplifier and a .5-megohm potentiometer. The other 510 pf. capacitor is connected from Pin 1 of the 12AX7 to Pin 2 of the 12BY7 audio driver.

After making this modification my modulation percentage was averaging 60 per cent with peaks up to 95 per cent.

One other DX-100 note: It is advisable to replace the .02-μf. 1600-volt capacitor across the modulation transformer with one that has a 3000-volt rating. Many DX-100 owners have experienced difficulty with the 1600-volt unit breaking down.

—W1ECH

[1] The 510-pf. capacitors are used in the DX-100 to reduce low-frequency response (see *Handbook* chapter on speech equipment). Replacing the 510 pf. capacitors with .05 μf units will restore the low-frequency response of the preamplifier.—ED.

USING THE HEATHKIT SB-10 WITH THE JOHNSON VIKING VALIANT

Our "Stray" in November, 1959, *QST*, asking for information from those using the SB-10 and Valiant, produced quite a response. In fact, we received so many replies it is impossible to credit any one person with the Hint & Kink below. Most of the material is taken from KH6CEA's letter, but credit should also go to K6JCN and W5WCP for their contributions.

If these step-by-step instructions are followed, the SB-10 sideband adapter can be made to work with the Valiant transmitter. The modification is simple and utilizes all the existing r.f. circuitry in the Valiant. No panel drilling is necessary and, except for the added coax fitting at the rear of the Valiant, there is no change in the appearance of either unit. The modification does not in any way affect normal operation on a.m. or c.w. Step-by-step modifications to the Valient are:

1) Disconnect the wires on terminals 9, 10 and 11 of switch section SW_{4C}.

2) Tie together and solder the above leads.

3) Disconnect capacitor C_{101} (100 pf.) from terminal 12 of switch SW_{4C}.

4) Disconnect the coaxial cable attached to terminal 4 and C_{101}.

5) Disconnect resistors R_{10} and R_{54} (100 ohms) for terminal 12 of switch SW_{4C}.

6) Remove the switch wafer SW_{4C} from the switch assembly and replace it with a 2-pole 3-position wafer (Centralab type RRD).

7) Install a jumper wire between terminals 1 and 2 of switch SW_{4A}.

8) Unsolder the connection between capacitors C_{96}, C_{97} (25 pf.) and pin 5 of the 6146s.

9) Mount a single lug terminal strip or standoff insulator adjacent to capacitors C_{96}, C_{97}; e.g., on the 6146 tube socket mounting screw farthest left on the chassis.

10) Connect the capacitors C_{96}, C_{97} to the lug on the terminal strip. Don't solder.

11) Connect one end of a heavy wire to the same lug on the terminal strip and solder. Connect the other end of the wire to terminal 1 of the new switch wafer SW_{4C} (see Fig. 3-4).

12) Connect the open end of the coax (from step 4) to terminal 2 of SW_{4C} (see Fig. 3-4)

13) Connect a jumper wire between terminals 3, 4, 7 and 8 on switch SW_{4C} (see Fig. 3-4).

14) Connect a heavy wire from pin 5 of the 6146s to terminal 5 of switch SW_{4C}.

15) Drill hole in rear chassis apron to fit coax connector such as the Amphenol 83-1R.

16) Connect a length of RG-59/U cable from the above connector to terminal 6 of switch SW_{4C} (see Fig. 3-4).

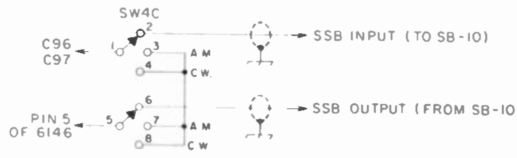


Fig. 3-4—Switch connections for Valiant modification. SW_{4C}—Centralab type RRD switch wafer.

INCREASING THE HEATHKIT "SHAWNEE" SPOTTING SIGNAL

Some Shawnee owners have found that, due to the extensive shielding incorporated in the units, the spotting signal is rather weak. More spotting signal can be achieved by connecting the doubler stage to the spot switch. The necessary changes are as follows:

1) Disconnect the blue lead coming from BO No. 2 at lug 5 on terminal strip BB.

2) Remove the red lead between lugs 5 and 2 of terminal strip BB.

3) Connect the blue lead from BO No. 2 to lug 2 of terminal strip BB.

4) Connect a short length of insulated wire between lug 5 of terminal strip BB and lug 5 of terminal strip AA.

—*Robert B. Hazelton, K3RBH*

AUDIO FILTER FOR THE SB-10

To obtain sideband suppression in the Heathkit SB-10 phasing exciter it is necessary to limit the audio frequencies to a range of 300 to 3000 cycles. By adding the filter shown in Fig. 3-5, the audio band pass is restricted to approximately 400 to 2700 cycles. The heavy lines in Fig. 3-5 indicate the parts that have to be added to the existing SB-10 circuit. Consult the schematic diagram in the SB-10 instruction book.

R. J. Dauphinee, K6JCN, ex-W1KMP

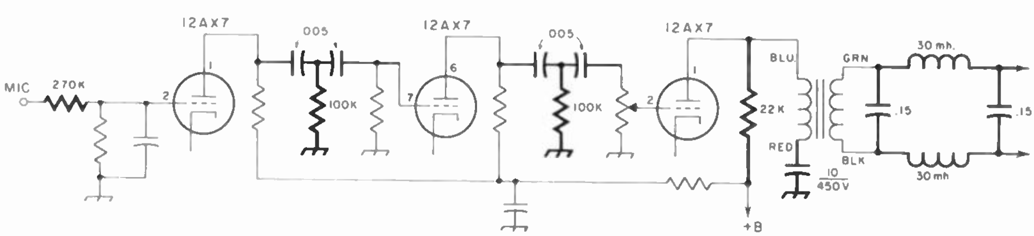


Fig. 3-5—The heavy lines indicate the parts that are added to the existing SB-10 circuit, below. Capacitances

EMERGENCY TRANSMITTER OPERATION

Occasionally I have found it necessary to operate my HT-32 transmitter on frequencies for which I do not have an antenna to match the fixed 50-ohm impedance of the pi-section output. Lacking an antenna tuner, I found that the simple arrangement shown in Fig. 3-6 will work satisfactorily with most random-length antennas.

The normal 50-ohm pi-section output circuit is shorted to ground by means of a shorting plug which is inserted into the transmitter's output jack. This converts the output circuit into a simple *LC* tank circuit (L_1C_1) which may be tuned to the operating frequency by means of the regular output tuning capacitor, C_1. The antenna, which in my case consisted of a 10-meter folded dipole with the lead-in wires tied together, is attached to a lug on the hot end of the final tuning capacitor frame. An isolation capacitor, C_2, is connected between the frame and the antenna. I used a 100 pf. mica capacitor, although a variable capacitor could be used. With the antenna connected, the final tuning capacitor is adjusted for peak output. In the case of the HT-32, the output level meter is sensitive enough to give an indication even though the output circuit has been shorted.

It should be noted that the scheme described here may degrade harmonic suppression characteristics. However, in the case of the HT-32, no difficulty was experienced with spurious radiation. Here is another word of caution: The high voltage remains on the plates of the 6146s when the HT-32s in the stand-by position. Be certain that the transmitter is off before removing the final-amplifier cage!

—Richard F. Burns, W9NVC

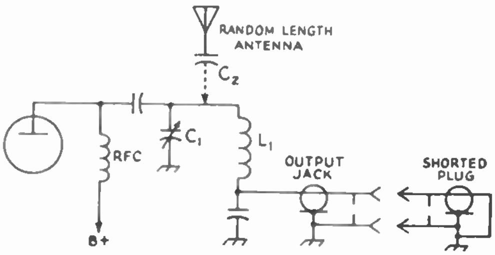


Fig. 3-6—The pi-section output circuit of the HT-32 is converted into an *LC* tank circuit by means of a shorting plug inserted into the transmitter's output jack. C_1 and L_1 are the regular capacitor and coil of the original circuit.

C_2 is an isolating capacitor and may be a fixed or variable unit.

STAND-BY NOISE IN THE GSB-101

The Gonset GSB-101 Linear Amplifier may cause noise in the receiver during standby periods, since the pi network is working at the operating frequency and there is high voltage present on the final tubes. This noise can be easily eliminated by making a simple wiring change to the antenna relay as shown in Fig. 3-7. With this change, the output tank circuit is grounded during receive, preventing any noise from feeding through to the receiver.

—John Hunt WA6HXE

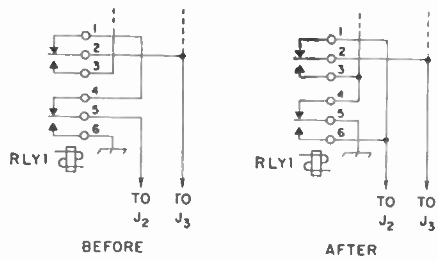


Fig. 3-7—GSB-101 relay change eliminates noise generated in the final amplifier during standby.

NOTES ON THE HEATHKIT GW-30 TRANSCEIVER

The performance of the GW-30 hand-held ten-meter transceiver can be improved by using a 12-volt battery pack and by removing a few turns from the toroid antenna loading coil. Eight penlight cells wired in series, bundled together and taped, will fit in the battery space normally occupied by the nine-volt battery furnished with the kit. All of the transistors will run within their dissipation ratings. For a better match to the whip antenna, remove turns one at a time from the toroid antenna loading coil while observing the relative output on a field-strength meter until maximum output is obtained. Also, a phono jack can be mounted on the chassis under one of the flaps of the leather case with its center terminal connected directly to the antenna terminal on the push-button send-receive switch. This will provide a low-impedance unbalanced output terminal for connecting an external antenna, such as a beam or d.f. loop. Connecting a d.f. loop to the GW-30 turns the unit into a transmitter hunter. K8DCE and myself won first place in a local transmitter hunt by using this combination!

After the above modifications were made, hand-held operation of the unit resulted in contacts over one mile to fixed or mobile stations. Using a beam antenna, K8LAP reported my signal "loud and clear" over a distance of a couple of miles. Of course, radiation from the superregenerative receiver in this case could be a problem.

By the way, concerning sources of subminiature 10-meter crystals to fit the GW-30, the type ML-18 crystals can probably be obtained from the Midland Mfg. Company, 3155 Fiberglass Road, Kansas City, Kansas, or from Anderson Electronics, Altoona, Penna., or from Sherold Crystals, Kansas City, Missouri.

—Al Robertson, K8BLL

TALK-IN ON FREQUENCY WITH THE GSB-100

The effectiveness of the CALIBRATE function of the Gonset GSB-100 transmitter can be improved by a very simple change in the wiring associated with the FUNCTION switch. Normally, the CALIBRATE position disables the modulator circuits so that only an unmodulated signal is available for calibration purposes. The changes described here add modulation so that relatively great accuracy is attained in zero beating.

Wire a jumper from terminal 9 to terminal 8 or 10 on switch S_{2C}. On section S_{2A}, remove the connections from terminals 2 and 8. Tape the ends of the removed wires and leave them in place so that the transmitter can be restored to its original circuitry if desired.

—Grant N. Nickerson, W1RWD

CARRIER WARNING LIGHT

The GSB-100 transmitter requires some carrier insertion when tuning up or when changing bands. Often, I find myself forgetting to remove the carrier in the s.s.b. mode and finally hit upon a scheme to remind me to do so.

I removed the 1000-ohm carrier level potentiometer and replaced it with a 1000-ohm potentiometer-s.p.s.t. switch combination. The original potentiometer would not accommodate a switch section.

The switch is wired so that when the control is advanced it turns on a pilot lamp as a reminder that carrier is inserted. Power for the lamp can be obtained from the transmitter's dial lamp power supply.

—Kermit Slobb, W9YMZ

EXTRA COVERAGE ON 20 WITH THE KWM-1

KWM-1 owners who wish to operate the new phone segment, 14.300 to 14.350 Mc., can replace the 9100-kc. crystal in position 2 in the KWM-1 crystal box with a 9125-kc. crystal. This will change the tuning range of position 2 to 14.250-14.350 Mc. The red scale on the tuning dial is used with this arrangement. Another alternative would be to replace the crystal in position 3 (WWV) with the 9125-kc. crystal.

—Rich Wright, W7PT

HEATHKIT WARRIOR NOTES

The bias supply filtering system in the Heathkit Warrior can be improved by removing the 11-ohm 5-watt resistor and installing a Zener diode in its place. A current limiting resistor is placed between the bias line and the 100-μf. capacitor. The circuit in Fig. 3-8A shows the original and modified bias circuits. The Zener diode, CR_1, that I used was an International Rectifier Corp. type 3Z4.7 capable of 3.5 watts dissipation. In this application the dissipation is less than one watt, and therefore, no heat sink is required. The current limiting resistor, R_1, limits the current through the Zener diode to about 45 ma.

Fig. 3-8B shows a modification to the high-voltage power-supply section that will eliminate annoying impulse noise caused by the mercury vapor rectifiers. I noticed the noise especially on 40 meters and it appeared to climb with the 811s biased to cutoff. The noise was eliminated by adding a .002-μf. 3000-volt capacitor, C_1 (actually two .001-μf. units in parallel), between the heaters and ground, and a 4.5-μh. coil, L_1 (B & W Miniductor No. 3104), between the 866A heaters and the load.

—Joe Santangelo, W1NXY

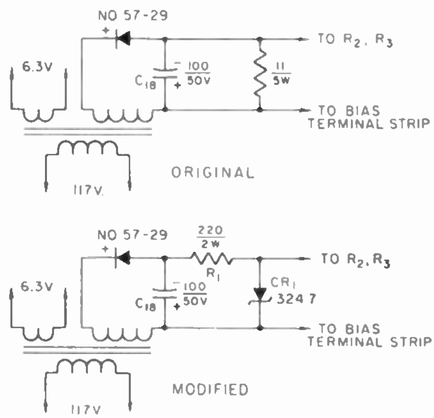


Fig. 3-8A—Improved bias circuit for the Warrior.

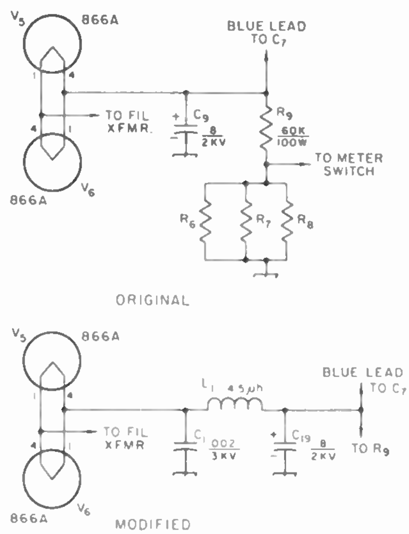


Fig. 3-8B—The addition of C_1 and L_1 reduces rectifier noise in the Warrior.

MARS FREQUENCIES WITH THE HT-37

THE HT-37 transmitter has very little overlap at the ham-band edges and thus presents a problem to those interested in working some of the MARS frequencies.

A study of the v.f.o. circuit revealed a feed-through terminal, designated "TP2" or "FSK," originally included for the addition of an RTTY circuit. By adding a fixed silver-mica capacitor, C_1 in Fig. 3-9, at this point, the v.f.o. frequency will shift down, which results in an increase in the output frequency on 80 and 40 meters because of the heterodyning process in the HT-37. With a value of 250 pf. for C_1, the output frequency is shifted up about 30 kc. On 20, 15, and 10 meters, the output frequency is lowered by about the same amount.

When trade-in time rolls around, a soldering gun easily restores the transmitter to its original condition.

—Robert L. Schaffer, W8EWP/K3BWI

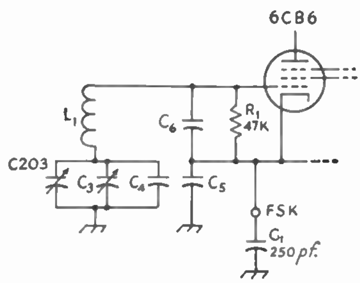


Fig. 3-9—A 250-pf. capacitor at the FSK terminal will shift the HT-37's output frequency about 30 kc.

S.S.B. WITH THE 10B AND VALIANT

IT may interest other Valient owners to learn that the Central Electronics Exciter 10B makes a nice s.s.b. exciter for the Johnson Valiant transmitter. Only one minor change in the Valiant is necessary. Replace the sideband input coupling capacitor C_{101} with a 0.01-μf. ceramic capacitor. Also, the 10B output inductance should have its 10,000-ohm swamping resistor removed.

—Dorothy C. Saunders, W4UF

TWO-TONE TEST WITH THE 32S-1

WHEN an s.s.b. exciter is followed up by a home-built or commercial linear amplifier, it is a good idea to check the operation of the amplifier with a two-tone test, a check essential for determining proper amplifier bias and loading. However, with filter rigs such as the 32S-1, a two-tone test becomes rather involved since there is no provision in the equipment for permitting any appreciable carrier insertion. In order to make a two-tone test with these transmitters, two audio oscillators are required. They must be properly mixed with little interaction. Since the 32S-1 already has a tone oscillator a simple connection can be made so that only one external audio oscillator is needed for the test. Items required are a 100-ohm resistor and a shorting plug that will mate with the SPARE jack on the 32S-1. Fig. 3-10 shows where the resistor is inserted in the circuit. Actually, the resistor R_1 could be disregarded but was used in this case to keep the plate resistance of V_{1A} as high as possible so that the internal audio oscillator would not be loaded too heavily.

To make the two-tone test, turn the EMISSION switch to LOCK KEY and turn up the MIC GAIN enough to produce an indication on the oscilloscope. Now insert the shorting plug P_1 into the SPARE jack J_1. Connect an external audio oscillator (set to about 1000 cycles) into the MIC jack of the transmitter and increase the gain of the external oscillator until a two-tone test pattern with good crossover nulls appears. Leave the external oscillator gain at this setting and make all further adjustments with the MIC GAIN control. The two-tone test frequency will be approximately 400 cycles.

Since the cathode of V_1 is grounded some distance from the tube there may be a small trace of 60-cycle ripple present on top of the two-tone pattern. If the ripple is annoying, change the external oscillator frequency slightly so as to change the beat frequency between the two-tone difference and 60 cycles.

—N. C. Stavrou, W4MXL

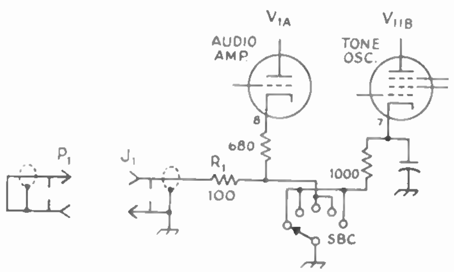


Fig. 3-10—Diagram showing connections to the 32S-1 for making the two-tone test.

J_1—"Spare" jack on 32S-1 transmitter.
P_1—Shorted plug to mate with J_1.
R_1—100-ohm ½-watt resistor.

TAKE-OFF FOR R.F. SAMPLER

ANYONE who is using a coax switch with a spare unused fitting can easily convert the device into an r.f. sampler for feeding a specimen signal into a scope for monitoring purposes. Simply connect a low-value capacitor, about 5 or 10 pf. for medium-power transmitters, from the center conductor of the unused connector to the center conductor of the input connector. The monitoring device is then connected to the spare fitting.

—Paul Goldman, K1GKU

AUTOMATIC GBB-101 AND KWM-2 OPERATION

If the changes shown in Fig. 3-11 are made to the Gonset GSB-101, it can be used with the Collins KWM-2 (or S-line) for either "barefoot" or amplifier operation.

The GSB-101's antenna relay, RLY_1, comes from the factory wired as shown in Fig. 3-11A. Change the wiring to that shown in Fig. 3-11B. The modification requires the addition of two other relays, K_1 and K_2. Relay K_1 is a 6.3-volt a.c. unit keyed from a voltage derived from the KWM-2's accessory socket. The other relay, K_2, has a 117-volt a.c. coil and is connected across the red pilot lamp in the GSB-101.

When the plate switch on the GSB-101 is in the "off" position, relay K_2 is open. When the KWM-2 goes to "transmit," 6.3 volts is applied to relay K_2, closing it. However, the 117 volts necessary at Terminal J_4 to close RLY_1 isn't present since K_2 is open. Therefore, output from the KWM-2 comes in jack J_1, through the relay RLY_1 (which is not closed), and out to the antenna, for "barefoot" operation.

However, when the plate switch on the GSB-101 is closed, power is applied to the red pilot lamp which closes relay K_2. When the KWM-2 goes to transmit, 6.3 volts is applied to K_1. Now there is 117 volts appearing at J_4 which closes relay RLY_1. The KWM-2 output is now fed to the 811A cathodes and the GSB-101 amplifier is in the circuit.

—Eugene M. Zimmerman, K1ANV

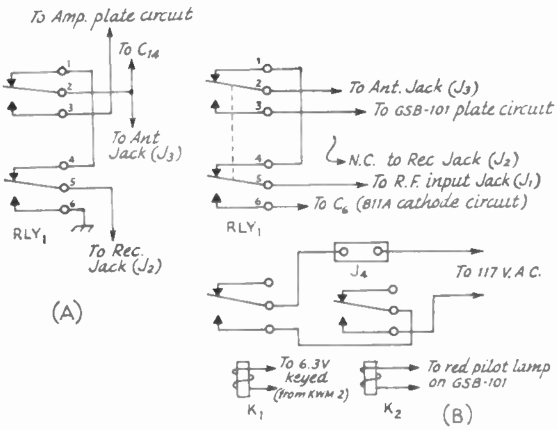


Fig. 3-11—Modifications to the GSB-101 for automatic operation with the KWM-2, Relay RLY_1 is the GSB-101's antenna relay.

K_1—6.3-volt relay.
K_2—117-volt relay.

IMPROVED SCREEN PROTECTOR

One of the screen protection methods described by Evans in *QST*, October, 1960, page 22, depends on the inertia of a relay armature to turn off the screen voltage in case of nates this short-coming and insures positive screen voltage cutoff. Most 2500-ohm relays will close whenever a maximum of about 25 volts is developed across the relay coil. Resistor R_1 is in shunt with the coil so that the trip point of the relay may be adjusted to the desired value. If the current should rise above the predetermined value, the relay armature will pull away from its normally closed position and turn off the screen voltage. As soon as the relay contacts which normally connect R_1 across the relay coil open, resistor R_2 will draw sufficient current through the relay coil to keep the relay energized. The relay will remain in this condition until the reset button is pushed, which opens the circuit to R_2 and drops the relay back to its normal position. This system assures positive operation of the relay and does not depend on the inertia of the armature to open the screen circuit. The value of R_1 is found by

$$\frac{25}{\textit{screen current (in amps.)} - .010}$$

and R_2 by

$$\frac{\textit{screen supply voltage}}{.010}$$

—James E. Goff, W4ZXB

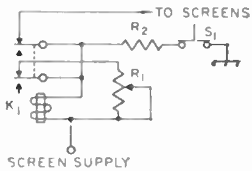


Fig. 3-12—Screen overload protector.

K_1—2500-ohm, d.p.d.t. relay.
R_1, R_2—See text.
S_1—Normally closed pushbutton switch.

TRANSFORMER SAW

I tried using fine pitch coping saw blades to cut through the windings on some transformers. However, the blades broke easily and would bind up in the small wires. I found that the Tyler Spiral blades available at most hardware stores do the job with ease. These blades will not catch on the wires or cut your fingers, and one hand can be left free so that you can hold the material adjacent to the blade.

—Gene Fry, K2CW

PLATE CAP CAUTION

Tubes, such as the popular 7094, can be easily broken while you're trying to remove the plate cap. This happens when the set screw on the cap flattens the sleeve on the projecting pins from the tube, making removal of the cap difficult. If you drill out the plate cap with a 5/32-inch drill, there will be plenty of clearance for easy removal.

PRINTED CIRCUIT DUMMY LOAD

An anonymous Canadian amateur sent in the novel low-power dummy load shown in the accompanying photograph (Fig. 3-14). All that's required for construction are six pilot lamps, wire, and a small piece of copper-clad printed circuit board. Mount the bulbs and wire as shown in the photograph. Solder all the lamp shells to the copper lamination on the phenolic board. To connect the lamps in series cut a series of slits in the copper material (but not through the phenolic) as shown in the sketch in Fig. 3-13.

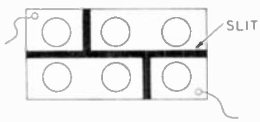
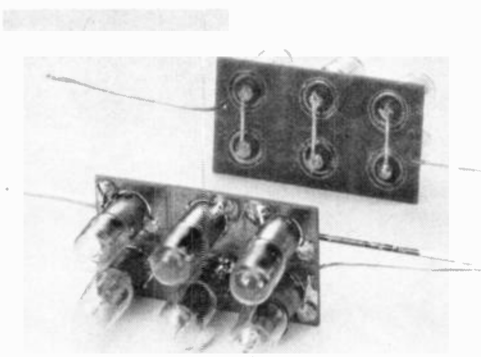


Fig. 3-13—(left) Slit pattern.

Fig. 3-14—(below) mirror photo of completed dummy load.



CRYSTAL PULLER

Amateurs who use Johnson Viking transmitters such as the Ranger or Valiant will find that a small piece of electrical tape attached to the crystals to form a small tab (Fig. 3-15) will aid in removing the crystals from their housing.

—*Dick Minnick, K8KCO*

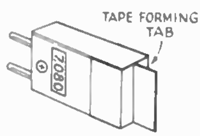


Fig. 3-15—Crystal remover made from electrical tape.

HEAT DISSIPATING TUBE SHIELDS

In Hints and Kinks, *QST*, October 1963, K9APE and K9TYH suggest that HX-30 owners boil the tube shields (except that of the 6360) in salt water in order to blacken them and thus increase their heat radiating ability.

I tried this process and found that it did not work with the shields supplied with my HX-30. I did, however, find a source of heat-radiating shields available in small quantities for one dollar each from the William M. Jones Co., 1107 Echo Court North, Hampton Village, Towson 4, Md. The 6U8, 12AX7 and 12AT7 tubes require shield No. TR 6-6020-B, the 6AK6 and 6CB6 size is No. TR 5-5020-B and the 6AL5 size is No. TR 5-5015-B.

By using these shields and a 4-inch low-speed fan on the back of the cabinet, the HX-30 runs extremely cool and stable, and short tube life is no longer a problem.

—*David S. Blew, WA2KWM*

VF-1 STABILIZER

A slight instability in my VF-1 v.f.o. was traced to the 2200-ohm grid resistor, the one between the 40-meter positions on the v.f.o. band switch. Replacing the resistor with the same value but a 2-watt unit eliminated the trouble. It is also a good idea to periodically clean the contacts on the band switch with contact cleaner.

—*Bob Richardson, W6WHM*

DOUBLE COAX FOR THE VO-CAN

As W4AMN points out in his VO-Can article, April 1963, *QST*, a suitable double coax cable is hard to find. A neat yet flexible cable can be made by using two lengths of Amphenol Subminax, type 21-598, pushed side-by-side through a piece of ¼-inch clear plastic tubing.

—*Harry E. Adams, W9JX*

BETTER HEAT RADIATING TUBE SHIELDS

K9APE suggests that HX-30 owners boil the tube shields of all the tubes, except the one for the 6360, in salt water. This blackens the shields and increases their ability to radiate heat, thus extending tube life. I tried the scheme and found that I now can touch the drive tube of my HX-30, which I could not do before the salt water treatment.

—*From K9TYH's OES report*

715B TUBE DATA

The 715B tetrode is a popular surplus tube but little information on its base and ratings can be found. The base diagram for the tube is shown in Fig. 3-16. The tube requires a standard Johnson socket (No. 124-234-1). Plate dissipation is rated at 50 watts and the filament requirements are 26 volts at about 2 amps. Typical operating voltages are plate 1500 and screen 300. The plate current should be held to 125 ma.

—*Robert L. Peck, W9MOW*

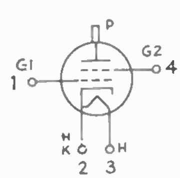


Fig. 3-16—Base diagram of the 715B tube.

REDUCING STAND-BY NOISE IN THE VIKING RANGER

Use of a t.r.-switch with my Viking Ranger allowed for fast, quiet antenna switching. However, when the Ranger was in STANDBY position an annoying hash, caused by the diode noise generated in the Ranger's final amplifier, was piped into my receiver through the switch. To do away with this noise I merely connected the — 28 volts used for modulator bias to the final amplifier grid and thus cut off the amplifier tube. See Fig. 3-17 for the connection. Of course, this arrangement stopped the action of the clamp tube so the — 28 volts was disconnected from the amplifier during c.w. operation.

Use of this circuit also reduced the level of my v.f.o. to a comfortable volume during zero beating. These modifications are only applicable to Rangers with bias rectifiers.

—G. D. Rolls, K6BWC

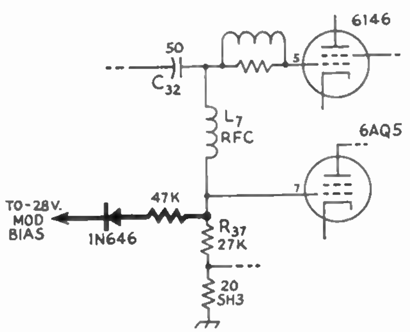


Fig. 3-17—Applying —28 volts bias to the final amplifier grid reduces diode noise.

APACHE SPOTTING SWITCH

As pointed out in the recent report on the Heath Apache in *QST*, March, 1959, page 44, a minor inconvenience exists in using the Apache for c.w. break-in operation. The difficulty lies in the use of a push-button "spotting" switch which is in shunt with the key so that in c.w. operation it is necessary to throw the plate switch off in order to zero beat. This requires two switching actions and means wasted motion.

The situation can be remedied by disconnecting the push-button spotting switch and substituting a normally closed push-button switch in anoher part of the circuit. Fig. 3-18 shows where the new spotting switch is connected. When the switch is in its normally-closed position, the v.f.o. and buffer tubes are cut off by the — 120-volt bias supplied at point *K*. When the spotting switch is opened, the bias is removed from the v.f.o. tube which then supplies a v.f.o. signal.

To make the change, disconnect the yellow wire running from the wiring harness to the spotting switch. Tape the wire end and fold it out of the way. Splice two leads in the circuit at the junction of the 33,000-, 100,000-, and 47,000-ohm resistors (see Fig. 3-18) and connect the leads to the normally-closed push-button switch. While you are at it, bring out another pair of leads and connect them in parallel with the switch and install a connector at the rear panel of the Apache so that a remote spotting switch can be installed.

—Gary Lindstrom, K2UZJ

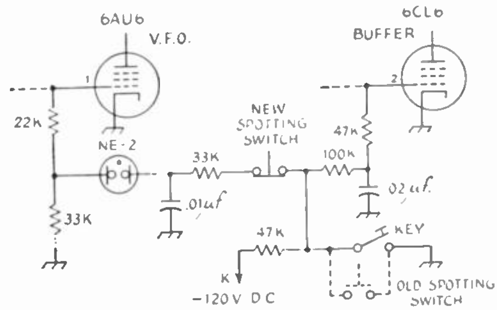


Fig. 3-18—Diagram showing a new spotting switch for the Apache transmitter.

RANGER HEAT REDUCER

To combat the v.f.o. drift caused by heat from the power supply in my Viking Ranger, I substituted silicon rectifiers for the 5U4 rectifier in the Ranger power supply. I mounted the diodes on a small fiber board which was cut to fit into an old octal tube base that had been removed from a burned-out tube. The diodes were wired as shown in Fig. 3-19 and connected to the proper tube pins on the base. Then the assembly was plugged in the 5U4 tube socket on the Ranger. The new semi-conductor rectifier reduces the heat by at least 50 per cent and, since the voltage drop through the diodes is very low, the output voltage is higher by about 45 volts. Best of all, the v.f.o. now stabilizes in about ⅓ the previous time. I used the Sarkes Tarzian 1N2489/6OH diodes that have a PIV raing of 600 volts and can handle about 750 ma. The diodes retail for about $1.83 each.

—Louis A. Gerbert, W8NOH

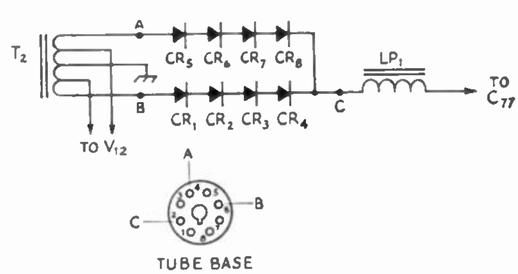


Fig. 3-19—Heat is reduced in the Ranger power supply by substituting semiconductor diodes for the 5U4 rectifier. Points A, B, and C in the diagram are connected to the corresponding tube pins shown on the tube base. CR_1 through CR_8 are 1N2489/60H diodes.

APACHE ADJUSTMENTS MADE EASY

In order to make adjustments on the clamp control, final-amplifier bias control and modulation bias control in the Apache transmitter it is necessary to remove the chassis from the cabinet—a job that requires the removal of 10 panel screws, 8 rear cabinet screws, coax fittings, etc. This chore can be eliminated simply by drilling three holes in the Apache cabinet. The holes should be located so that adjustments can be made from outside the cabinet with the chassis fully assembled. Location of the three holes is shown in Fig. 3-20. If the diagram is followed exactly, the slotted shafts of the controls will line up in the center of these access holes. The holes can be covered with snap hole plugs available from most radio supply houses. Remember, always make adjustments with an insulated tool or screwdriver.

—*Peter H. Shavney, Sr., W3FFR*

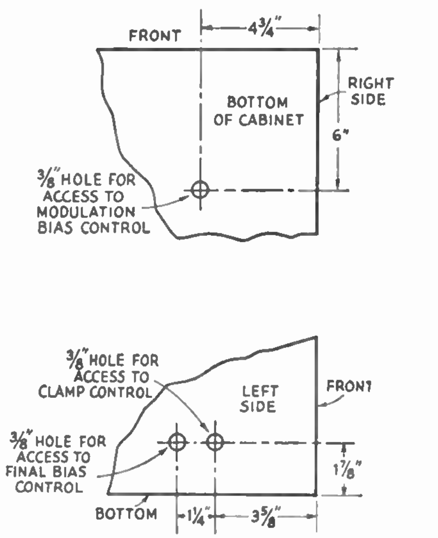


Fig. 3-20—Dimensions for placement of access holes.

MORE AUDIO FOR THE KNIGHT C-100

Many people in our area have purchased hand-held CB transceivers for use on the amateur bands.[1] Those who have the Knight C-100 units have complained about the lack of modulation. I have found a simple correction for the difficulty.

Locate the 0.1-μf. disk capacitor (C_8) located near the transmitting crystal. Remove this capacitor and replace it with a 1.0-μf. *nonpolarized* one. I used three 0.33-μf. disk ceramic capacitors in parallel. It is necessary to use a nonpolarized capacitor since the polarity across C_8 changes between receive and transmit. If several disks are paralleled, be careful that no short circuits occur in the limited space around the

This modification will change the tuning of the crystal somewhat, so it will be necessary to retune the r.f. stages. Use the tune-up procedure outlined in the instruction manual.

—*Francis J. Merceret, Jr., K3MDL*

[1] "Converting the Knight C-100 CB Transceiver to 50 Mc.", *QST*, March, 1964.

RANGER OPERATING CONVENIENCE

A simple external metering circuit which facilitates tuning the Johnson Viking Ranger is shown in Fig. 3-21. This circuit replaces the high-voltage jumper wire on the Ranger auxiliary power plug X_{13B}.

During phone operation, the milliammeter (M_1) indicates 6146 plate current. The Ranger meter switch can remain in the final-grid-current position continuously. Tuning of both grid and plate circuits is accomplished more quickly because the necessity for back-and-forth meter switching is eliminated. Continuous monitoring of plate current will prevent many unintentional overloads and prolong 6146 life.

The meter may be mounted in any convenient location near the transmitter. Precautions should be observed to prevent accidental physical contact with the meter terminals since approximately 500 volts d.c. is present at any time the Ranger OPERATE switch is moved to PHONE or CW. However, because of internal wiring, the outboard circuit will not function in the c.w. mode of operation.

—*John W. Browning, W8DDF*

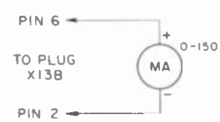


Fig. 3-21

4CX250 TUBE LIFE IN THE KWS-1 TRANSMITTER

Some owners of the Collins KWS-1 transmitter have experienced short tube life from the 4CX250B, 4X250B, or 4X150A (as the case may be) final-amplifier tubes. Examination of some of the defunct tubes showed that life had been limited by high filament voltage. Upon questioning some owners of KWS-1 equipment, it was found that some of them were under the impression that the nominal filament voltage of the transmitter (as read on the panel meter) should be 6.3 volts, and therefore adjusted the filament-voltage control accordingly. In addition, spot checks made on a few KWS-1 units showed that the panel voltmeter monitoring the filament voltage was out of calibration—as much as 10 per cent in one case.

Adjusting the filament-voltage control for 6.3 volts, especially when the accuracy of the filain an applied filament voltage to the amplifier tubes which may be excessively high. Filament-voltage limits on this family of tubes are 6.0 volts plus or minus five per cent, or a range of 5.7 to 6.3 volts. For longest tube life, it is recommended that the filament voltage not exceed 6.0 volts.

The KWS-1 owner, therefore, should check his filament voltmeter against a one per cent laboratory instrument of known accuracy—replacing the solid-state diodes in the metering circuit and recalibrating the meter, if necessary. Filament voltage should then be held close to 6.0 volts for maximum tube life.

—William I. Orr, W6SAI

HIGH-OUTPUT OSCILLATOR

THE CIRCUIT shown in Fig. 3-22 provides a higher output than is normally obtained from a Franklin oscillator. I found that the 6AW8A tube performed best in the circuit and that other triode-pentode tubes, such as the 6AX8, did not do so well. The 27 pf. capacitor C_3 has a critical value and, if made any larger, produces squegging. When connecting the cathodes to ground, connect the lead first to Pin 1, then through the center socket sleeve to Pin 6, and then to ground. With the tuned circuits L_1C_1 and C_2L_2 tuned to 80 meters, the output voltage measured about 40 volts r.m.s. across a 22,000-ohm load. When tuning L_2C_2 to 40 meters, the output voltage measured 15 volts r.m.s.

—Oscar F. Porth, W3GYR

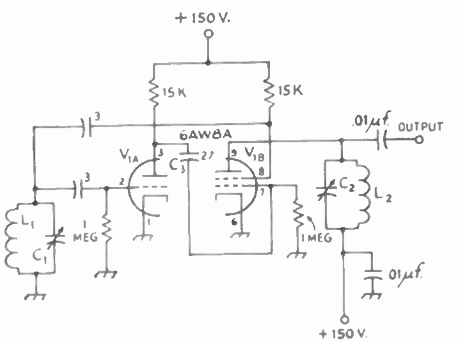


Fig. 3-22—Modified Franklin oscillator. Unless otherwise indicated, capacitances are in pf., resistors are ½ watt.

DX-100 HIGH-VOLTAGE RECTIFIER ARCING

THE CERAMIC SOCKETS provided in DX-100 transmitters for the 5R4 rectifiers, if mounted with hardware provided, have caused many owners headaches. After some use, arcing appears to take place from the tube base to the metal parts of the socket. Actually, however, arcing is between the chassis and these metal parts, and efforts at sticking electrical tape and other material between the tube base and socket won't give much relief. A simple remedy is to remove the supporting hardware from each socket and replace this with longer screws. Put in ½- or ⅜-inch insulators or washers on the screw shafts between the chassis and the top of each socket. Be sure the nut in each case doesn't come too close to the pin connections under the socket. If this is done with any care at all, it isn't even necessary to touch socket wiring.

—W1ECH

KWS-1 HUNT

AFTER receiving several T8 reports while using the KWS-1 transmitter on c.w., I checked my equipment and found that the trouble was caused by the audio section of the station receiver modulating the transmitter. The condition was also responsible for erratic operation of the VOX system. Somehow, due to the interconnections between the receiver and transmitter, audio was "leaking" into the transmitter audio circuits.

To rectify the situation I modified the speech amplifier circuit of the KWS-1 as shown in Fig. 3-23. I disconnected the ground leads from the cathode circuits of V_{101A} and V_{101B} and reconnected them to pin 8 of the EMISSION switch, S_{101C}. When the switch is positioned to cw, the cathodes of V_{101} are disconnected from ground and thus no audio will find its way into the modulator. During a.m. or s.s.b. operation, the cathodes are automatically grounded and the stage functions normally as a speech amplifier. My thanks to Jack Chapman for his help in solving this problem.

—George Morton

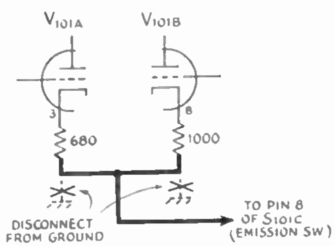


Fig. 3-23—A change in the KWS-1 speech amplifier insures against modulation during c.w. emission.

Hints and Kinks . . .

for the Phone Rig

NOVEL PUSH-TO-TALK CIRCUIT

IMPULSE or latching relays are a handy means of providing push-to-talk operation without need for holding the talk button down during transmissions. The button, in such applications, is pushed momentarily to turn the transmitter on and pushed momentarily again to turn it off. The main disadvantage of such relays is the price tag, which generally starts at about eight dollars and goes up. However, a simple counting circuit using two surplus relays can be employed to achieve the same end.

Fig. 4-1 shows the circuit with the two relays energized. Here's how it works: When the button is pushed, K_1 is grounded through the normally-closed contacts of K_2. When K_1 operates, the transmitter control circuit is completed through contacts K_{1B} and the top end of K_2 is grounded through contacts K_{1A}. Notice that the bottom end of K_2 is permanently grounded and that the return supplied through K_{1A} does not cause the relay to close. Nothing further happens until the push button is released.

Releasing the button removes the ground from the junction of K_1 and K_2, leaving the two relays in series across battery BT_1. K_2 now operates. Contacts K_{2A} transfer one side of the button to the coil of relay K_2, while contacts K_{2B} connect the other side of the button to battery BT_2. Nothing comes of this since both relays are locked in the "operate" position and the push-button is released.

When the push-button switch is again closed, voltage from BT_2 is applied to both relays through contacts K_{1A}, K_{2A} and K_{2B}. K_2 will "hold," but K_1 will open because it now has plus voltage at both ends of its solenoid. When the button is released, voltage from BT_2 is removed from K_2, the relay opens and the circuit is ready for another complete cycle.

Proper operation of the circuit necessitates that both relays have the same coil resistance and current rating, and that the supply voltage be twice the rated voltage of a simple relay (24 volts for two 12-volt relays, 12 volts for two 6-volt relays). One other requirement is apparent from close examination of the circuit: with the button released after having turned the transmitter on, it is essential that contacts K_{1A} must maintain a voltage path (from BT_1) for K_2 long enough for the current to build up to the point where the resultant voltage drop will hold both relays closed. Should K_1 open before this happens, K_{1A} will remove voltage from K_2 and *both* relays will open. This means that relay K_1 should have a reasonably long time constant, which most relays have. If both relays drop out after the button is released, the release time of K_1 is too short and the effect can be remedied by connecting a crystal diode across the coil. Also, the spring tension can be reduced for increased "hold" time.

For the purpose of description, it was assumed that d.c. relays would be used. A.c. relays would do just as well as long as the above requirements are met.

—Robert S. McMullen, WØLOV

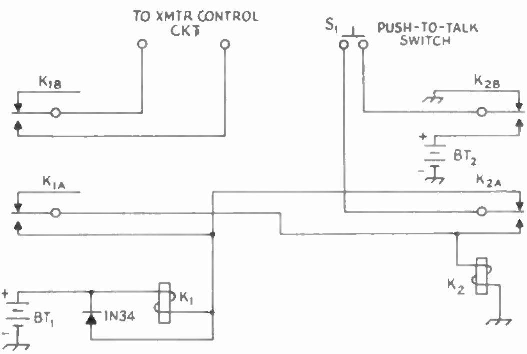


Fig. 4-1—Schematic diagram of WØLOV's push-to-talk circuit. See text for component specifications. S_1 is the push-to-talk switch or microphone button of the momentary contact type.

MODULATION-PERCENTAGE INDICATORS

THE CIRCUIT of a modulation indicator that I use with my 813 rig is shown in Fig. 4-2. It indicates by the use of neon lamps when the modulation exceeds 89 and 100 per cent and is superior to a meter indicator since the flashing lamps can be seen at a glance without looking directly at the indicator. The audio gain controls on the speech amplifier-modulator are set so that the 89 per cent indicator flashes only occasionally. The indicators are NE51 neon lamps.

Variable resistor R_3 is adjusted, with the r.f. amplifier plate voltage turned off, until indicator I_1 ignites from the voltage source at "A". In actual on-the-air use, the r.f. amplifier plate voltage will swing to zero on negative peaks during 100 per cent modulation and the lamp will ignite. Indicator I_2 is biased to about 200 volts by choice of the proper values for the voltage divider R_1 R_2. I used two 47,000-ohm, 2-watt resistors with 400 volts at point "A". The ignition voltage for the NE51 is around 65 volts. When the r.f. amplifier voltage is less than 135 volts (200–65) the indicator will ignite. The formula for calculating per cent modulation is

$$\%\ \text{modulation} = \frac{E_S - (E_B - E_I)}{E_S} \times 100$$

Where E_S is the r.f. amplifier d.c. plate voltage, E_B is the neon lamp bias voltage and E_I is the neon lamp ignition voltage. Substitution in the formula for indicator I_2 in Fig. 4-2:

$$\frac{1200 - (200 - 65)}{1200} \times 100 = 89\%$$

The 5R4GY rectifier can be used in circuits where the plate voltage does not exceed about

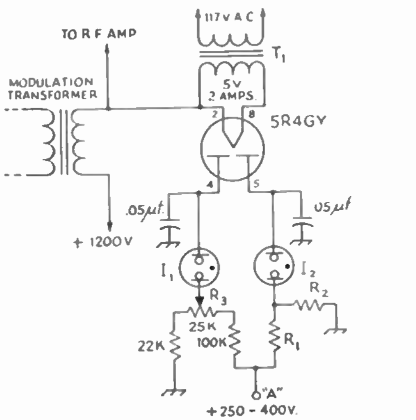


Fig. 4-2—Diagram of W1IOW's modulation indicator. Transformer T_1 should have high-voltage insulation.

1400 volts d.c. For higher voltages a 2X2A can be substituted (along with a suitable filament transformer).

—Charles R. Greene, W1IOW

—•••—

The modulation-monitor circuit shown in Fig. 4-3 does away with the necessity for using a separate filament transformer or a filament winding with high-voltage insulation, and can be used at Class C plate voltage levels as high as 10,000 volts d.c.

The monitor uses a diode designed for television receiver power supplies, and will work with any a.m. transmitter in which the Class-C plate current is 125 ma. or more. The diode direct-emitting filament nominally requires 200 ma. at 1.25 volts, but the tube will operate as a monitor with as little as 125 ma. through the filament. When the tube is connected as shown, the power dissipated is only about ¼ watt. Therefore, heat generation is not a problem and the tube may be mounted in any convenient spot.

Resistor R_1 should be included in the circuit if the d.c. plate current of the r.f. amplifier exceeds 250 ma. The resistor's value may be calculated by using Ohm's law. Substitute 1.25 volts for E, and the excess current over 200 ma. for I in the formula.

Resistor R_2 is a current limiting resistor which protects the rectifier. Its value depends on the type of rectifier and neon bulb used, but something around 100,000 ohms should be about right.

More than one rectifier may be used by connecting the filaments in series. Again, if the Class C plate current exceeds 200 ma. connect resistors in parallel with each filament.

—Eugene A. Anthony, W2GOO

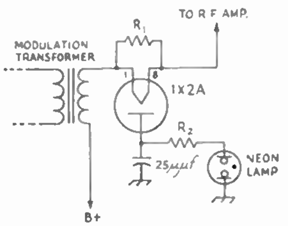


Fig. 4-3—Diagram of W2GOO's modulation indicator which obtains filament power from the r.f.

CRYSTAL MICROPHONE TIPS

Most crystal microphones contain a Rochelle salt crystal which should be protected from high temperature, humidity, and high voltage. The Rochelle salt crystal can be permanently damaged by temperatures above 125 degrees F. (50 degrees C.) and by excessive humidity. The best service from a crystal microphone will be obtained if it is used at room temperature, at a humidity of about 50 percent. Since inside automobile temperatures rise to high values in the summertime, it's not a good idea to use crystal microphones for mobile service during hot weather. Be careful when soldering connections to a crystal mike. Don't connect the mike to speaker or power outlets carrying high voltage.

—R. Bruce Campbell

CONTROLLING MODULATION OF THE SCREEN IN 4CX250B A.M. TRANSMITTERS

Full modulation of a.m. transmitters is important if good readability is to be achieved at low signal levels. This is particularly true in v.h.f. work, where much of the communication is at signal levels close to the noise. One source of trouble with modulation of tetrodes is getting the right amount of audio on the screen. Many v.h.f. rigs with tubes of the 4X150-4CX250 series tubes suffer on this account.

The accompanying circuit, Fig. 0, shows a cathode follower arrangement that permits the operator to adjust the audio level on the screen of an amplifier. As used at W8WNX, the system works with a plate voltage of 750. For higher plate voltages it would be well to make the 6S4 plate connection to an adjustable

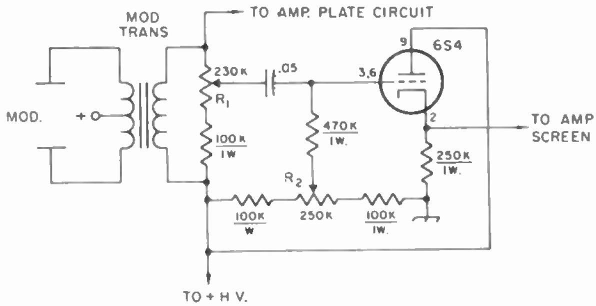


Fig. 4-4—The 6S4 cathode follower permits adjustment of the audio level on the screen of a tetrode amplifier. A separate heater supply should be used for the 6S4.

bleeder across the high-voltage supply, with the arm bypassed for audio.

The control R_1 sets the level of the audio on the amplifier screen. The d.c. screen voltage is controlled by R_2. Both controls should be mounted on good insulating material, and operated by means of adequately-insulated extension shafts. Tests show that approximately 55 percent modulation of the screen gives best plate modulation characteristics with the 4CX250B.

—Lawrence P. Kurtinitis, W8WNX

MODULATION MONITOR

The circuit shown in Fig. 4-5 is an inexpensive modulation-percentage indicator consisting of four neon bulbs and eight resistors. The monitor is wired across the modulation transformer (or choke) secondary. When the modulation percentage reaches the predetermined value, the neon indicator will flash. Of course, the neon bulbs and associated circuitry should be well insulated against the high voltages encountered. When the B-plus voltage is higher than 500, it is a good idea to place several resistors in series for R_1, R_3, R_5 and R_7, in order to decrease the chance of arc-over.

—Neil Iverson, W7PVF

MIKE HOOK

After assembling a Heath Sixer, I realized that there were no provisions for holding the microphone when it was not in use. My solution to the problem was to attach a small hook to the back of the mike so that it could be hung on one of the ventilation holes in the side of the cabinet.

The hook is an adhesive picture hanger, commercially sold as a Jiffy Picture Hanger, and available at most five-and-dime stores for less than "six for a quarter." The hanger may be used as purchased; I had little trouble getting the hanger to stick to the back of the microphone, although a little Elmer's glue will insure a good connection.

Benjamin W. Day, Jr., K3HSF/1

HIGH-Z-TO-LOW-Z MICROPHONE ADAPTER

Many commercial and home-built mobile transmitters are designed for low-impedance carbon-microphone input. The input speech circuit is usually a grounded-grid arrangement as shown in Fig. 4-6. However, it is sometimes desirable to use a high-impedance microphone with the equipment, since a crystal or dynamic microphone has better fidelity and freedom from the hiss and "blasting" sound familiar to the carbon type.

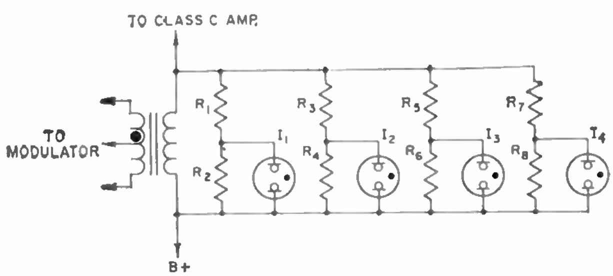
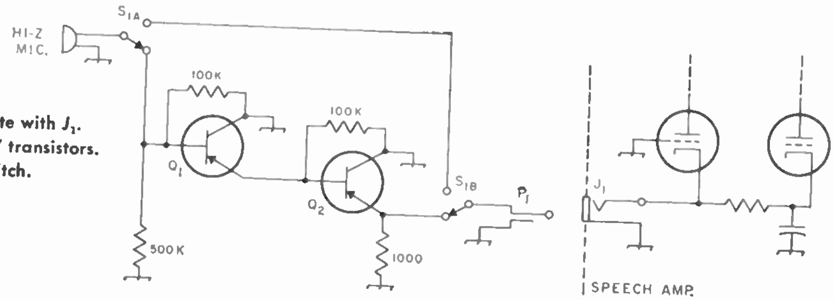


Fig. 4-5—Modulation-percentage indicator. Resistors are ½ watt. I_1 indicates 25 per cent, I_2 50 per cent, I_3 75 per cent and I_4 100 per cent modulation. I_{1-4}—NE-2 neon lamps.

B+ Voltage	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
250	270K	open	270K	270K	560K	270K	820K	270K
400	390K	820K	560K	270K	1 meg	270K	1.4 meg	270K
500	470K	510K	760K	270K	1.3 meg	270K	1.8 meg	270K
600	560K	430K	1 meg	270K	1.6 meg	270K	2.2 meg	270K
750	760K	390K	1.3 meg	270K	2 meg	270K	2.8 meg	270K
1000	1 meg	350K	1.8 meg	270K	2.8 meg	270K	3.9 meg	270K



P_1—Plug to mate with J_1.
Q_1, Q_2—2N107 transistors.
S_1—D.p.d.t. switch.

Fig. 4-6—Microphone impedance step-down adapter. Jack J_1 is the microphone jack on the transmitter's speech amplifier. All resistors are ½ watt.

The circuit shown in Fig. 4-6 is a matching device which will allow a high-impedance microphone to be used with the original speech circuit in the transmitter without any changes in the equipment. It uses two transistors and doesn't need a power supply, since its operating voltage is obtained from the voltage developed at the cathode of the speech-amplifier tubes. It probably could be built small enough to be installed in the microphone case or under its base. By throwing switch S_1, the microphone feeds straight through so that it can be used with equipment designed for high-impedance input.

Transistor Q_1 is used in a common-collector circuit to step down the impedance of the microphone to match the emitter-follower transistor Q_2, which feeds the signal into the low-impedance jack of the speech amplifier. The output voltage from the unit is comparable to that of a carbon microphone but is free from its characteristic hiss sound and nasal quality.

—E. S. Millman, W3WNE

ADDING SQUELCH TO THE HEATHKIT VX-1

FIG. 4-7 shows the arrangement I use to add squelch to the Heathkit Electronic Voice Control unit. The 12BY7's cathode resistor is replaced by a potentiometer, R_1, and is adjusted to allow the tube to conduct and close the control relay. A.v.c. voltage from the receiver is applied through another potentiometer, R_2, to the 12BY7 grid. When a signal is present, a.v.c. voltage is applied to the grid, cutting off the plate current and releasing the relay. The relay is used to control the station speaker circuit.

To operate the squelch, switch the transmitter to standby and the VX-1 to vox. Adjust R_1 so that the relay closes when there is no signal present. Adjust R_2 so that receiver background noise does not trigger the system. The unit is now ready for squelch operation. Rotation of R_1 to the off position restores normal VOX operation.

I mounted R_1 to the lower left of the time-delay control and R_2 directly below R_1.

PARALLEL-FED PLATE MODULATION

THE CIRCUIT shown in Fig. 4-8 makes use of a modulation principle that is more or less standard in commercial broadcast transmitters but is seldom used in ham equipment. It consists of two capacitors and one filter choke in addition to the usual plate modulation components. Capacitors C_1 and C_2 isolate the r.f. amplifier plate voltage from the modulation transformer and if, for some reason, the r.f. amplifier is turned off before the modulator, the choke will act as a load and protect the modulation transformer.

—Michael Novick, K2EKC

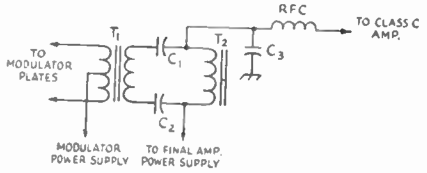
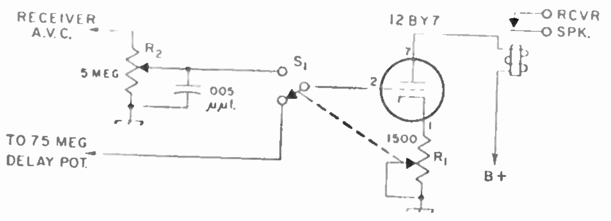


Fig. 4-8—Parallel-fed plate modulator. Capacitors C_1 and C_2 should have a voltage at least twice the modulated-amplifier plate voltage.

C_1, C_2—4µf.
C_3—.005 µf. bypass.
T_1—Modulation transformer.
T_2—Filter choke, 20 or 30 henrys (capable of carrying amplifier plate current).

Fig. 4-7—Squelch circuit for Heathkit VX-1.
R_1—1500-ohm potentiometer.
R_2—5 meg-ohm potentiometer.
S_1—S.p.d.t. switch on R_1 wired so that the arm is at minimum resistance when in the VOX position.



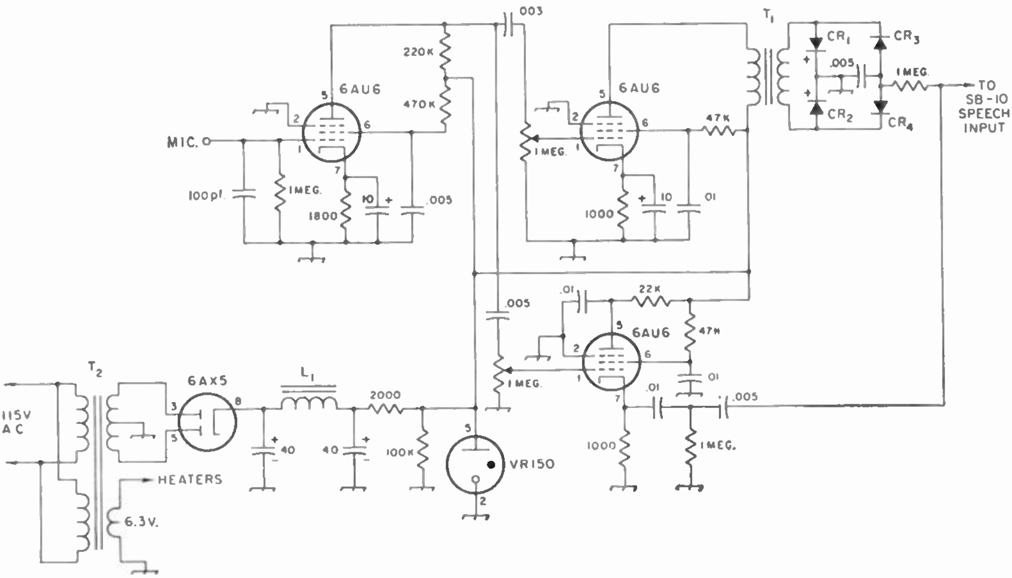


Fig. 4-9—W9CZZ's speech compressor. Unless otherwise indicated, capacitances are in μf., resistances are in ohms. Except for the 2000-ohm, 2-watt resistor in the power supply, resistors are ½-watt. T_2 is a receiver-type power transformer. The diodes, CR_{1-4}, are 1N34As.

SPEECH COMPRESSOR

The hookup shown in Fig. 4-9 is the speech compressor I use between the microphone and my SB-10. Quality reports have been good with the unit and I find that my VOX system seems improved too. The transformer, T_1, is an interstage job with a primary-to-secondary ratio of 1 to 5.

—*M. W. Richardson, W9CZZ*

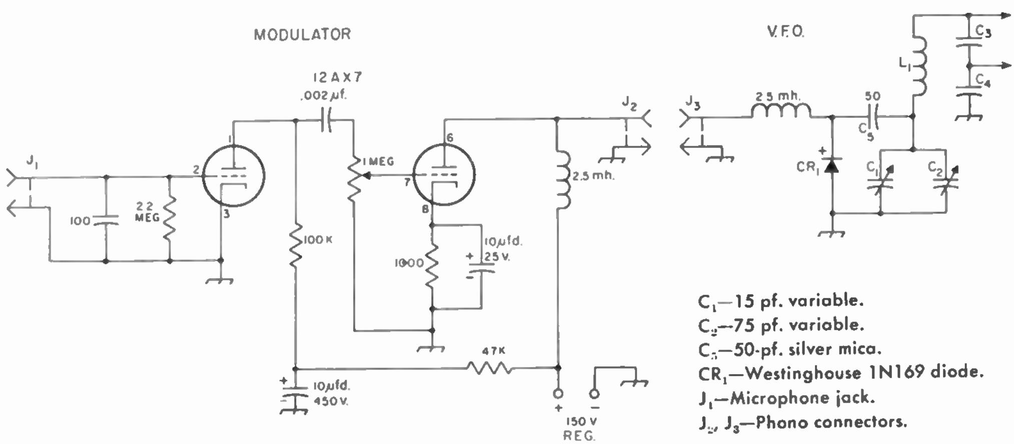
REMOTE F.M. MODULATOR FOR V.F.O.s

The circuit in Fig. 4-10 shows a six-meter remote tuned f.m. modulator and v.f.o. that makes use of the junction capacitance of a silicon semiconductor diode.

The v.f.o. consists of a standard 8-Mc. Clapp oscillator with the diode (CR_1) connected in the tuned circuit. The 12AX7 modulator is connected to the v.f.o. through a length of shielded wire.

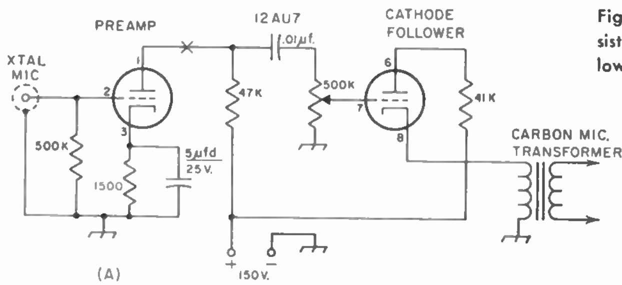
When audio is applied across the diode, the junction capacitance varies and changes the frequency of the oscillator at an audio rate, producing frequency modulation. Deviation of the system is controlled by the gain of the modulator.

—*Leonard Kudravy, K3ASU*



C_1—15 pf. variable.
C_2—75 pf. variable.
C_5—50-pf. silver mica.
CR_1—Westinghouse 1N169 diode.
J_1—Microphone jack.
J_2, J_3—Phono connectors.

Fig. 4-10—Circuit of the f.m. modulator. Unless otherwise indicated, capacitances are in pf., resistances are in ohms, resistors are ½ watt. L_1, C_1, C_2, C_3 and C_4 determine the frequency of oscillation of the Clapp oscillator.



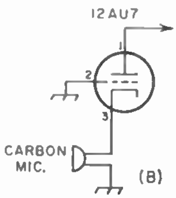


Fig. 4-11—Microphone circuits. All resistors are ½ watt. The cathode follower plate load resistor is 47,000 ohms.

MICROPHONE CIRCUITS

The speech quality of a transmitter that uses a carbon microphone can be improved by substituting a crystal microphone. The diagram shown in Fig. 4-11 (A) shows a 12AU7 crystal microphone preamplifier and cathode follower which feeds into the low-impedance winding of a carbon microphone transformer. Fig. 4-11(B) shows an alternate preamplifier circuit which will provide more gain for a carbon mike. Here, the tube is connected as a grounded-grid amplifier. The carbon microphone receives its operating voltages from the 12AU7's cathode current. If this circuit is used, it should be substituted for the part to the left of point "X" in Fig. 4-11(A).

H. J. Hoechestetter, W6UVM

THE SIMPLICITY MODULATOR

The modulator shown in Fig. 4-12 is an inexpensive means of converting a c.w. transmitter to a type of carrier-control a.m. transmitter. The system incorporates ease of adjustment, simplicity, and versatility, while providing an effect similar to carrier-control systems using only one tube and one adjustment. Operation is practically foolproof and it can be applied to practically any transmitter.

The c.w. transmitter need only meet the following requirements: Tetrode or pentode final amplifier, and separate oscillator and final with adequate isolation (to reduce frequency shift). Some transmitters use a single tube for an oscillator and final, and these must be changed to incorporate a separate oscillator before the modulator can be used.

The audio amplifier used to drive this modulator is not required to furnish much power. Practically any audio amplifier, such as one salvaged from an old radio, TV or phonograph, will work. With a carbon mike, only one stage of amplification is needed.

To adjust the simplicity modulator, load the transmitter for maximum c.w. output. Record the plate current reading and divide this value by 2. Connect the output of the modulator to the screen grid of the r.f. amplifier tube. Apply high-voltage power and adjust the variable resistor R_1 until the transmitter plate current is the value of the original plate current divided by 2. The plate current should increase with modulation and the neon modulation indicator should flash on modulation peaks.

Have a friend check the sound of the modulation or use a scope to adjust the audio amplifier for the best audio level. It may be necessary to lower the transmitter plate current another 10 or 15 ma. to obtain better audio quality. Power for the modulator may be obtained from the original screen supply, providing there is not too much variation in voltage with modulation. This system is not difficult to use, but some experimentation may be necessary. The screen bypass capacitor of the r.f. amplifier tube should be about 0.002 µf.

If a carbon mike is used, it would be best to employ a d.p.s.t. switch to connect the mike circuit and to key a relay which would turn on the high-voltage power. If a heavy switch is used to do this, the relay may be unnecessary. If a push-to-talk mike is used, a relay must be keyed by the mike switch to turn on the high-voltage power.

—*From* The Carrier, *by John Solman*

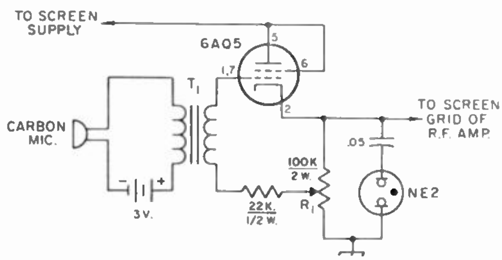


Fig. 4-12—The Simplicity Modulator. Capacitances are in µf. Resistances are in ohms.
R_1—100,000-ohm 2-watt variable resistor.
T_1—Carbon mike-to-grid transformer (Triad A-1X).

Hints and Kinks . . .

for the Power Supply

HANDY SOURCE OF POWER FOR D.C. RELAYS

Discarded pinball machines, old juke boxes and ARC-5 gear are just several sources of excellent d.c. relays. All too often, though, this type of relay is passed over by amateurs because of the d.c. power requirements. However, it is *not* necessary to provide a special d.c. pack for this type of relay and the following explains how relay power is obtained by several of us fellows up here in W8-land.

Here at W8NOH, we connect the d.c. relays in series with the center tap of a low-voltage plate supply. Not only does this method of connection provide relay power, but it provides a source of negative voltage that may be filtered and used as fixed bias for a keyed c.w. stage. Approximately 18 volts was developed across one of the relays so connected and about — 35 volts was obtained across the windings of a pair of relays connected in series. In each case, adequate filtering was provided by an 8-μf. capacitor. Naturally, the relays contacts may be employed for a variety of switching operations such as the control of other supplies, receiver muting, antenna change-over, shorting of a modulation transformer, etc.

W8PUV has a d.c. relay connected in the grid-circuit return of his final amplifier. With the relay contacts controlling the screen and the plate supplies for the stage, it is impossible to apply power without first having excitation available.

W8GJS uses a d.c. relay in the negative return of his plate supply to control a red *warning* light.

Of course, with the relay connected in series with the center tap of the supply, the voltage developed across the solenoid must be subtracted from the original effective value of plate voltage. In other words, if you pick up — 18 or — 20 volts of bias, you lose that amount at the positive output terminal of the supply.

—Louis A. Gerbert, W8NOH

Editor's Note: When using this system, it is advisable to study the current handling capability of the relay winding, remembering that the solenoid must pass the full-load current of the supply. Furthermore, this method of developing bias should be installed only when the supply load is reasonably constant. Serious fluctuations in bias voltage would result if, for instance, a relay was so installed in a supply delivering power for a Class-B audio stage.

SURGE PROTECTION FOR DIODES

One way that I have found to protect semiconductor diodes from starting-current surges is to use a thermistor in series with the primary voltage. The circuit in Fig. 5-1 shows a typical application using a thermistor, RT_1, in the transformer primary circuit. Of course, the d.c. resistance in the transformer winding gives some current limiting. Probably the best application of the thermistor along these lines would be in a "transformerless" power supply.

The thermistor I use has a cold resistance of 80 ohms which drops to about 0.5 ohm when hot. It is a Workman type FR .49 (the number indicates the "hot resistance"), and is available from most radio and television parts distributors as a TV replacement.

—James E. Goff, W4ZXB

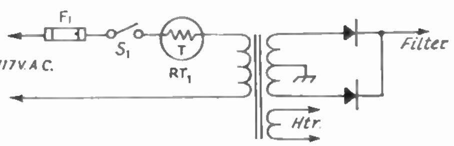


Fig. 5-1—W4ZXB uses a thermistor for surge protection.
F_1—Fuse of the proper rating.
RT_1—0.49-ohm thermistor (Workman FR .49)

ON-OFF SWITCH IDENTIFICATION

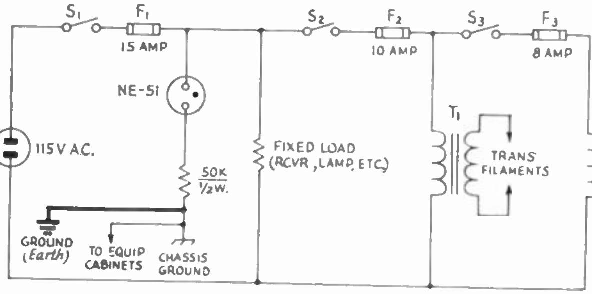
The name plates on small toggle switches are not always legible enough to show their off or on positions. A positive indicator is desirable and can be obtained by using some quick-drying red lacquer or red nail polish. Apply the paint to the under side of the switch handle with the switch in the off or down position. Make sure the red is not visible when the switch is in the down position. After the lacquer is dry, snap the switch handle up and the red indicator, showing the switch is on, will be visible. I have tried this idea on a small switch panel which has a row of nine toggle switches and the on positions of the switches really stand out.

—Peter H. Shavney, Sr. W3FFR

SWITCH-TO-SAFETY IDEA

Having in mind the worthwhile purpose of increasing the longevity of ARRL members and other amateurs, I would like to add a sug-

Fig. 5-2—Diagram of W8-DDF's switch-to-safety power control circuit.
F_1, F_2, F_3—Line fuses; see text.
S_1, S_2, S_3—S.p.s.t. power switches.
T_1, T_2—Filament and plate transformers.



gestion to the several technical Switch-to-Safety items which have appeared in *QST*. Fig. 5-2 illustrates a simple power wiring arrangement which provides continuous safety checks on power and ground connections. With this arrangement, all switches and fuses are located in the "hot" side of the 117 volt a.c. line, carrying through the scheme used in standard house wiring. (When fuses are installed in both sides of the line, it is possible for the cold fuse to operate from overload and still leave equipment and wiring energized with 117 volts with respect to ground.)

One side of a neon panel light is connected to the "hot" side of the a.c. line after the fuse and main power switch. The other side is connected to station equipment cabinet ground through a 50,000 ohm resistor. A standard bayonet panel socket with a clear glass jewel is used for lamp (NE-51) installation. Before connecting the power plug to an outlet, the main power switch, S_1, is placed in the off position. Some resistive load normally connected after the main power switch should be present. This fixed load may be provided by a desk lamp and a receiver.

If the NE-51 illuminates when the power plug is inserted in an outlet, reversed polarity is indicated. The NE-51 will then go out if the main power switch, S_1, is placed to on. Reversing the power plug will result in opposite- and proper-operation of the panel light. It will illuminate only with the main switch on. Failure of the light to glow with either position of the power plug indicates an absence of the vital connection between chassis and actual ground (shown as heavy line in Fig. 5-2). With the power plug properly installed, all station equipment is completely deenergized by operation of the main switch or fuse. Improper installation of the plug is immediately apparent from the appearance of the neon lamp.

In addition to the main power switch, S_1, the circuit includes S_2 and S_3 for control of the filament and plate supplies, respectively. Of course, S_2 and S_3 may be used to control additional transformers provided these are properly connected in parallel with the primaries of T_1 and T_2. Ratings shown for fuses F_1, F_2 and F_3 may be varied to suit individual requirements.

—*John W. Browning, W8DDF*

GROUND AND POLARITY TESTER

In the interest of safety, it is advisable to test all leads to ground (earth) for resistive characteristics. A resistive circuit or lead to ground is not a safe one and may not be depended on as a means of preventing accidental shock.

The simple circuit shown in Fig. 5-3 may be as familiar to many hams as it is new to others, but it does provide one of the quickest means of checking the effectiveness of a ground lead. An ordinary lamp bulb of almost any wattage rating is used as the indicator for the tester. One terminal of the bulb is connected to a standard 115-volt plug and the second terminal of the lamp is connected to a heavy clip or probe which in turn is used to make contact with the ground point under test. The bulb will light to full brilliancy when connected between the a.c. line and a good ground point. On the other hand, less than normal brilliancy indicates a poor ground connection.

A second use for the simple circuit is that of testing for either the hot or the grounded side of the a.c. line. The bulb will light when the active side of the plug makes contact with the hot side of the a.c. receptacle and will fail to glow when contact is made with the grounded side of the line.

—*Joseph A. Wright, Jr.*

Editor's Note: Two precautions should be observed when using the lamp-bulb ground tester. When testing the effectiveness of a lead, make sure that the test lamp is lighted to full brilliancy by checking it against a lamp of similar rating that has been plugged into a convenient 115-volt socket. Second, when attempting to determine the polarity of an a.c. outlet, make sure that the test lamp is a good one; remember, a *burned-out lamp won't glow even when* connected to the *hot* side of the line.

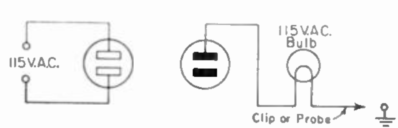


Fig. 5-3—Diagram of the simple ground tester.

TIME-DELAY PROTECTIVE CIRCUIT FOR HIGH-VOLTAGE POWER SUPPLIES

A WELL designed power supply using mercury-vapor tubes includes protective circuitry which assures adequate filament warm-up time for the rectifiers. The simple circuit shown in Fig. 5-4 will, with the thermal relay specified, provide a thirty-second delay or warm-up period before the high-voltage transformer is turned. The circuit is used here at VE3AXC with an 866 supply and functions as follows.

When S_1 is closed, 115 volts a.c. is applied to the heater of the thermal relay, K_2, through the normally-closed contacts of K_1. The rectifier-tube filament transformer also receives primary power with the closing of S_1. K_2 closes thirty seconds later and completes the a.c. circuit for the solenoid of K_1. K_1 now closes, feeds power through its normally-open contacts to the primary of the plate transformer, and breaks the 115-volt connection to K_2. The thermal relay cools off and opens, but K_1 remains closed to complete primary wiring for the plate transformer.

A break in a.c. primary power (power failure or accidental unplugging of the line cord) will open K_1 and disconnect primary voltage from the plate transformer. When a.c. power is restored the complete cycle of relay operation will repeat itself as long as S_1 is closed.

—*T. R. Baker, VE3AXC*

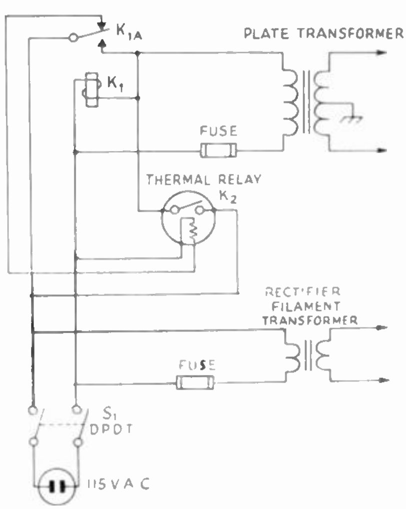


Fig. 5-4—Schematic diagram of VE3AXC's time-delay protective circuit for high-voltage power supplies.
K_1—S.p.s.t. normally-open 115-volt a.c. relay.
K_2—S.p.s.t. normally-open 115-volt a.c. thermostatic delay relay (Amperite 115NO30).
S_1—S.p.s.t. power switch.

NOVAL BIAS SUPPLY

A TRANSFORMERLESS bias supply suitable for use with almost any amplifier that doesn't draw grid current is shown in Fig. 5-5. The value of C_1 *and* R_2 are selected to result in a d.c. output voltage across R_1 that is slightly higher than the bias required. This system has a definite advantage over any equivalent resistive divider, since the capacitor dissipates practically no power and also isolates the bias supply for d.c. as well. The values given in Fig. 5-5 are the ones I use to supply bias for my 50-watt 2-meter transmitter. The diode, CR_1 can be any general-purpose silicon type of sufficient rating.

—*Robert Mudra, K9YQD*

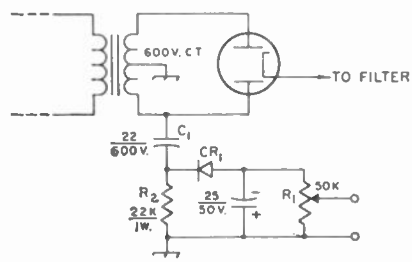


Fig. 5-5—K9YQD's bias supply.

PILOT LAMP INSTALLER

TO INSTALL pilot lamps in hard-to-get-at places in equipment, use an eye-dropper bulb. Cut off the rubber suction part of the dropper so that it will fit snugly over the pilot lamp. Insert the lamp into the rubber holder and then position the lamp base into the socket. The rubber will provide enough grip on the glass lamp so that it may be twisted into place.

—*Bill F. Agee, WA4AVX*

SAVE BURNED-OUT TRANSFORMER

A POWER transformer with an open primary winding can still prove useful. Connect the 6-volt winding of the defective transformer to the 6-volt winding of another transformer and the defective transformer will supply high voltage as before. Of course, this scheme should be employed only as an emergency or breadboard method. Be sure not to exceed the power ratings of the transformers.

—*Robert B. Hazelton, K3RBH*

STOP POWER-SUPPLY OSCILLATIONS

SEVERAL hams in this area who have used the 6AS7G electronically-regulated bias-supply circuit appearing in *Handbooks* prior to the 1959 edition have had trouble with oscillation in the vicinity of 13 kc. This oscillation has resulted in modulation of the transmitters with which the supply has been used, causing spurious signals to appear at approximately 13 kc. either side of the transmitting frequency. The trouble was avoided very simply by connecting a 0.02-μf. disk capacitor from grids to cathodes of the 6AS7G/6080.

—*Dallas Johnston, W9AAG*

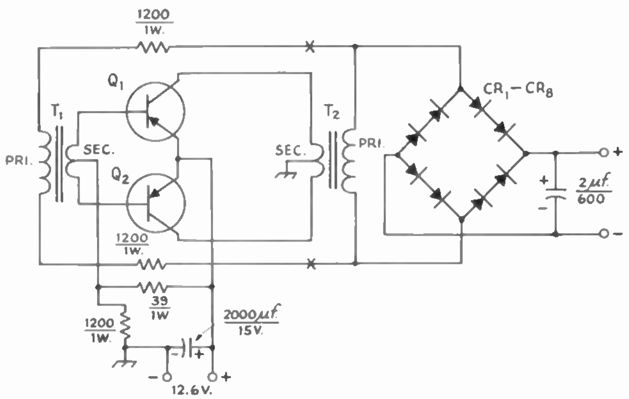


Fig. 5-6—Inexpensive transistor power supply.
CR_1-CR_8 inc.—150-ma. rectifier (Sarkes Tarzian M-150 silicon rectifiers).
Q_1, Q_2—Delco 2N173 transistors.
T_1, T_2—Filament transformers, 6.3 volts, 3 amp., center-tapped. (Stancor P-6466).

TRANSISTOR POWER SUPPLY

In transistor power supplies the most expensive component is usually the power transformer. The supply shown in Fig. 5-6, above, overcomes this problem by using inexpensive filament transformers. The unit will deliver about 300 volts at 120 ma continuous duty. Although designed for 12-volt d.c. input, the supply will operate from 6 volts d.c. Of course, the output will be cut in half when operation is from 6 volts.

I built my supply in a 4 × 3 × 6-inch chassis. A heat-sink channel (see Fig. 5-7 below), made from aluminum is mounted atop a 4 × 6-inch cover plate which has the two transformers and resistors (supported by terminal tie points) connected underneath. The silicon diodes, input and output terminals, and the filter capacitor are all mounted inside the chassis. Layout is not critical and components can be located at will.

After wiring and checking the unit, apply power. If the supply fails to oscillate, reverse the leads at points *X-X* in Fig. 5-6.

—Robert A. Finch, K9IWI

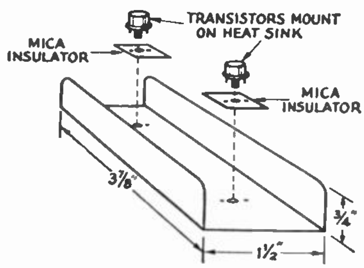


Fig. 5-7—The heat-sink channel is made from sheet aluminum. Transistors must be electrically insulated from the sink.

ADJUSTABLE POWER SUPPLY

Fig. 5-8 shows a power supply with d.c. output adjustable over about a 3-to-1 range. Although not a regulated supply, it does tend to compensate for a.c. line fluctuations and changing d.c. load. The diagram shows a 6N7 dual triode used as a rectifier, but triode-connected pentodes such as the 6L6 can also be used. Surprisingly enough, the normal 5-volt winding intended for a conventional rectifier tube will usually power the 6.3-volt heater satisfactorily for the triode or pentode rectifiers. If this arrangement bothers the constructor, the rectifier heaters may be powered from the 6.3-volt heater winding. However, this winding should not be grounded or used to power any other tube heaters since the heater-to-cathode insulation will probably break down unless it is rated to take the full d.c. supply voltage.

Variable resistor R_1 can be any type of potentiometer but one with a linear taper is preferred. Resistance should be in the order of 100,000 to 500,000 ohms in most cases.

An added feature of the circuit is the fact that the potentiometer acts as a bleeder and will discharge the filter capacitors when the supply is turned off.

—F. T. Swift, W6CMQ

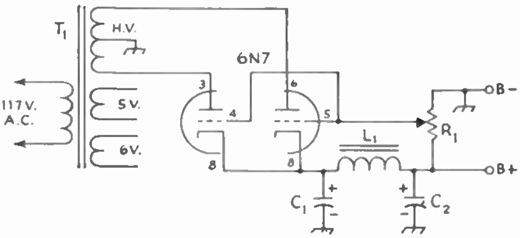


Fig. 5-8—Adjustable power supply. $L_1C_1C_2$ is a conventional filter section.
R_1—See text.
T_1—Power transformer. When using a 6N7, the transformer voltage should not be over 300 volts each side of center tap. The load should not exceed 70 ma.

VACUUM-TUBE RECTIFIER REPLACEMENTS

W8NOH's tip in "Hints & Kinks," *QST*, January, 1961, was a good one. However, semiconductor diode units are available for exact replacement of common vacuum-tube rectifiers. These rectifier packages are contained in octal-based holders and simply plug in the vacuum-tube rectifier's tube socket. Sarkes Tarzian, Inc., of Bloomington, Indiana, has several replacement types, such as the type S 5018 which replaces the 5U4, the S-5019 for a 5R4, and the S-5130 for an 816 or 866 (10,400 p.i.v., 300 ma.). The semiconductor versions have proved much more reliable and longer-lived than the thermionic vacuum-tube rectifiers and, of course, provide cooler operation and less voltage drop.

—Neil Johnson, W2OLU

24-VOLT D.C. SUPPLY

There are many good relay bargains on the surplus market today, but almost universally they require 28 volts d.c. A small, but husky, one-ampere solid-state power supply shown in Fig. 5-9 can be built up in a matter of minutes.

The unit is constructed on a 3¼ × 2¼ × 2¼-inch Minibox. The diode can be any silicon rectifier with 50 volts p.i.v. or more. The current rating should be at least 1.5 amperes. A test point is included for an easy check of voltage output from the power supply.

—W1KLK

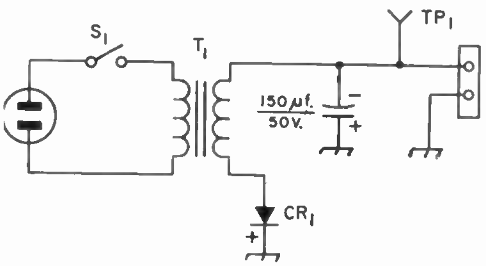


Fig. 5-9—W1KLK's 24-volt d.c. power supply.
CR_1—See text.
S_1—S.p.s.t. switch.
T_1—Pri. 117 volts, sec. 25.5 volts, 1 amp. (Stancor P6569 TR1 or Allied 61 F 421).
TP_1—Phone tip jack.

BLEEDER SAFETY LIGHT

Power-supply bleeder resistors sometimes do burn out despite conservative ratings. One method of insuring against burnout is to use two bleeders in parallel, each one having a higher value than the original single one. It is rather unlikely that both resistors will open up during the normal life of a power supply.

Another solution, shown in Fig. 5-10, gives a visual warning whenever a bleeder resistor opens up. Four resistors, R_1, R_2, R_3, R_4, each of the same resistance but rated one-quarter of the power of a single bleeder resistor, are used in a bridge along with a neon bulb connected between the two junctions. When any one of the four resistors opens up, a voltage difference will appear across the neon bulb, causing it to ignite and thus giving indication of a burnout. In most power supplies, additional current limiting resistance, R_5, will be needed to protect the neon bulb; the value of R_5 can be calculated or found experimentally. If a 1/25-watt neon bulb is used, try a value around 500,000 ohms for each kilovolt of total power-supply voltage.

—Harry L. Cox, Jr., W3MJC

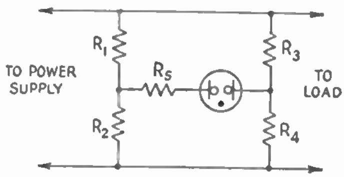


Fig. 5-10—Power supply bleeder circuit with burn-out indicator.

POWER SUPPLY TURN-ON CIRCUIT

Power supplies using very large values of filter capacitance must be turned on at a reduced power level so as to limit the capacitor-charging current to a value that is safe to the rectifiers. This can be done by inserting some resistance in series with the primary of the plate transformer; the resistance is shorted out after the capacitors have become charged. The diagram in Fig. 5-11 shows a fool-proof method for doing this, and it does not matter which switch is closed first. The resistor, R_1, is always in the circuit when one switch is closed. Closing the second switch shorts out the resistor. The supply is off when both switches are open. A household lamp makes an inexpensive resistor for R_1.

—Melvin Leibowitz, W3KET

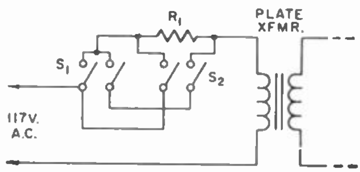


Fig. 5-11—W3KET's switching circuit. S_1, S_2, D.p.s.t. switch.

CENTER-TAPPED CHOKES

The power-supply article by W3FQB in *QST*, October, 1962, was most interesting, especially his solution to the perplexing problem of achieving a choke input filter on a voltage-doubler-type power supply. The use of a center-tapped choke certainly solves the problem. However, as W3FQB mentions, the center-tapped choke is not a common item but a satisfactory substitute can be found among those "older transformers still on hand that are designed for 110-volt operation."

I found that the high-voltage winding of any old power transformer with sufficient current-carrying capacity can be used. It is just a matter of removing all of the windings except the high-voltage secondary and restacking the core laminations to provide a butt joint.

Experimenting with two transformers, I found the inductance at zero-current d.c. measured about 3 henrys for one half the winding. In using them in a power supply with an old television transformer whose total secondary voltage is 660 volts, the d.c. voltage under a 40-ma. bleeder load is 1180 volts. This is pretty close to the value of 1.8 times the r.m.s. a.c. voltage value mentioned in the subject article. The voltage drops about 100 volts under full load of 200 ma.

—*A. O. Phares, W5MCV/Ø*

NOVEL REGULATOR

Regulator tubes can't be paralleled directly to obtain greater current capacity because one tube will always ionize at a slightly lower voltage, thus preventing the other tube from firing.

The diagram in Fig. 5-12 shows how parallel operation of VR75s may be used without the usual equalizing resistors in series with each tube.

The transformer T_1 can be any universal output transformer having a center-tapped primary. The secondary winding is not used. The d.c. resistance of the transformer winding is sufficient to accommodate the slight difference in operating potential of the two VR tubes.

—*W. E. Witte, WØDYW*

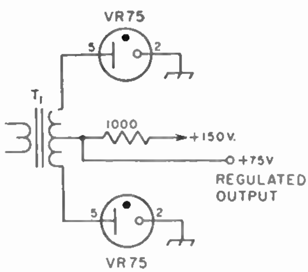


Fig. 5-12—WØDYW's voltage regulator.

TRANSIENTS AND POWER-SUPPLY DIODES

One of the important factors to consider when designing a power supply that uses semiconductor diodes is the p.i.v. rating of the diodes. Formulas are available for determining this value on the basis of the known r.m.s. values of the line voltage, but little information is available as to what can be expected from transients which appear via the power line. These transients are probably responsible for a large majority of semiconductor failure in power supplies. The following information and chart concerning transients appeared in a GE *Newsletter* for March 1963, and is reprinted here in part.

> The chart (in Fig. 5-13) shows the frequency and severity of random voltage transients on typical 120-volt mains in seven homes, two hospitals, and three commercial establishments. The data represents approximately 8000 hours of testing time. Locations were in two states. What the data shows: 1. Some locations have considerably more and higher transients than others. In other words, just because you're not having trouble in one place does not mean you won't have trouble someplace else. 2. The highest transient measured to date on a 120-volt line was 3470 volts peak-to-peak. It occurred in a Florida home during a lightning storm. 3. Relatively frequent transients occur up to 1600 volts, with most frequent occurrence around 500 to 600 volts. 4. Most of the voltage surges last less than 50 microseconds.
>
> While the data is limited, it still constitutes the most complete information taken to date. It proves conclusively that voltage transients must be reckoned with in semiconductor apparatus operating from utility lines.

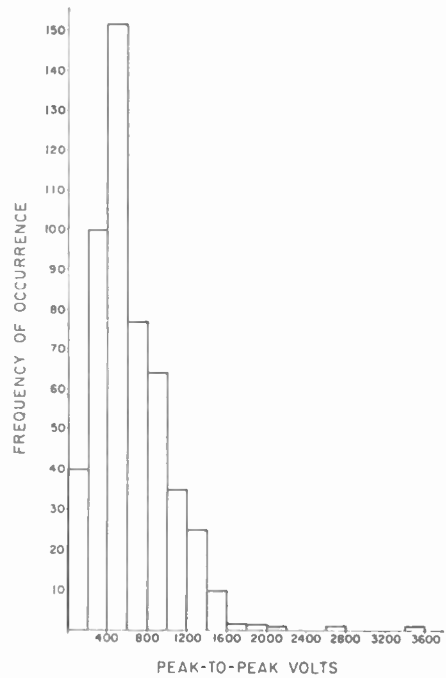


Fig. 5-13—Histogram of frequency of occurrence of surges. Data was taken with a Tektroniks automatic oscilloscope 515A, Model 760A, a Beattie & Coleman automatic camera. Data includes 7 homes, 2 hospitals, 1 hotel, 1 motel and 1 department store.

MULTI-ELMAC M1070 POWER-SUPPLY NOTES

The problem of short vibrator life in the Elmac Model M1070 power supply can be remedied by making a few revisions in the

for the Power Supply

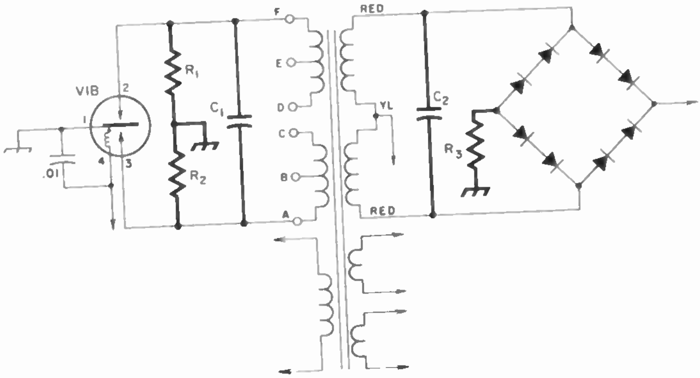


Fig. 5-14—Changes to the Elmac M1070 power supply.
C_1—0.5 µf., 200 volts.
C_2—0.015 µf., 1600 volts.
R_1, R_2—390 ohms, 2 watt.
R_3—100 ohms, 7 watts.

original circuitry. The heavy lines in Fig. 5-14, indicate the parts to be added. The capacitor C_2 originally was 0.0047 µf. and should be changed to a 0.015µf., 1600-volt unit. One other suggestion: Change the 100-µf. capacitor C_{210} to a 250-µf., 25-volt unit. This will give better action to the antenna changeover relay.

—*Harry Stewart, W8PSV*

SCREEN-GRID PROTECTION WITH A SURPLUS RELAY

While overload relays operating in the region of 100 to 500 ma. are readily available, it may be difficult to locate one suited for use in the screen-grid circuit of an r.f. amplifier which employs a tube such as the 4X250B. The requirements in this case call for a relay that will disconnect screen voltage at a screen current of 50 ma. or somewhat less.

Use of an inexpensive surplus relay of the dual-winding type provides a simple solution to the problem. Fig. 5-15 is the diagram of a relay-type protective circuit that was whipped up and placed in operation in less than one evening. Although no new principle is involved, the system does provide dependable protection for those expensive pentode and tetrode tubes which ruin so easily because of excessive screen dissipation.

The s.p.d.t. surplus relay has a pair of 200-ohm windings on a common core. One of these windings is connected in series with the screen-grid lead, the normally-closed contacts of the relay and the line from the screen supply. The path between supply and screen grid remains closed until a predetermined value of screen current activates the relay and opens the normally-closed contacts. When the relay is tripped by overload current, voltage is transferred to the second winding which now receives voltage through the normally-open contacts and R_1. The second coil will hold the screen circuit "open" until the relay is re-triggered by the opening of reset switch S_1.

R_2 is a sensitivity control for the relay and, in the original circuit, is adjusted so that the relay kicks over at screen current in excess of 35 ma. Of course, any abnormal operating condition that usually causes excessive screen current will operate the relay.

Reverse the leads to one of the windings if the relay chatters or fails to hold when activated by screen current. If the relay has a spare set of contacts, these may be used to control a "screen-on—screen-off" pilot lamp.

—*I. S. Simpson, W1FYN*

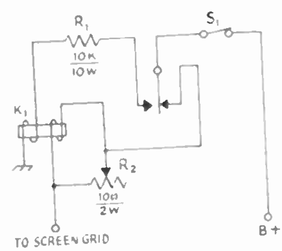


Fig. 5-15—Diagram of W1FYN's screen-grid protective circuit.

K_1—Surplus relay; see text.
R_1, R_2—See text.
S_1—S.p.s.t. toggle switch.

LINE VOLTAGE ADJUSTER

In some areas, line voltage is either too high or too low. Most electronic equipment is designed for a nominal voltage of, say, 120 volts and serious damage can occur to the equipment when the voltage swings far beyond this value.

One obvious solution is to use a variable autotransformer (Variac), and simply adjust for the desired voltage. However, there is another method that has been used for many years, yet may not be familiar to the new generation. The line-voltage adjuster consists of a common junk-box variety 6.3-volt center-tapped filament transformer, *T1* in Fig. 5-16. The transformer is in the circuit so that, by positioning switch S

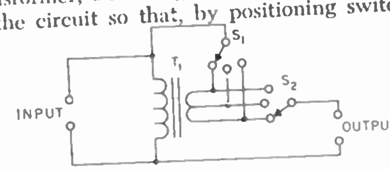


Fig. 5-16—Line-voltage adjuster.
T_1 is a 6.3-volt filament transformer.

and S_2, the 6.3-volt winding will either "buck" or add to the line voltage. Switch S_1 and S_2 allows for either adding 6.3 volts or 3.15 volts, or subtracting 6.3 volts or 3.15 volts.

Power rating of the system is determined by the current rating of the filament transformer. If the transformer is rated at 5 amp., then the total power to the load should be limited to 5 amp. Only one caution need be observed: the center tap of some filament transformers is a small conductor, smaller than the two outside leads. If this is the case, it may be necessary to assign a lower power rating than indicated to the transformer. Of course, other filament transformers can be used for more (or less) voltage.

CONVERTING FILAMENT TRANSFORMERS FOR PLATE-SUPPLY USE

In searching for miniature power transformers for such low-power items as grid-dip oscillators, etc., I have found it convenient to make my own, using small filament transformers. Since most of these have the low-voltage winding wound on the outside, it is easy to remove the few filament turns to make room for the rewinding.

The procedure is simple. Count the turns removed to determine the turns-per-volt ratio for the core. Now rewind the filament turns with a smaller size wire. Follow this with the "high-voltage" winding using the number of turns per volt previously determined. The wire sizes should be chosen so the I^2R losses in the two secondaries under load do not exceed the rated I^2R loss for the removed turns. This allowable loss is fairly flexible and can be exceeded by 50 per cent or so for intermittent duty or where some ventilation is present.

—Ben Vester, W3TLN

VARIABLE A.C.-D.C. POWER SUPPLY

Anyone who has done electronic construction or experimentation has certainly found need for both a d.c. and a.c. voltage source which can be varied over a reasonably-wide range. The supply shown in Fig. 5-17 will supply 0 to 135 volts a.c., variable d.c. voltage and 6.3 volts a.c. The maximum d.c. output will depend on the plate transformer (T_2) used and whether choke or capacitor input is used in the filter. Switch S_3 allows switching the filter circuit between choke or capacitor input. Switch S_2 switches the variable a.c. voltage from T_1 either directly to the variable a.c. output terminals or to the primary of the plate transformer. S_1 switches the entire supply on or off by control of the line voltage.

—William D. Rexroad, KØGDW

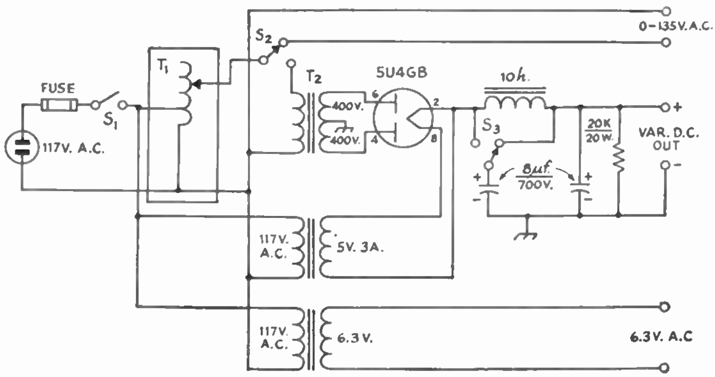


Fig. 5-17—KØGDW's variable a.c.-d.c. power supply.
S_1—S.p.s.t. toggle switch.
S_2—S.p.s.t. toggle switch.
S_3—S.p.s.t. switch (high-voltage insulation).
T_1—Variable - voltage transformer (General Radio Variac, Superior Powerstat, Standard Adjust-A-Volt).
T_2—Plate transformer.

Hints and Kinks . . .

for Keying and Monitoring

FINGER KEYING

The article, "A Novel Key for Use with Electronic Keyers," in *QST*, August 1962, is somewhat similar in principle to a key I have used for some time. Although my key is a little less sophisticated than W5HPB's key, it can be used for c.w. "finger keying."

My pair of finger keys is made from two strips of ½ × 3-inch aluminum sheet cut from scrap (brass, steel, etc., may be substituted) and mounted about ¼ inch apart on a wooden base. A side view of the arrangement is shown in Fig. 6-1. The contacts should have very close clearance and require very little effort to close. A piece of plastic tape on top of each strip provides insulation and gives a softer "feel" to the finger. Since my index finger is the most agile, I operate the dots with it (via the electronic keyer) and the dashes with the adjacent middle finger.

The scope of this type of key using multiple finger operation is not limited to electronic keyers; the keys may be operated without an electronic keyer assist. Perhaps a bank of four keys, mounted in a row and played like a piano with a rolling motion of the fingers, could be used. Or still another version—add a fifth key for the thumb and make all the dashes with the thumb. One's imagination and practice are the only limits to the combinations that can be worked out for the various letters and characters.

—W. W. Johler, W9UZS

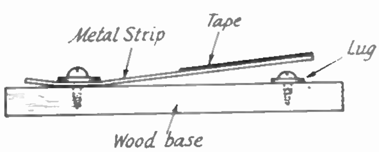


Fig. 6-1—W9UZS's finger key.

BETTER GRID-BLOCK KEYING WITH THE W3OPO ELECTRONIC KEYER

Although the transistor grid-block keying arrangement described in the author's original article on page 51 of *QST* for December, 1962, worked well with the transmitters with which it was tried, several hams have reported difficulty. In some grid-block systems, Q_{12} is being held in an "off" state (not saturated) because of insufficient emitter driving current which, in turn, prevents the transmitter from keying.

The revision shown in Fig. 6-2 was suggested by K4NST and some of his friends in Birmingham, Alabama. With this common emitter configuration, Q_{12} is easily driven to the "on" state (saturated), which allows the transmitter to be keyed. One additional transistor is required. The circuit has worked well with transmitters having voltages as high as — 175 volts (K4NST) and as low as — 65 volts (WA2VLK) across the key contacts.

—James C. MacFarlane, W3OPO

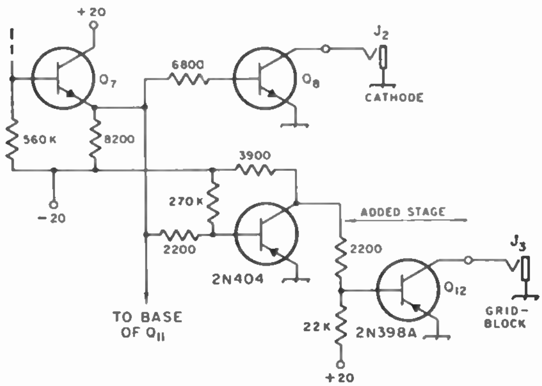


Fig. 6-2—Circuit for better grid-block keying with W3-OPO keyer.

CONTACT BOUNCE MAY CAUSE KEY CLICKS

If you are using a semiautomatic key and are receiving reports of bad key clicks, check the adjustment of your "bug." With some high-speed dot adjustments, the dot contact actually bounces and breaks up the first part of the dot into a series of sharp pulses. Some transmitters will attempt to follow these pulses and will exhibit clicks under these conditions. Also, electronic keyers, such as the HA-1 (T.O. Keyer), will attempt to follow poor bug contacts.

—Fritz A. Franke

NO-CHIRP KEYING

My transmitter, which consists of a DX-35 and VF-1 v.f.o., had a bad chirp on 20 meters when operating c.w. By applying an old principle, which may be new to some, I completely cleaned up the signal. The solution was to power the v.f.o. from an independent source (other than the transmitter), such as from the receiver power supply, and to let the v.f.o. run continuously. Now, keying just the DX-35 results in a clean keyed signal.

—B. H. Carveth, VE3BC

GROUP CODE-PRACTICE OSCILLATOR

Some months ago, armed with an old copy of *Learning the Radiotelegraph Code,* I took on the chore of teaching my son's Boy Scout troop members a smattering of the code. It soon became apparent that the first desirable requirement was a good group code-practice oscillator to substitute for the three or four bad-sounding buzzers the Scouts were using.

The above manual had the perfect answer, an excellent switching setup and an oscillator to match. The only difficulty came when I couldn't find a 220-ohm line cord or the 70L6GT amplifier-rectifier tube, which has entered the realm of the high-priced obsoletes. So I revised the circuit, substituting a 35B5 and a 35W4 for the 70L6GT, and a 35W4 for the dropping resistor line cord. The diagram of the revised oscillator is shown in Fig. 6-3.

I did not have a universal adjustable-ratio output transformer called for in the original circuit so I substituted an output transformer, T_1, with a 14,000-ohm primary and a 3.2-ohm secondary.

The frequency of the oscillator wasn't just right and, after some experimenting, capacitors C_6 and C_7 in Fig. 6-3 were put into the circuit as shown. This gives a high or low tone which can be selected by switch S_3. Switch S_1 was changed from the original circuit to an s.p.d.t. unit so that J_1 could be added. This jack is used when it is desired to feed a signal through the student's earphones from a tape recorder, ham receiver, or from another oscillator. In order for this new input signal to be heard, the instructor's key must be closed. For safety's sake, the complete code-practice circuit must be isolated from the metal chassis. The chassis must be connected to an earth ground.

—Jack Davis, K3DKE

NO-TIP J-38 KEY

The popular J-38 key can be used on the operating table without fastening it down by simply removing the key from its base, turning it around 180 degrees, and remounting it on the same base. Use the same mounting holes for attaching the key to the base.

—Charles O. Alexander, WØKCG

LEVER FOR ELECTRONIC KEYERS

The popularity of building electronic keyers has given rise to the necessity for electronic keyer actuators. An old 6- or 12-volt vibrator should not be overlooked as an excellent source of a set of contacts. In some cases, the armature from the vibrator can also be used.

—James T. Lawyer

BETTER TONE FOR LITTLE OSKEY

I built the "Little Oskey" strictly according to the article in *QST* and it worked fine, performing all its duties. However, the tone generated in the audio oscillator was far from being a sine wave and had an annoying rough sound.

I changed the original 0.51-megohm grid resistor to a 500,000-ohm potentiometer, R_1 in Fig. 6-4. Also, I bypassed the red transformer lead with a .05 μf. capacitor, C_2. Now the tone

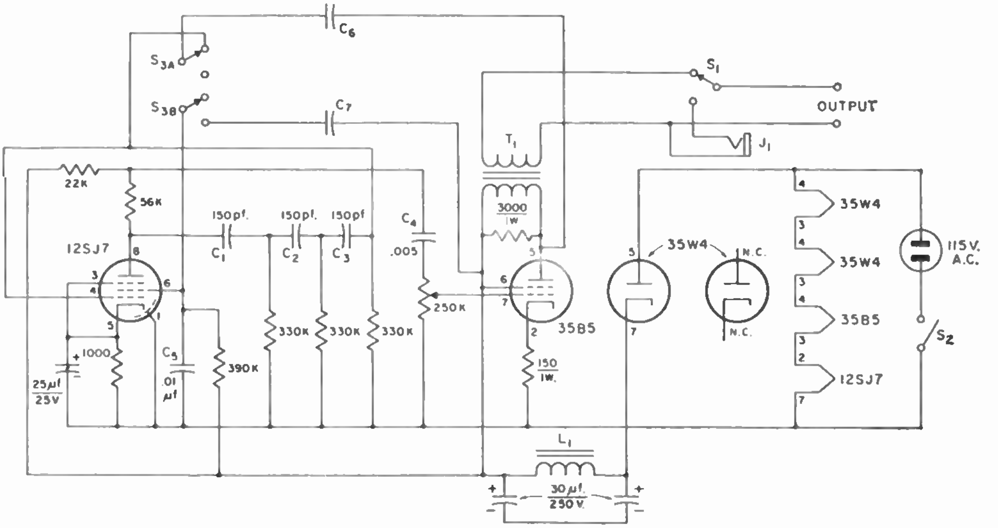


Fig. 6-3—K3DKE's group code-practice oscillator.

Unless specified otherwise, resistors are ½ watt. See the text for components not listed below.

C_6—0.001- to 0.01-μf. mica capacitor.
C_7—0.1- to 10-μf. paper or molded plastic capacitor.
J_1—¼-inch phone jack.
S_1—S.p.d.t. switch.
S_3—D.p.d.t. switch.

is clean and pure and can be varied over the frequency range of about 500 to 1200 cycles by adjusting the position of the potentiometer, R_1.

—Dr. Benjamin H. Sullivan, K4DKD

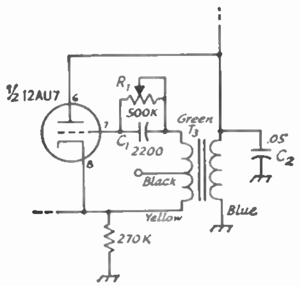


Fig. 6-4—The quality of Little Oskey's side tone can be improved by substituting the above values at R_1 and C_2.

MODIFIED CQ SENDER

W9JCV's "Simple Automatic CQ Sender," *QST*, October, 1963, works fine with most full-size a.c. tape recorders that have a watt or two audio output. However, the inexpensive imported transistor tape recorders simply do not have enough "oomph" to drive the keying relay directly. The circuit in Fig. 6-5 shows an amplifier that can be used between a low-output tape recorder and the keying relay.

The transistor is any general-purpose audio type; T_1 is a transistor output transformer with the low-impedance side connected to the tape-recorder output. Relay K_1 is a 300-ohm unit I happened to have in the junk box. As in W9JCV's circuit, capacitor C_1 should be reduced in value to 0.05 µf. when using speeds above 20 w.p.m.

—Bob Herman, WN5JEX

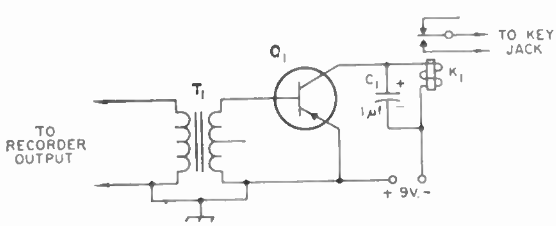


Fig. 6-5—This transistor amplifier will boost the output from a transistor tape recorder.

TUBELESS MINI-KEYER

Except for a weight control, the circuit in Fig. 6-6 is basically similar to the Corkey, *QST*, November, 1950, but is considerably simpler. The operation is as follows: When the key is moved to the dot position, C_2 charges and, at the same time, the relay K_1 closes. When the relay closes, it breaks the circuit to C_2, which then discharges through the relay coil and R_1. When C_2 discharges to a certain value, the relay will drop out, completing the dot to the keyed circuit. When the key is moved to the dash position, C_1 charges and diode CR_1 conducts, connecting C_2, which also charges up. The same cycle as explained in the dot position is repeated for the dash, except that the delay is longer due to the higher value of capacitance. The circuit is self-completing and R_1 provides a speed control for a range of about 10 to 45 w.p.m. C_1 and C_2 should be selected for the correct dash-to-dot ratio with the particular relay used. A sensitive relay must be used, or very large values of capacitance will be required for C_1 and C_2.

—Roger Grant, VE1ŎI/VE3

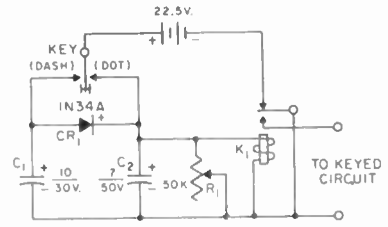


Fig. 6-6—VE1OI's tubeless keyer.
K_1—10,000-ohm sensitive plate relay.
R_1—50,000-ohm linear control.

RECEIVER MUTER

For those using a J-38 or similar type hand key here is an extremely simple receiver muter which will turn the receiver off when the transmitter is keyed on Drill a hole in the J-38 key just below where the gap-adjusting screw touches the key base. Through the hole place a bolt with a tip of coin-silver solder to it. This bolt is insulated from the key base and a lead is run from the bolt to the mute terminals of the receiver. (The mute circuit of the receiver must be one that mutes the receiver when the terminals are open.) Of course, the key lever must be grounded as it usually is in cathode or grid-block keyed circuits. When the key is up (open), the lever will make contact with the post, turning the receiver on. When the key is pushed down (closed), the mute contacts will open, muting the receiver.

—F. P. Hughes, VE2AQJ

BUG HOLD DOWN

Many methods have been proposed for keeping a "bug" from walking around the operating table, particularly when you're trying for a little speed. Minnesota Mining and Manufacturing Co. has the answer: Scotch Double Stick Tape. This is a product that is sticky on both sides. Just put a ½-inch square piece on each of the rubber feet of the bug and set the bug down on the desk. It won't move.

—R. B. Jeffrey, W8GDC/WA8FWF

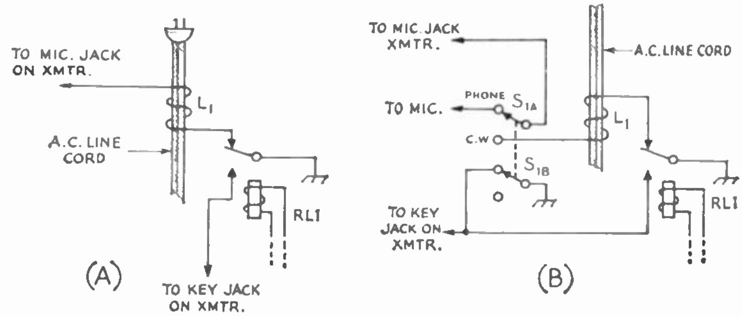


Fig. 6-7—System for using VOX as an automatic change-over system for c.w.
L_1—2 or 3 turns of wire around the a.c. line cord.
RL_1—S.p.d.t. keying relay.
S_1—D.p.d.t. switch.

USING VOX FOR AUTOMATIC CHANGE-OVER ON C.W.

Fig. 6-7(A) shows a simple way to add automatic change-over on c.w. to almost any transmitter equipped with VOX. When the keying relay RL_1 is closed it keys the transmitter and at the same time ungrounds the coil, L_1, which is a few turns of wire wrapped around the a.c. line cord. The coil, L_1, picks up some a.c. voltage from the line cord and this voltage is connected to the transmitter's microphone input where the "hum" triggers the normal VOX system. With key up, the relay opens, and coil, L_1, is shorted to ground. This turns off the VOX and returns the station to receive. By adjusting the transmitter's VOX controls, the desired amount of delay between change-over can be set.

To simplify the phone-c.w. switching, the arrangement in Fig. 6-7(B) is used. This scheme automatically removes the c.w. change-over system and grounds the key terminal of the transmitter when in the phone mode.

—Harry J. Gensler, Jr., K8OCO

CODE-PRACTICE OSCILLATOR

The transistorized code-practice oscillator shown in Fig. 6-8 can be thrown together in a few minutes with junk-box parts or can be built by the beginner with new parts for only a few dollars. The power supply is made from two flashlight cells; the pitch control, R_1, is a standard volume control. About the only critical item in the unit is the headphones; they must be the 2000-ohm magnetic type. Since the headphones, HT_1, along with other components in the circuit, determine the frequency of oscillation, it may be necessary to select values for C_1 for the desired tone. Transistor Q_1 can be any of the common audio types.

—L. Jacques Filion, VE2AES

FINGER KEYER

Some operators have found that the change-over from a semiautomatic "bug" key to an actuator for electronic keyers ruins their sending on the bug because of the new response required when sending dashes. What is needed is some different muscular approach so that keying habits on the bug could remain unaltered.

My solution is shown in the photograph in Fig 6-9. Two surplus straight keys are mounted at a slight angle to one another and are provided with extensions. The left-hand key is connected to the electronic keyer dot contact and the right-hand key to the dash contact. The extensions are manipulated with two fingers, exactly as in piano playing. Some practice is needed; but quite quickly, the mental and muscular reactions drop into place. Since the action is different from that used with the bug, no difficulty is experienced when changing over from one type of key to the other.

The actuator and electronic keyer can be built into a single box as in Fig. 6-9, making the whole unit self-contained.

—R. W. Bailey, G2QB

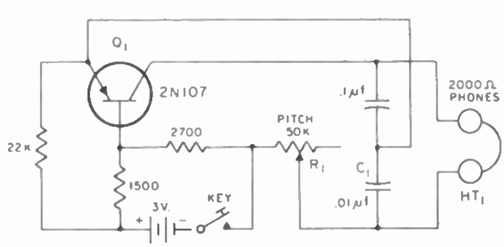


Fig. 6-8—VE2AES's code-practice oscillator.

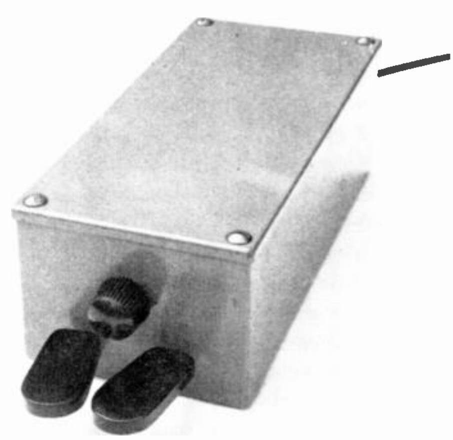


Fig. 6-9—G2QB's finger keyer.

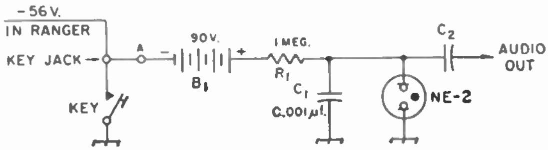


Fig. 6-10—WØCHM's Ranger keying monitor.

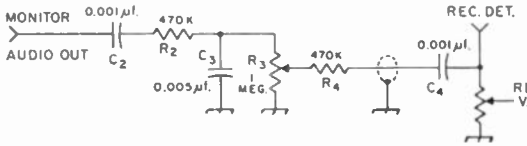


Fig. 6-11—This shows how the monitor can be fed into the station receiver.

RANGER KEYING MONITOR

The keying monitor shown in Fig. 6-10 differs from others used with the Ranger in that it uses no relays and connects directly to the key itself. The monitor uses the simple and reliable neon-bulb oscillator circuit shown. With the key open, the voltage difference between battery B_1 and the -56 volts keying voltage in the Ranger appears across the NE-2 neon lamp. Capacitor C_2 isolates the keying circuit from the outboard equipment. When the key is closed, the monitor receives the full 90 volts from BT_1, the NE-2 fires, and the Ranger is simultaneously keyed in the normal fashion.

Various schemes[1] can be used to couple the monitor output to headphones, speaker, or the station receiver. I use the circuit shown in Fig. 6-11, where R_2 and C_3 filter the high frequencies from the harmonic rich neon-oscillator waveform, and R_4 isolates the monitor volume control, R_3, from the receiver volume control. I also open point "A" in Fig. 6-10 with a pair of normally open contacts on the antenna relay, so that the monitor is inoperative when the Ranger v.f.o. is zeroed. The values of R_1 C_1, and C_2 may be varied to obtain best operation for the particular NE-2 used.

—M. Gerald Arthur, WØCHM

[1]Paddon, "The 'Monitone.'" *QST*, September, 1948; Tanner, "A Neon-Tube Keying Monitor," *QST*, "Hints & Kinks," November, 1955; McCoy, "A \$1.69 Keying Monitor," *QST*, September, 1957.

10-MINUTE TRANSMISSION REMINDER

Those who have 24-hour digital read-out clocks with plastic number wheels will note that the wheel which shows minutes has ten sides and makes one revolution every 10 minutes. By arranging a pair of fingers made from shim stock or other similar material against this wheel and then pasting a very thin narrow strip of the same material across one of the faces of the wheel, contact is made between the strip and the two fingers once each 10 minutes. This contact can be used to control a light, bell or buzzer to remind the operator that a 10-minute period has passed. In my case it actuates a small solenoid which taps a glockenspiel bar and gives a musical tone.

CODE-PRACTICE OSCILLATOR

About any receiver with two stages of audio can be made to perform as a code-practice oscillator by the modifications shown in Fig. 6-12. Capacitor C_1, which can be a fixed or variable unit in the 100- to 500-pf. range, couples energy back to the low-level audio stages and causes them to oscillate. The pitch of the audio oscillation can be controlled by the value of C_1. When the key is opened, normal receiver operation is returned. However, during code practice, the note generated is much stronger than the received signals, so they do not interfere with code practice. If the system fails to oscillate, it may be necessary to reverse the output transformer's primary leads.

—Ed Hartwell, KNØYOL

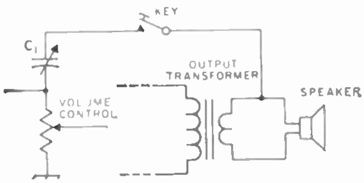


Fig. 6-12—KNØYOL's code-practice oscillator.

KEY BASE

I use the bottom portion of an old electric flat-iron, smooth side up, as a base for my transmitting hand key. The heavy weight, plus three rubber feet attached to the base, give the combination "stay-put" stability, and it looks good, too!

—H. C. Nenstiehl, W2EAT

A TIP FOR EX-BUG USERS

Here is an idea for the c.w. man who has acquired an electronic keyer and has an "old fashioned" semi-automatic key. Before going out and purchasing a deluxe key designed for electronic keyers, try this modification on your present key. Tighten the dot contact screws enough to make the contacts stay closed whenever the dot lever is struck. Disconnect the metal strap that runs from the dot contact to the binding post (the one that is not connected to binding post to it. You now have a three-terminal key that can be used to actuate the electronic keyer. If you want to restore the bug to its original condition, just reconnect the metal strap to its original terminal.

—*John Dalrymple, K7QER*

R.F.-POWERED C.W. MONITOR

While experimenting with the code practice oscillator described in *QST*, July, 1959, page 30, I discovered that the unit could be powered by rectified r.f. from my transmitter. The circuit in Fig. 6-13 shows how the addition of a 1N34 diode, CR_1, in place of the dry cell power supply converts the code practice oscillator into a c.w. monitor. The pick-up wire can be a small probe placed near the feed line or near the transmitter final tank. (Danger—high voltage!)

—*Ernie Cataldo, K1ECD*

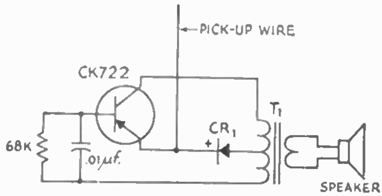


Fig. 6-13—R.f. powered c.w. monitor.
CR_1—1N34 crystal diode.
T_1—Output transformer, 12,000-ohm primary to 3.2-ohm voice coil (Thordarson 22S48).

OUTBOARD KEYING TERMINALS

The photograph in Fig. 6-14 shows how I attached additional keyed terminals to my hand key. These terminals are electrically independent from the circuit keyed by the conventional contacts, and they can be used to key a monitor or other external circuit. A standard surplus J-38 key is mounted on a suitable base. One of the contact arms is attached to the key armature by securing between the knob and the armature. An oversized hole is used in the contact arm, which is then sandwiched between the insulated knob and a fiber washer or the like, and then attached to the armature. Make sure the contact arm does not touch the armature when the knob is tightened. The other contact arm is mounted on the key base. By placing this terminal between two nuts, it can be positioned up and down for optimum keying. Ideally, the two contacts will make contact at the same instant as the regular key contacts.

—*Frank O'Nell, W1HRR*

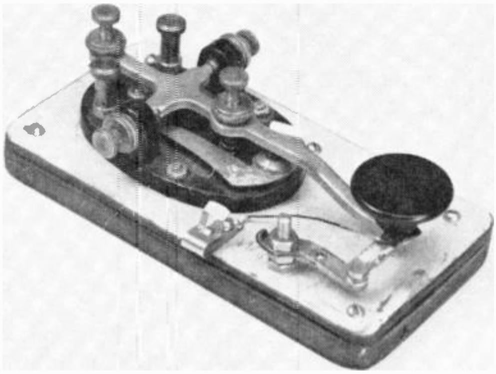
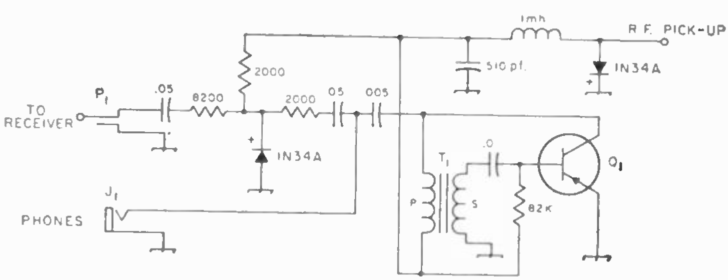


Fig. 6-14—Outboard keying terminals provide switching for an external circuit.

IMPROVED KEYING FOR THE BC-459

Part of the conversion of the ARC-5/T18 transmitter mentioned in *QST*, February, 1963, page 35, involved the addition of a 12A6 buffer stage. This system also makes a satisfactory conversion for the BC-459 transmitter and will improve its keying characteristics considerably. I substituted a slug-tuned coil along with a 50-pf. fixed silver mica across it, in place of the tuning capacitor C_1 in the original circuit and the r.f. chokes in the plate circuit of the 12A6 tube. The combination is resonated at 7100 kc. and will give adequate grid drive for the c.w. portion of the 40-meter band. The hot side of the heaters was wired with shielded wire and bypassed at the socket connections according to another article that appeared in *QST*, October, 1949, page 112. I use two power supplies with the transmitter; one gives about 240 volts for the oscillator, buffer, and the final-amplifier screens, and the other delivers about 400 volts for the 1625 plates. After the modification, no one recognized my signal as one from a "Command set!"

—*Bob Richardson, W6WHM*



Hints and Kinks . . .

for V.H.F. Gear

A NOISE GENERATOR HINT

Here's a noise generator hint that came from W9EHX. It uses a 2-volt 60-ma. pilot lamp instead of a crystal diode, but is otherwise similar to the diode job described in *QST* for July, 1953. The r.f. choke didn't appear necessary but is advisable to prevent loss of noise through battery circuit. Output is constant, in comparison to the rather variable results obtained with some crystal diodes. I built mine in an old soup can from junk parts, which kept the cost close to nothing. The load resistance should be equal to the impedance of line used to feed antenna. It shows about 4.5 db. of noise with my best 144-Mc. converter. More noise could be obtained with increased filament voltage, at expense of shorter lamp life. Other types of lamps deliver about the same noise output, so a 60-ma. type is most economical. The coax fitting should match that on converters to be checked. Make all leads as short as possible.

W. E. Rose, Jr., W9KLR

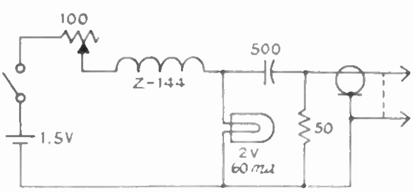


Fig. 7-1—Noise generator using 2-volt 60-ma. pilot lamp, in place of the usual crystal diode.

ANTENNA HINT FOR THE GONSET COMMUNICATOR

Horizontal polarization of a Gonset portable antenna can be most easily obtained by mounting the whip in an Amphenol type 83-1AP right-angle connector. When this assembly is mated with the Gonset antenna receptacle, it will cause the whip to extend out in a horizontal plane without need for tipping the Communicator on its side. If the 83-1AP is not too tightly coupled (mechanically) to the antenna connector it will allow the whip to be swiveled about in *beam* fashion, thus introducing some choice of directivity to the system.

—Lester Reiss, W2BR

MULTIPLE-CRYSTAL PACKAGE

Crystal switching is nice, but it takes up room and requires several parts. Those who, for one reason or another, still plug their crystals into a single socket may find a simple crystal package used by VE3DMK interesting. To facilitate changing crystals in a neat 144-Mc. transmitter he had on display at the recent Ontario ARRL Convention, VE3DMK tapes several crystals together, as shown in Fig. 7-2. The crystal socket should be mounted so that its entire body is outside the mounting surface. Any number of crystals may be taped together, the number being limited only by the space available around the crystal socket.—*W1HDQ*

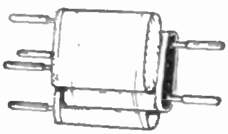


Fig. 7-1—Noise generator using a 2-volt 60-ma. pilot lamp, in place of the usual crystal diode.

NOTES ON THE GONSET COMMUNICATOR III

One possible characteristic of the Gonset Communicator III is hum modulation of the transmitted signal. This occurs only during push-to-talk operation when microphones similar to the surplus T-17 are in use. Under these conditions, modulation by a.c. hum or vibrator whine can be quite severe. A glance at the microphone circuit will show that the relay circuit and microphone "talking" circuit have a common return wire in the microphone cable. Therefore, these circuits are coupled across the resistance of a common wire, namely the resistance of a five-or six-foot length of wire. This condition can be alleviated if a four-wire microphone cable is substituted for the original three-wire cable. This eliminates the common return lead and reduces hum modulation to negligible proportions. Self-coiling four-wire cords which are ideal for this purpose are sold as replacement cords for some types of dynamic microphones. One possible trouble which will remain after this modification is the contact resistance between the sleeve of the PL-68 and the jack. Be sure that the PL-68 is clean and bright, and that it is not worn to a sloppy fit.

—R. A. Johnson, K2EOC

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Some owners of the popular Gonset Communicator III have run into difficulty with the push-to-talk arrangement. Carbon mikes which do not have a conventional push-to-talk circuit, or do not open the mike circuit when the button is released, have been found to cause feedback. In addition, when a conventional push-to-talk mike is used, hum is often evident. This hum disappears when the front-panel "transmit-receive" switch is used instead of the push-to-talk button. The hum is caused by the a.c. component of the voltage drop in the mike control wire appearing on the grid of the speech amplifier. Both of the above difficulties may be remedied by making the following modifications.

First, locate the 1.5-megohm resistor connected at pin 2 of the 12AX7. This is R_{31} in the 6-meter or R_{32} in the 2-meter model. Lift the other end of this resistor from ground. At this end, connect a 0.1-µf., 200-volt capacitor and a 470,000-ohm resistor. The free end of the capacitor is then grounded to a convenient spot, such as pin A of the heater terminal strip. The free end of the 470,000-ohm resistor is then connected to the tip prong of the mike jack which already has a 0.01-µf. ceramic and a 68,000-ohm resistor connected to it.

If your transmitter is stamped with "M-1" or higher on the rear chassis lip, the above modification has already been made at the factory.

—Samuel M. Bases, K2IUV
—Rudolph Schwerdt, Jr., K2QVU

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To copy c.w. with a Communicator III simply plug in a crystal having a frequency at the i.f. of the Communicator. The function switch is thrown to "spot" for weak signals. For stronger signals requiring greater injection, the switch is thrown to "exciter." In this way, a crystal controlled b.f.o. is furnished. A 2.3-Mc. crystal is used for the 6-meter Communicator and a 6-Mc. crystal for the 2-meter model.

—Irvin L. Schroeder, W9VCL

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The accessory v.f.o. for the Communicator III can be employed as a b.f.o. for both the 6- and 2-meter Communicators by throwing the v.f.o. switch to "spot" and beating the c.w. signal with the v.f.o.

—Woodrow Smith, W6BCX

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While trying out a factory-fresh Gonset Communicator III, I was intrigued by how I could arrange my surplus FT-243 crystals in the six-position socket. The spacing is too close to accommodate more than three crystal holders. Two adjacent crystal positions will accept FT-243 crystal holders back to back.

Examining my 243 crystals I found that they all have about the same outside dimensions, but that some cases are shallow with thick plastic covers and some are deep with thin metal covers. Using parts from a handful of junk crystals, I assembled my crystals in "thin" FT-243 holders made up of a shallow case with a thin cover. The modified cases measured about ⅜-inch thick and racked up neatly in the crystal sockets. Before starting this project, be sure to clear your working space since crystals may look alike when out of their holders. Clean the rubber gasket off the metal cover, then insulate the center, at the point of spring bearing, with a bit of plastic electrician's tape. Use the YL's tweezers to handle the crystals and pressure plates. The three screws will be too long, so cut them down with a file using a nut as a thread guard. Seal the modified crystal cases with a plastic spray after assembling and checking. Be sure to mark the cases with the correct crystal frequency if the covers have been changed.

—Phares W. Calliham, W4ZIO

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Late productions of all models of the Gonset Communicator III incorporate the following circuit modification. The purpose of this change is to delay the application of a.v.c. voltage to the cascode r.f. amplifier, thereby improving signal to noise ratio on medium strength signals. (Receivers having "a.v.c." stamped on the rear apron of the receiver chassis have been wired with this change at the factory).

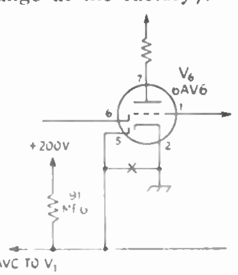


Fig. 7-3—Diagram showing modification to Communicator III a.v.c. circuit.

First remove the jumper connected between pins 2 and 5 of the 6AV6 socket (X in Fig. 7-3). Also remove the lead between pin 5 and the ground lug. Disconnect the 0.01-µf. capacitor lead from pin 5 and connect to the ground lug. This frees all connections from pin 5. Next, locate the three lug terminal strip mounted between the v.h.f. oscillator coil and i.f. transformer No. 5, see Fig. 7-4. Connect a 3-inch length of No. 20 solid insulated wire between pin 5 of the 6AV6 socket and the forward lug of the terminal strip. Then connect a 91-megohm, ½-watt resistor between the forward and

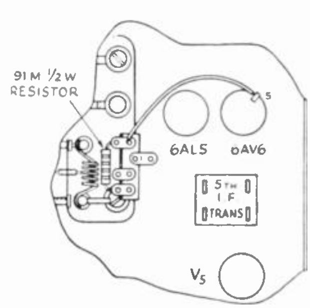


Fig. 7-4—Sketch showing placement of the 91-megohm resistor and the new lead to the 6AV6.

aft lugs of the terminal strip. Now replace the 3rd r.f. amplifier tube (V_5) with a 6BJ6 tube.

The above modification is very desirable, but obtaining a 91-megohm resistor may be a problem. However, it is a standard Motorola replacement part on certain late model Motorola auto radios and probably can be found in service shops which specialize in repair of Motorola sets.

—Woodrow Smith, W6BCX

144-MC. TVI TIP

INTERFERENCE caused by rectification in the first audio stage of either a broadcast or a TV receiver can usually be eliminated by adding a 250 pf. bypass capacitor between grid and chassis, and by lowering the value of the grid-leak resistance to something less than 3 megohms (see BCI and TVI Chapter of *The Radio Amateur's Handbook*). The most difficult phase in testing to determine the effectiveness of this preventive measure is the pulling of the chassis —particularly if the set is not one's own.

A simple method of making the initial test or making a permanent installation without "pulling" the chassis is to use a CBS-Hytron test adapter that has been equipped with the bypass capacitor and a shunt resistor. Merely remove the audio tube, insert it in the adapter, and then plug the whole business back into the audio tube socket. Types SH-27 and SH-29 adapters are available for the 7- and 9-pin miniature tubes, respectively, and Type SH-28 accommodates the 8-pin octals.

This method of demonstrating how certain types of TVI can be remedied without appreciable bother or fuss is bound to impress the complainant and, in all probability, will result in a better understanding of where the trouble really lies.

—Jack Livingston, K2POO

SIMPLE V.H.F. R.F. OUTPUT INDICATOR

AN inexpensive trimmer capacitor and an ordinary pilot lamp, wired in series as shown in Fig. 7-5, makes a useful output indicator for v.h.f. transmitters. An indicator of this type is especially helpful at v.h.f. where one of the most common indications of circuit resonance—minimum plate current—is frequently difficult to observe.

The indicator may be permanently connected across the series-tuned output circuit of a transmitter. A 3-30-pf. trimmer and a 60-ma. bulb are used with the 30-watt rig here at W2FFY. The power consumed by the lamp, about a tenth of a watt, is negligible. By adjusting the trimmer and by employing lamps of various current ratings, the indicator circuit can be used with a wide range of power levels.

In addition to providing means for indicating maximum power output, the arrangement provides a continuous check on transmitter performance. The fact that the indicator is permanently connected across the output circuit prevents the need for retuning as is frequently the case when plug-in or clip-on indicators are temporarily installed.

—George E. Hyde, W2FFY

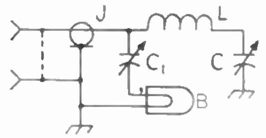


Fig. 7-5—Circuit of the simple v.h.f. output indicator. C, L and J are transmitter components; B and C_1 are indicator components.

CRYSTAL SAVER

I CONSTRUCTED the 6-meter transmitter in the 1959 edition of the *Handbook*, page 435, and in *QST*, October 1958. However, after I used the rig for a short period of time, the crystal (Y_1 in Fig. 7-6) failed—apparently due to too much feedback in the oscillator circuit. W1HWM suggested that I insert a loading resistor R_1 and a capacitor C_1 in the circuit to reduce the feedback and thus protect the crystal. I tried the circuit and found that it functioned perfectly.

—Dick Solomon W1KSZ

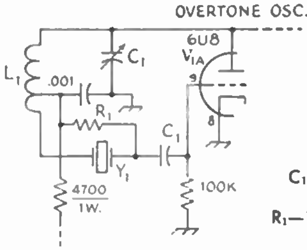


Fig. 7-6—New oscillator circuit for the Handbook 6 meter transmitter.

C_1—.001-µf. ceramic.

R_1—1 megohm, ½ watt.

THE JOHNSON RANGER AS A 50-MC. EXCITER

OWNERS of the Johnson Ranger transmitter may obtain 25-Mc. output for driving a 50-Mc. doubler in the following way:

Using the v.f.o., tune up the transmitter in the normal way with the band switch in the 11-meter position and the v.f.o. at the low edge of the band. Now switch to an 8-Mc. crystal and retune the buffer and final for resonance points nearer maximum capacitance (toward the 0 end of the dials). With the usual surplus type crystals, it is possible to develop nearly maximum grid drive. Keying ranges from fair to very good, depending on the crystal. The audio output of the Ranger is available at the accessory socket for use in such an application.

The rabid 50-Mc. man may decide to pad the 11-meter position of the v.f.o. to obtain v.f.o. control at the above frequencies. I have not tried this and therefore cannot vouch for the idea.

—Otto Woolley, WØSGG

IMPROVED V.H.F. COIL FOR GRID-DIP METERS

V.H.F. MEN who use any of the popular makes of grid-dip meters know that they all leave something to be desired when it comes to convenience above about 50 Mc. The coil for the highest range is a stubby loop of such dimensions that it is difficult if not impossible to couple it closely to many of the circuits one wants to check. In addition, at least one manufacturer divides his scales in such a manner that the 144-Mc. band comes close to the ends of the ranges on the last two coils. This makes for frequent coil changes when working in the vicinity of that band.

One method of working in cramped quarters with the coils that come with the instrument is to use a short transmission line, with loops at each end. This link-coupling is likely to be awkward. It also may be confusing, due to resonances in the line.

The plug-in inductor shown in Fig. 7-7 takes into account the fact that a given length of wire formed into a circle or semicircle has a lower resonant frequency than the same length made into a hairpin loop. As the sides of the hairpin are brought closer together the resonant frequency for a given setting of the tuning capacitor goes higher. It is thus possible to make a loop of considerable length that will tune the same frequency range as the stubby loop that is part of the original coil complement of the grid-dip meter. A loop 3 inches long will enable you to couple to many converter and transmitter circuits that cannot be reached with the tiny loop that came with the meter.

The copper wire used in the loops shown in Fig. 7-7 has a rectangular cross section 0.31 by 0.19 inches. Rectangular wire or rod makes a neater looking inductor than round wire, and it is easier to drill, but the same idea may be used with round stock. Inductance for the same loop spacing will be higher for round wire of the same area of cross section. The table gives dimensions of several inductors made for use with Millen and Heathkit grid-dip meters.

It will be seen that Coil 2 duplicates the highest range of the Millen meter, but it is more than 2½ inches long, as compared with the Millen coil that is only about a half inch in length. Coils 3 and 4 give a more useful frequency spread for the amateur who is frequently called upon to work around both 144 and 220 Mc. They hit both amateur bands, with convenient leeway on either side of each band.

To make the loops it is well to start with a piece of wire about 10 inches long, for ease in handling. Secure the wire in a vise, with 5 inches extending. Bend the wire 90 degrees, using a block of wood as a cushion for the hammer. Using a spacer of a thickness determined from the table, bend the other side down and squeeze the sides together in the vise. Bend the ends at right angles, using the hammer and wood block. Drill the legs for proper pin spacing, insert pins and solder them in place. Trim the legs to a suitable length for the instrument.

The finished inductor may be sprayed with clear lacquer, to prevent shorts when using the meter near live circuits. The insulating quality of the lacquer coat should be tested at frequent intervals. It goes without saying that the meter should never be brought close to circuits carrying dangerously high voltages.

The new tuned circuit must now be calibrated. This can be done in several ways. Perhaps the simplest is to borrow another grid-dip meter that tunes the same frequency range. The oscillator may also be monitored in a receiver that tunes the desired range, if one is available. Lacking either of these facilities, calibration at a few points can be made with Lecher wires. As the calibration requirements for grid-dip meters are not critical, any of these methods should give satisfactory accuracy.

Dimensions and frequency ranges for Heathkit and Millen grid-dip meters are given below:

Coil	Freq. Range	A	B	C	D
1 (Heathkit)	85-240 Mc.	2.69"	0.75"	0.125"	0.116"
2 (Millen)	125-300 Mc.	2.69"	1.25"	0.05"	0.125"
3 (Millen)	120-270 Mc.	2.5"	1.25"	0.125"	0.125"
4 (Millen)	110-260 Mc.	3"	1.25"	0.125"	0.125"

—*A. J. Newland, W2IHW*

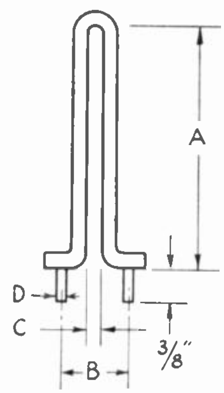


Fig. 7-7—Dimensions of modified v.h.f. inductor for Heathkit and Millen grid-dip meters. See table.

MINIATURE 6-METER TRANSMITTER

THE diagram in Fig. 7-8 is a miniature transmitter of the "wrist-radio" variety which developed from a circuit used in a transmitter for tracking small animals. The transmitter was attached to the animal and tracked with direction finders. A modulator is included for listening to the sounds or calls of the animals themselves and to their breathing and heartbeats. Although the equipment was designed for use with animals, the circuit should be of interest to those who like to experiment with miniature transmitters. The one shown in Fig. 7-8 was constructed so that the transmitter and batteries occupied a volume less than one cubic inch! The total weight was about 2 ounces. Now, can

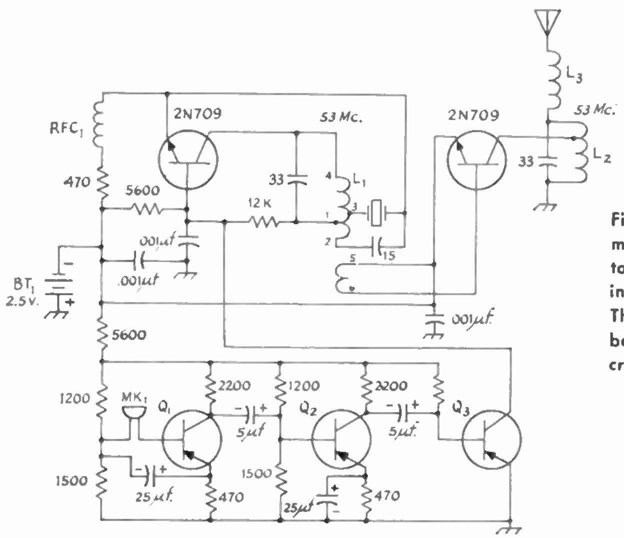


Fig. 7-8—W8BEB's miniature 6-meter transmitter. The modulator section is a transistorized hearing aid. Capacitor values are in pf. unless marked, resistors are ½ watt. The 0.08-inch diameter coil form for L_2 can be a length of insulated rod or tube. The crystal is a 53-Mc. overtone type.

BT_1—2.5-volt battery (Mallory RM1RT2).
L_1—See Fig. 7-9.
L_2—22 turns No. 30 enam. on 0.08-inch-diam. form, ⅜ inch long, tapped 15 turns from bottom.
L_3—The antenna consists of 8 inches of No. 22 7-strand hookup wire. Coil L_3 is made by cutting a 2-inch slit lengthwise in the wire insulation at the center of the antenna and removing the conductors from this 2-inch portion of wire. It is important not to damage the insulation when removing the wire because this insulation is used as the coil form. The insulation from which the conductors have been removed is now wrapped with close-spaced No. 36 enameled wire for the full 2 inches. The ends of the No. 36 enameled wire are soldered to the ends of the two remaining 3-inch pieces of No. 22 wire. A length of polyethylene tubing is slid over the coil for protection.
MK_1—Miniature hearing-aid microphone.
Q_1, Q_2, Q_3—Small signal audio transistors.
RFC_1—30 turns of No. 36 enameled on 0.08-inch-diam. form.

someone come up with a matching one-cubic-inch receiver?

The entire transmitter is operated from a single 2.5-volt mercury battery. Since the manufacturers of hearing aids have built very satisfactory small audio amplifiers and it would be unnecessary to duplicate their efforts, a used hearing aid was purchased to provide the modulator. The circuit shown in Fig. 7-8 includes the diagram of the Dahlberg Magic-Ear hearing-aid modulator.

—*Edward C. Pienkowski, W8BEB*

Editor's Note: Similar equipment has been developed by Philco's Western Development Laboratories for use in tracking grizzly bears in Yellowstone National Park, operating with a power output of some 100 milliwatts on 32 Mc.

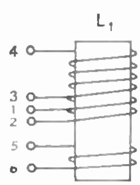


Fig. 7-9—L_1 is wound on a CTC form, LS12-6D.
Pin 6 to Pin 5, 2-1/16 turns No. 30 enam.
Pin 2 to Pin 1, /16 turn No. 30 enam.
Pin 3 to Pin 4, 3-5/16 turns No. 30 enam.

WIDE-BAND F.M. RECEIVER—THE EASY WAY

Availability of two-way f.m. communications gear for the 50- and 150-Mc. regions has given wide-band f.m. a considerable boost of late. This fixed-frequency equipment is ideal for nets and other routine communications work by amateurs, but to many of us the idea of being stuck on one frequency, especially for receiving, takes most of the fun out of it. W3ZWR, Philadelphia, comes up with a solution to the receiving problem that is so obvious that one wonders why more v.h.f. enthusiasts have not thought of it: the discarded TV set.

A high percentage of retired TV receivers land in the scrap heap because of picture tube trouble, or other failings concerned with the video portion of the set. The sound often is as good as ever. It's a simple matter to retune Channel 2 in most TV tuners so that the low end of the fine tuning range will be 52.5 Mc., the lowest frequency where wide-band f.m. may be used. The tuning range will usually be enough to cover the frequencies normally used by hams for wide-band f.m. in the 50-Mc. band.

This can be carried a step further by converting other channels to 144- or 220-Mc. service. We can't go into details for the countless types of TV tuners now in circulation, but some years ago we did a detailed conversion job on the Standard Coil Tuner, a device found in many makes of receivers. We revamped one for 28, 50, 144 and 220 Mc. This was intended to be used as a converter with a communications receiver, but using it with the TV set's wide-band f.m. sound i.f. is a very simple matter.

Another good bet, suggested by W3ZWR, is the Mallory Inductuner, a continuous-tuning front end used in many TV sets of early vintage. This one may cover 50 through 220 Mc. without modification, plus the f.m. band and all v.h.f. TV channels. If it doesn't quite make the two ham bands at the ends of the tuning range, it should be a simple matter to adjust the oscillator frequency slightly as required.

—W1HDQ

TWOER OR SIXER BAND MONITOR

The device shown in Fig. 7-10 consists of a small display motor mechanically coupled to the tuning dial of a Heath Twoer or Sixer. As the motor turns, it tunes the receiver back and forth across the band, allowing the operator to minitor the entire band without touching the controls. When a station is heard or when it is desired to tune the receiver manually, the wire is pulled out of the hole in the tuning dial.

The linkages are formed from an old coat hangar; the motor and gear drive were salvaged from a store advertising-display sign. I mounted my drive assembly in an 3 × 5 card file box. It was necessary to cut a slit in the side of the box to allow for movement of the "push rod."

—Bruce Block, K2YSN

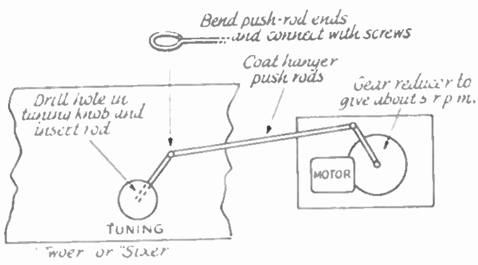


Fig. 7-10—K2YSN's automatic band monitor.

LOW-FREQUENCY CRYSTALS FOR THE 6-METER GONSET III

While the manufacturer recommends the use of 8-Mc. crystals in the 6-meter Gonset Communicator III, I have found that 6-, 5-, 4-, and 3-Mc. crystals, having harmonics between 50 and 54 Mc., can be used successfully. An approximate check on harmonic frequency can be made by using the Communicator receiver with the meter switch in "Spot" position.

Grid drive may be low while using these crystals, so tune-up is a little more critical than with 8-Mc. crystals. Output may be down 20 or 30 per cent but signal reports from local contacts should not suffer. Performance of individual transmitters varies, therefore it would be well to have a friend check on his receiver to verify that unwanted harmonics are not present.

—Phares W. Calliham, W4ZIO

TWO-METER TVI HINTS

There's always something new on the TVI front. You think you know all the answers—and then along comes a new model with some special TVI features built in. Such is one of the 1956 RCA receivers. It has a top-tuning setup that requires long leads to the volume control—and, of course, they would turn out to be almost exactly a quarter-wavelength long at 134 Mc.!

W1VSE, New Britain, Conn., ran into a hornet's nest with several of these receivers, the trouble being audio rectification. No picture interference, but W1VSE and any other 2-meter station within a half mile or so came in S9 on all channels. The manufacturer shielded the volume control leads, but the length being what it is the shielding is ineffective at 144 Mc. The solution was two-fold.

First, the bracket on which the tuner and volume control are mounted should be bonded to the chassis with a strip of copper or aluminum about one inch wide. Then the shielded volume control leads should be tied together to the strap in at least three places.

Another suggestion that works with all forms of 2-meter TVI where the interfering signal comes in on the TV antenna: Insert traps in each side of the 300-ohm antenna lead. These may have to go right at the point where the lead enters the tuner, if the field around the TV set itself is strong. The traps are made of three turns of No. 18 wire, about ¼ inch diameter, tuned with a 3-30 pf. trimmer. These can be tuned up at home by putting them on your own TV set and resonating the traps with a grip-dip meter.

No grid-dip meter? No TV set? You can still do it. Put them in the antenna lead to your 2-meter receiver and null out a strong signal near your regular frequency. If your converter uses coaxial input, use a balun to provide a balanced line in which to insert the traps for adjustment purposes.

USING THE MONIMATCH ON 6 AND 2 METERS

My Monimatch, Mark II (February, 1957. QST, page 38) works well on 50 and 144 Mc. with feed-through bypasses in place of the 0.001-μf disk ceramics used in the original. This scheme eliminated the need for tie points for mounting the diodes.

—Fernando Cordova Soto, XE1CT

V.H.F. PANORAMIC RECEIVER

By using a couple of test gear items and a surplus AR-5 receiver, a v.h.f. panoramic receiver can be included in an existing v.h.f. receiving setup. All that is required is a TV alignment sweep generator (I use the Heath TS-4A), oscilloscope, a 6- to 9.1-Mc. ARC-5 receiver and the station broad-band converter and receiver.

Also necessary is a mixer, shown in Fig. 7-13. The mixer circuit includes a grounded-grid amplifier that provides some isolation between the sweep oscillator and the station receiver. Power for the mixer can be picked up from the receiver, or a separate power supply can be constructed for the purpose.

Fig. 7-12 shows the modification that is necessary to the ARC-5 receiver. Components CR_1 and C_1 are the only additions to the circuit. The pulse output from the ARC-5 receiver connects to the vertical amplifier input on the oscilloscope.

—*F. T. Swift, W6CMQ*

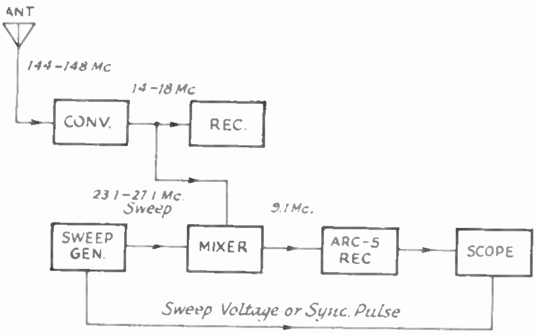


Fig. 7-11—Block diagram of the panoramic receiver.

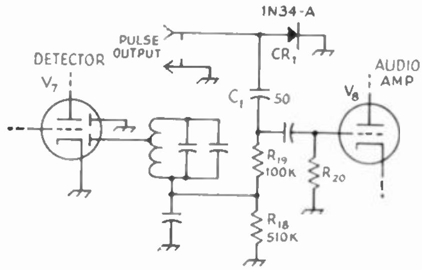


Fig. 7-12—Modification to the ARC-5 receiver includes the addition of CR_1 and C_1.

USING THE JOHNSON VIKING VALIANT V.F.O. ON SIX AND OR TWO METERS

Since my Valiant is used quite often as a power and modulation source for the Johnson 6N2 transmitter, I decided to modify the 11-meter portion of the v.f.o. for operation on six or two meters. The coax lead and fitting normally used for s.s.b. input on the Valiant can be used as the connection for the v.f.o. output. To make the modifications the following step-by-step procedure should be followed:

1) Remove the side cover plate and the U-shaped shield box on the v.f.o. Do not remove the four screws or top plate.

2) Locate C_4, the 11-meter band padder capacitor, and carefully solder a 20-μμf. NPO capacitor across its terminals. This will change the original frequency coverage of the 11-meter band for use on six meters. If 2-meter coverage is desired, place an NPO capacitor of 35 μμf. across C_4.

3) Replace the U shield and the side cover plate on the v.f.o.

4) Place the Valiant band switch in the 11-meter position and turn the oscillator switch to zero.

5) Listen on a suitable receiver tuned to 50 Mc. for the v.f.o. signal. Set the v.f.o. pointer to the extreme counter-clockwise position and tune capacitor C_4 until the 50-Mc. signal is heard. This will allow a full 2-Mc. coverage with 180-degree rotation of the v.f.o. dial.

6) Make a 1-inch loop with 6-inch leads out of No. 18 or 20 plastic-insulated wire. Tape or glue the loop to the cold end of the buffer coil, L_5. Bend the leads of the loop to bring them down to switch *SW4-C*.

7) Lift resistors R_{10} and R_{54} from terminal 12 of *SW4-C*.

8) Cut away ½ inch of the outer vinyl covering of the coax lead that connects to terminal 4 of switch *SW4-C*. Connect one of the leads from the loop to terminal 4. Connect the other loop lead to the coax shield.

If the final r.f. amplifier filament circuit is opened it will isolate this stage and allow the v.f.o., power supply and modulator to be used with the external 6N2 transmitter. To make this modification:

1) Lift the gray lead from terminal 2 of *TS33*

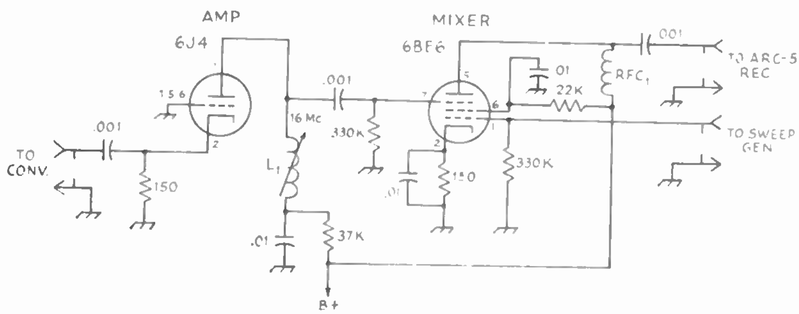


Fig. 7-13—The mixer for the panoramic receiver. A 6J4 grounded-grid amplifier is included for isolation. L_1—Slug-tuned inductance. RFC_1—2.5-mh. choke.

and tape it aside.

2) Lift the green lead that comes out of the laced cable from tube *XV8* and tape it aside.

3) Lift the longer green lead from terminal 3 of tube *XV6* and tape it aside.

4) Run a lead from terminal 2 of *TS33* to terminal 4 of *XV8*.

5) Run a lead from terminal 1 of *TS18* to terminal 2 of *TS6*.

6) Connect a jumper from terminal 1 to terminals 7 and 8 on the jumper plug, *P8*.

When *P8* is inserted in its receptacle, the filaments of the r.f. amplifier will be connected. When using the Valiant with the 6N2 remove the plug to disconnect the r.f. amplifier filaments.

—*Antonio G. O. Gelineau, W4LEQ*

PARAMETRIC AMPLIFIER FOR 432 MC.

SIMPLE modification of the 1296-Mc. parametric amplifier described in January, 1961, *QST* will make a parametric amplifier useful on 432 Mc. A small change in the dimensions of the idler cavity, and an increase in the length of the signal cavity with a corresponding change in the coupling loops of the signal tank are all that one needs for a 432 amplifier.

After one understands the construction of the 1296-Mc. parametric, he can adapt the following changes. First, the idler cavity is changed to 2.3 centimeters in length. Next, the signal tank must be changed to 9¼ inches in length by 2 inches wide and 1½ inches in depth. The center conductor is ⅜-inch brass tubing. Heavy brass is recommended for construction of the signal tank.

The coupling loops were made with about ⅞ inch of the loop wire parallel to the center conductor of the signal cavity. Provisions were also made to adjust the coupling loops. The tuning screw at the center of the signal cavity has a ¾-inch disk soldered to the end of it. There is also a ¾-inch disk soldered to the ⅜-inch center conductor. The screw and disk arrangement provides necessary signal tank tuning. The method of bypassing the half-wave signal tank center conductor at each end is the same, but the bypass plates were made larger to provide some additional capacity. The point at which the diode couples to the half-wave signal tank has been changed to 3 centimeters instead of 0.8 centimeters. See Fig. 7-14.

The same tuning procedure can be followed that is detailed for the 1296 amplifier.

Parametric amplifiers for 432 Mc. using quarter-wave signal tanks and similar design in the idler and pump cavities have also been built and may be tried by others. I sincerely hope more 432-Mc. amateurs will build parametric amplifiers for their receiving systems, as this should result in more reliable communication with stations over 200 miles away.

—*Gordon Sager, W8UST*

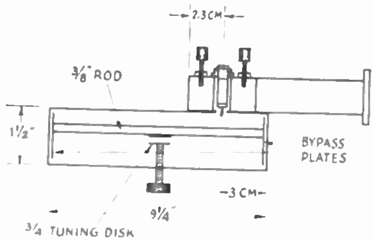
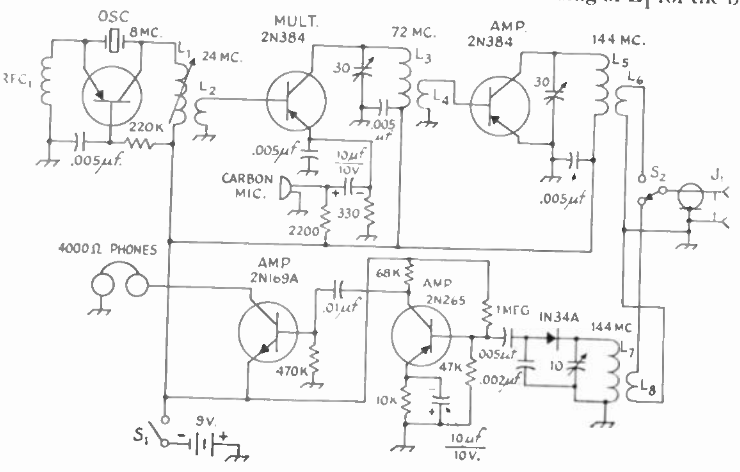


Fig. 7-14—Dimensions for W8UST's 432-Mc. parametric amplifier.

TRANSISTOR TWO-METER TRANSMITTER-RECEIVER

THE diagram in Fig. 7-15 shows my two-meter transistor transmitter-receiver. Although novel in some respects, the circuit is simple, straightforward and easy to construct. I assembled my unit on a piece of perforated phenolic board.

The oscillator stage is tuned by adjusting the slug of L_1 for the best oscillation.



L_1—11 turns No. 32 on ¼-inch diam. slug-tuned form.
L_2—3 turns No. 20 over cold end of L_1.
L_3—9 turns No. 20, ¼-inch diam., ½ inch long.
L_4—2 turns No. 20 over cold end of L_3.
L_5—4 turns No. 20, ¼-inch diam., ½ inch long.
L_6—1 turn No. 20 over cold end of L_5.
L_7—6 turns No. 20, ¼-inch diam.
L_8—1 turn No. 20 over cold end of L_7.

Fig. 7-15—Diagram of W2HRG's 144-Mc. transistor transmitter-receiver. Unless otherwise indicated, capacitances are in pf., resistances are in ohms, resistors are ½ watt.

W2HRG's sister, KN2IBL, gives the rig a tryout.

A crystal detector followed by two audio amplifiers make up the receiver. Although not particularly sensitive, the receiver is certainly easy to adjust!

The range of the transistor rig is only about 5 blocks, but it can be carried in the car's glove compartment to carry on after the roads run out in a transmitter hunt.

—John W. Roberts, Jr., W2HRG

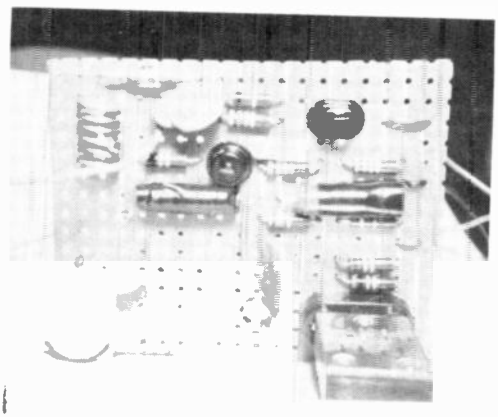


Fig. 7-16—Parts for the 2-meter transmitter-receiver are mounted on a piece of perforated phenolic board.

THE VIKING RANGER ON 50 MC.

SINCE the 11-meter band is no longer available, the 11-meter section of the Viking Ranger transmitter can be put to use on 6 meters. The Ranger v.f.o. tunes 6550 to 6865 kc. on 11 meters, giving a final output of 26.2 to 27.45 Mc. In order to use the v.f.o. for 6 meters it will be necessary to move the v.f.o. frequency down to 6250 kc. To do this, the small variable 15-pf. padder C_4 (marked 11M on top of the v.f.o. compartment) is rotated near maximum capacity until it hits 6250 kc. This frequency can be checked by listening on a communications receiver at the proper frequency. The following stages of the transmitter are tuned so that the final output will be on 25 Mc. There is plenty of 25-Mc. output power available to drive an external doubler and amplifier.

For those who would like to have 6-meter output direct from the Ranger, a little more work is involved. The inductance in the grid circuit of the 6146 is too high to hit 6 meters without changing the entire switching circuit. The easiest method is to double to 50 Mc. in the plate circuit of the 6146.

There are two sets of jumpers on the 10- and 11-meter positions of switch SW_{3B} (front and rear sections). These jumpers should be unsoldered from the front and rear sections of SW_{3B}. This gives a spare contact on SW_{3B} rear which can be connected to a tap on L_{11A} for 6 meters. Fasten on a piece of No. 14 solid wire to the turn closest to the plate end of the coil near C_{37} (0.002-pf. capacitor). Very carefully feed this lead through the same hole that the 10-meter lead passes through and connect it to the vacant contact on SW_{3B}. Be sure to space both wires evenly and don't allow them to touch each other or come too close to the chassis.

Put the band switch in the 11-meter position and tune up just as you would for the other bands.

L. A. Gerbert, W8NOH

NOTES ON THE GONSET V.H.F. V.F.O.

IN order to minimize spurious emissions, the Gonset V.F.O. for 6 and 2 meters has an output of 24 to 27 Mc. In spite of the fact that this is mentioned in the instruction manual, some hams seem to think that the v.f.o. is operating in the 8-Mc. range. This is not the case. When the v.f.o. is used with equipment other than the Communicator, it may be necessary to modify the crystal oscillator circuitry if the oscillator was designed for 8-Mc. crystals. The Communicator III crystal oscillator is designed to work either with an 8-Mc. crystal or from the 24-27 Mc. output of the v.f.o.

—Woodrow Smith, W6BCX

COMMUNICATOR SCREWDRIVER

MANY owners of early Gonset Communicators have found it difficult to locate a screwdriver convenient to use on the transmitter controls. I have found that a 3AG fuse holder stem will fit over the shafts and provide the necessary leverage to turn the shafts with ease.

—Robert Coviello, K1WNK

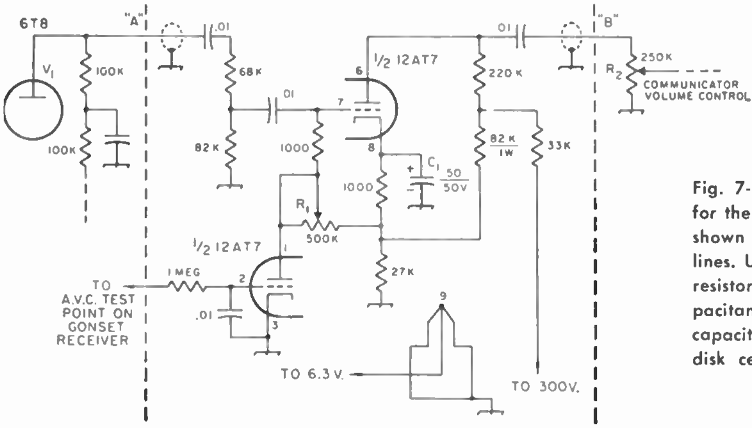


Fig. 7-17—Squelch circuit for the Communicator I is shown inside the dotted lines. Unless specified, all resistors are ½-watt. Capacitances are in μf. All capacitors except C_1 are disk ceramic; C_1 is electrolytic.

SQUELCH FOR THE COMMUNICATOR

The Gonset Communicator I has a long and useful history in the amateur service. One of the finer points it lacks, however, is a squelch to knock out the background noise during no-signal conditions. The addition of a one-tube squelch to the Communicator I is relatively simple. Adding the squelch circuit involves only a few connections to the receiver: one B plus lead, one heater lead, two shielded audio leads, a ground and a connection to the a.v.c. The only change to the Communicator is the snipping of both leads of the 0.1-μf. disk capacitor located on the Communicator's volume control, (R_2 in Fig. 7-17), and installation of two shielded audio leads at these same points.

The circuit diagram of the squelch is shown in Fig. 7-17. The connections for the shielded leads are shown at points "A" and "B" in Fig. 7-17. The shields of these leads are soldered to the grounded case of the Communicator's 250,000-ohm volume control. For convenience, both leads are terminated with phone jacks and are brought out along the left side of the chassis, as viewed from the rear. The use of phono plugs on the shielded leads facilitates connection of the squelch unit and simplifies removal of the Communicator receiver for servicing. Of course, soldered connections can be used if desired. The heater lead for the squelch unit is soldered to the hot side of the pilot light socket and the B-plus lead is tied to the 4000-ohm wire-wound dropping resistor on the CLIPPER switch in the Communicator. An a.v.c. lead is connected to the test point feed-through capacitor on the chassis rear.

All of the components for the squelch circuit, including the tube, are mounted inside a small Mini-Box. Mating connectors are provided for plugging in the leads to the Communicator. Mechanically, the completed squelch box is mounted to the Gonset case, or it can be placed outside the case as desired.

To use the squelch, rotate R_1 so the slider is at the right in Fig. 1. In this condition, the Communicator operation is normal with the front panel volume control providing its usual function. Now advance the squelch control, R_1, until the background noise suddenly drops out, leaving the receiver quiet in the absence of a carrier. An incoming carrier, higher in level than the background level, will open the squelch and the signal will appear in the speaker

—R. R. Welsh, W2PTM

IMPROVING THE K6AXN 1296-MC CONVERTER

Considerably more output on 1280 Mc. may be obtained in the K6AXN 1296-Mc. converter (March, 1961, *QST* and the ARRL *Handbook*) by back-biasing the multiplier diode. I obtained the small negative bias voltage by inserting a variable resistor in series with one of the doubler stages. The diode capacitance changes considerably with voltage, so adjustment must be done a little at a time, increasing the bias and adjusting the tuning capacitor until optimum output is obtained.

—Bruce W. Peterson, W6JWL

STABLE V.H.F. OSCILLATOR

V.h.f. men looking for high-stability crystal oscillators for s.s.b. or other applications would do well to try the Transitron, described by W3PYW in January, 1960 *QST*, page 18. In using this circuit we had some trouble with 6AS6 tubes, until the resistor across L_1 was changed from 3900 to 39,000 ohms. After that every 6AS6 tube we had worked equally well. With either value the oscillator stability is excellent.

—Paul M. Wilson, W4HHK

SAVE BLOWN FUSES

The life of small glass cartridge-type fuses does not need to end when the fuse elements blow. They make excellent forms for small v.h.f. chokes, and when pigtail leads are soldered to the ends, they can be mounted firmly the same as a resistor or capacitor.

—J. C. Nelson, W2FW

BETTER SELECTIVITY WITH THE APX-6

Selectivity and over-all performance of the APX-6 on 1215 Mc. can be greatly improved by substituting the i.f. strip of an ARN-21 for the original APX-6 i.f. system. The ARN-21 i.f. strip has been available on surplus for as little as $1.00, less tubes. Its frequency is 63 Mc., somewhat higher than the APX-6 strip, but this has no bearing on its use in the latter receiver.

The tube lineup is a 2C51/5670 cascode amplifier, followed by four 6AK5 amplifiers, a 6AK5 discriminator, and a 6AK5 video amplifier. All i.f. stages are controlled by an a.g.c. voltage of minus 1.7 to 6 volts. The amplifier tuning is adjustable, and the response can be sharpened considerably by tuning for maximum gain instead of for broad response. The value of the swamping resistors across the secondaries of the i.f. transformers can also be increased. My i.f. is about 450 kc. wide.

In converting the strip, the video amplifier components are removed and a 6AV6, V_1 is substituted as an audio preamplifier, as shown in Fig. 7-18. A 6AQ5 output amplifier, V_2, is added to complete the job. A test point on the discriminator output makes a handy place to connect a v.t.v.m. or high-resistance voltmeter, for use as a tuning meter.

This is an f.m. detection system, so reception of stable a.m. signals is not particularly good. Something akin to the slope detection, normally used on a.m. receivers for reception of f.m. signals, must be used if a.m. is copied. This works well enough except on very strong signals. On these, the bias must be increased to minus 15 volts. In converting my APX-6, a d.c. relay, K_1, was inserted in the negative lead of the power supply, so that the relay operates in the receive position. A convenient minus 16 volts was available across the relay, so a 1500-µf. 50-volt capacitor, C_1, was placed across it as a filter. A 5000-ohm control, R_1, provides bias adjustment for the i.f. strip.

Radar interference in the 1200-Mc. region is very bad in the Los Angeles area. Using the APX-6 i.f. strip it was often impossible to hear anything but radar. The improved selectivity of the ARN-21 greatly reduces this interference to the point where it is no longer necessary to hunt for a clear spot in which to operate. The radar signals are not nearly so troublesome, and TACAN signals are very sharp.

—Bruce W. Peterson, W6JWL

"PAWNEE" NOTES

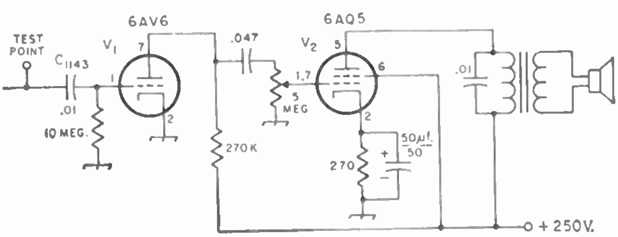
While preparing a recently-constructed Pawnee for mobile use, I noticed that the transmitter output was low and that the audio sounded "fuzzy" and had some feedback at certain settings of the FINAL TUNING control. The transmitter difficulty was traced to r.f. leaking out from the final-amplifier compartment. The 0.001-µf. (FT15, FT16) feedthroughs were bypassed to ground with additional 0.001-µf. disk capacitors. FT_{14} was bypassed with 0.001-µf. capacitors on both sides. RFC_{11} was replaced with a Millen 34300-2.7 r.f. choke which eliminated the r.f. leaking back into the modulation transformer and audio section. These modifications brought the r.f. output up to the rated 8 to 10 watts, and gave good audio with no signs of feedback.

The receiver section of the Pawnee had several images from local f.m. stations. The trap in the grid lead of the 6BS8 (V_1) was adjusted, using a signal generator as outlined in the instruction book, but the images were as strong as ever. I then tried adjusting the trap (capacitor C_1) by listening to the loudest image, which in my case was 144.9 Mc., with the antenna connected. I found a setting of C_1 that completely eliminated the image and, in tuning across the band, I could not find any other images.

—W1KLK

MORE ON V.H.F. COAXIAL TANKS

The information in *QST* for October, 1964, on v.h.f. coaxial tanks has been getting plenty of use, judging from mail recently received. Several correspondents have said that the 2-meter version cleaned up sundry neighbor troubles they've been having with simple rigs like the



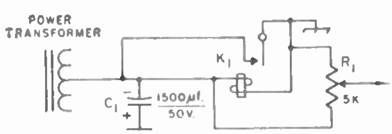


Fig. 7-18—Modifications to the ARN-21 i.f. strip. The lower diagram shows a source of negative 16 volts to power a relay. Capacitances are in µf., resistances in ohms.

Twoer, and though the giant 6-meter tank is a classic example of the tail wagging the dog, it has been doing a job for some Sixer owners, in preventing radiation of unwanted frequencies.

A/1C Joseph Pontek, Andrews AFB, who didn't meantion his call, contributes an idea for builders of the fruit-juice-can models. An easy way to keep the inner conductor lined up is to cut a hole in the center of a plastic cover from one of the new-style coffee cans. He says that the cover is just the right size to slip into the can, yet it slides down only until it hits the ridges that are formed into the can sides.

—W1HDQ

NOTES ON THE HEATH "SIXER"

We found that we could improve the frequency stability and also get rid of some of the f.m. that is occasionally noticed on signals from a Heath Model HW-29 Sixer by regulating the oscillator plate voltage, as shown in Fig. 7-19 (A). (A buffer stage might have been a more ideal solution, but the voltage regulation does the trick okay.)

Hum is another problem with some units, and it is particularly objectionable because it both frequency- and amplitude-modulates the carrier. This situation may be improved by reducing the value of R_{301}, the first audio grid resistor, from 10 megohms to 1 megohm and by decoupling the plate circuit of the same stage as in Fig. 7-19 (B). Don't worry about this reducing the audio gain a bit; as things stand there is so much gain one can't crowd the mike without overmodulating.

To avoid having to remove the rig from its box every time you tune the transmitter, drill a pair of holes in the cabinet top directly above the tuning slugs of L_{201} and L_{202}. The oscillator and amplifier can then be peaked with a long screwdriver.

Incidentally, I wonder how many Sixer users know they have a built-in b.f.o. not even mentioned in the manual. Simply turn down the regeneration control until the shushing just stops. The beat note obtained will permit you to copy c.w. and even s.s.b.

—Mason P. Southworth, W1VLH

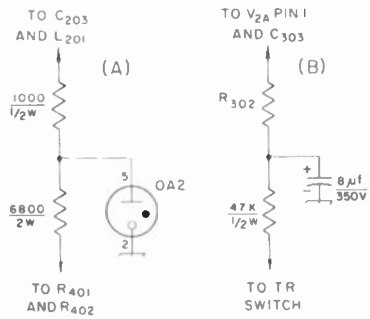


Fig. 7-19—(A) Circuit for regulating the oscillator plate voltage in the Heathkit Sixer. (B) Decoupling circuit for the speech amplifier plate lead.

Figure 7-20 shows a simple modification for using common, inexpensive 8-Mc. crystals in the Heathkit Sixer. By adding a 6C4 third overtone oscillator with 25-Mc. output and using the original oscillator stage as a doubler to 50 Mc., the drift, frequency jumping and f.m. common to these units can be eliminated.

First remove R_{201}, C_{202} and the crystal socket, and ground the end of C_{203} which formerly went to C_{202}. Remove the Heathkit nameplate from the front panel and enlarge the holes there to take an FT-243-type crystal socket. Now make an L-shaped bracket from sheet aluminum or flashing copper to hold the 6C4 and its plate coil as shown in the photo. The bracket is at-

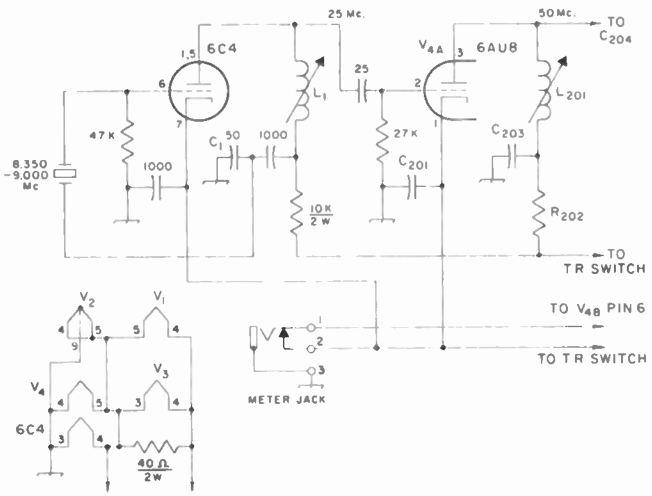
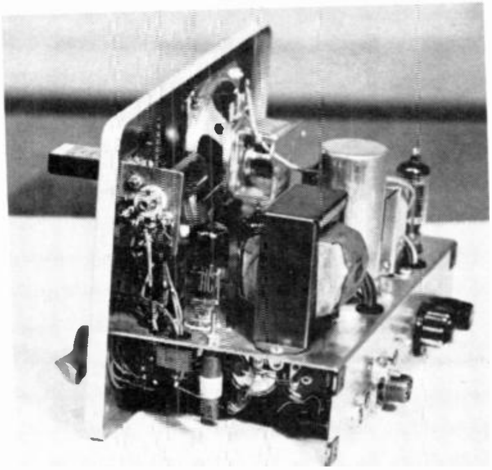


Fig. 7-20—Diagram of the 6C4 oscillator stage W9AMH added to his Sixer. C_{201}, C_{203}, L_{201}, R_{202}, V_{4A} are original parts. Resistances are in ohms, and resistors are ½ watt unless otherwise specified. Capacitances are in pf., and capacitors are ceramic except for C_1, which can be the silver mica originally used for C_{202}. L_1 is 3-5-µhy. slug-tuned coil (North Hills 120-B or similar). "X" and "Y" in the revised filament hookup refer to the power plug pins used to switch from 6-to 12-volt operation.



W9AMH's modification to the Sixer. The L-shaped bracket for mounting the 6C4 oscillator tube is visible in the foreground behind the front panel.

tached to the panel by the screws that hold the new crystal socket. Wiring can be run through grommets in the holes left by the original crystal socket.

When tuning up, simply adjust the slugs in the new coil, L_{201} and L_{202}, until the output indicator shows maximum brilliance. The output will be somewhat greater than before, since the two stages provide more drive to the final amplifier.

—Harry A. Perry, W9AMH

—•••—

THE overtone crystal oscillator in my Heathkit HW-29 six-meter transceiver worked somewhat erratically. After some experimentation I found that when the value of the oscillator grid resistor was raised from 10,000 to about 40,000 ohms the oscillator settled down to stable operation.

—Chester L. Smith, K1CCL

AN OSCILLATOR CIRCUIT FOR A 6-METER CONVERTER

WE (W4SGI, W4LQE, W4KNY) were interested in the transistor receiver described by W2TGP in *QST*, February 1959, page 11. It appeared from the data on the 2N384 r.f. amplifier that this transistor would also work on 50 Mc. After building the local oscillator portion of the "front end," we had difficulty getting it to oscillate so we tried a circuit suggested by W4LQE. The circuit is shown in Fig. 7-21. One feature of this oscillator is the feedback capacitor C_1, which may be replaced with a crystal so that the circuit becomes crystal controlled. Of course, the fundamental frequency (or overtone frequency) of the crystal must be the same as that of the tuned circuit. If more than one 2N384 is available, the one with the highest gain is selected for the r.f. amplifier and an inferior one is used for the oscillator.

With this oscillator circuit and W2TGP's r.f. amplifier and mixer circuit, we constructed a 6-meter converter. It was tested in W4SGI's shack and performed well. Naturally, it could not compare with our best tube converters, but it did a remarkably good job.

Some general remarks about the proper handling of the transistors may help those who have not had much experience along this line. Due to the capacity of sockets, it would be wise to solder the transistors in place rather than to use transistor sockets. The leads should be left as long as is consistent with wiring needs. During the soldering operation the transistor leads should be held firmly with a pair of long-nosed pliers which will act as a heat sink and keep the heat away from the transistor. The tuned circuits should be grid dipped before installation of the transistor. Normally the transistor will add only a few pf. of capacity to the circuit. If "dipping" is done after the transistor is installed, little or no dip will be observed and there is a chance of damage to the transistor.

—H. E. Banta, W4SGI

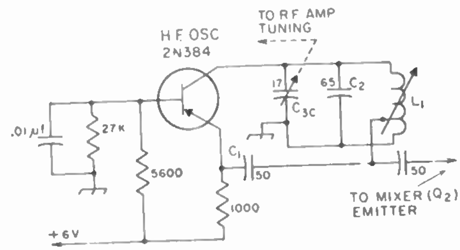


Fig. 7-21—Circuit of the 6-meter oscillator circuit. The tuned circuit C_2, C_{3C}, L_1 is tuned to the oscillator frequency. L_1 is tapped at one turn from the cold end. See QST, February 1959, page 11, for circuit information on the r.f. amplifier, mixer, etc.

V.H.F. CRYSTAL OSCILLATOR

SHOWN in Fig. 7-22 is a circuit that gives 2-meter output directly from 8-Mc. crystals. The circuit is actually two oscillators in one; L_1C_1 forms a tank for a conventional ultraudion 144-Mc. oscillator, and the tuned circuit L_3C_2 in conjunction with the crystal forms a tuned-plate crystal oscillator. The purpose of L_2 is to add some third harmonic voltage to the grid, thereby giving a more optimum wave form. With the circuit adjusted properly, the 144-Mc. oscillations are synchronized or "locked in" with the 8-Mc. oscillator, and hence give 144-Mc. crystal controlled output.

The circuit is not much harder to adjust than an overtone crystal oscillator. First grid-dip L_1C_1 to 144 Mc., L_2 to 23.1 Mc., and L_3C_2 to 8.7 Mc. These frequencies are about right for an 8-Mc. crystal; if some other crystal is used, they must, of course, be changed proportionately. Next, apply plate voltage and tune in the 18th harmonic of the 8-Mc. crystal on a two-meter receiver. Tune C_1 for maximum S-meter reading (being careful to avoid receiver overloading). It should be possible to find settings of L_2 and L_3 that will permit a very sharp but smooth peak in the tuning of C_1 without plops or heterodynes on either side of resonance. This will not coincide with the settings of L_2 and L_3 that give maximum output. The output is insufficient to drive a Class C amplifier directly but is adequate for local oscillator use.

—Frederick W. Brown, W6HPH

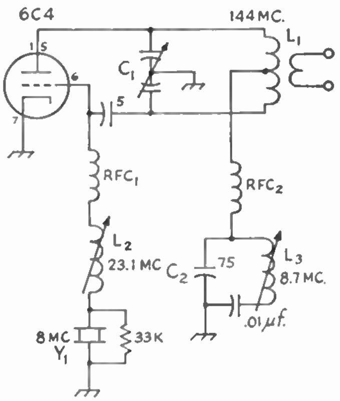


Fig. 7-22—V.h.f. crystal-controlled oscillator. Unless otherwise indicated, capacitances are in pf., resistances are in ohms, resistors are ½ watt.

C_1—5-pf.-per-section butterfly capacitor (Johnson 5MB11).

L_1—5 turns No. 19, ⅜-inch diam., ⅜ long, center tapped with 2-turn link.

L_2—17 turns No. 26 enam., ½-inch diam., slug-tuned form.

L_3—12 turns No. 26 enam., ½-inch diam., slug-tuned form.

RFC_1, RFC_2—30 turns No. 26, 3/16-inch diam., ¾ inch long.

AVOIDING CRYSTAL BURNOUT IN THE APX-6

In the APX-6 follow-up article in February *QST*, a circuit is shown in which the crystal current circuit is broken by the send-receive switch to avoid excessive crystal current. It should be pointed out that this method should be employed only if the t.r. system is adjusted so that the crystal current is quite low. Otherwise, there may be excessive back *voltage*, which could damage the crystal more readily than high crystal current. A forward current of 10 ma. or so will not bother a 1N25, provided the d.c. resistance of the loop is low, say, under 50 ohms; but a few volts, open circuit, may cause crystal burnout.

A cause of crystal trouble with the APX-6 may be excessive current because of oscillation in the i.f. system. The i.f. will oscillate wildly if operated without its customary shielding, or with any of its loading resistors removed or reduced in value. Mixer crystals available nowadays are more rugged than low-noise vacuum tubes, such as the 416B, as far as damage from excessive transmitter leakage is concerned.

—Henry H. Cross, W1OOP

APX-6 ON 1296 MC.

Much has been published on getting the APX-6 transmitter-receiver on 1215 Mc., but there is a great deal of activity on the high-frequency end of the band, and the APX-6 transmitter will not go that high in frequency "as is." To extend the range of the transmitter to 1296 Mc., remove the six machine screws that hold the cavity assembly to the drive-gear box and remove the cavity. With a fine-tooth hacksaw, modify the cavity slugs as follows: Transmitter slug, remove ¼ inch; receiver mixer slug (t.r. cavity slug), remove ¼ inch. Do not alter the receiver oscillator slug. After cutting off the slugs, file smooth to remove all burrs. It is also necessary to construct a new feedback cable for the transmitter. It should be 6½ inches long, tip to tip of the BNC connectors. Reassemble the cavity and adjust the feedback loop for maximum output. To operate on the low-frequency end of the band, it may be necessary to use the "old" 7$\frac{7}{16}$-inch feedback cable. Power output at 1296 Mc. runs about the same as it does at 1215 Mc.—that is, about 3 or 4 watts.

—Dick Stevens, W1QWJ

REDUCING SPURIOUS RESPONSES IN 220-MC. CONVERTERS

Reception on 220 Mc. is complicated, in many areas, by the presence of strong TV signals on the high bands. If you have a TV station on Channels 7 to 13 within line of sight, you're likely to hear it (and maybe little else) on 220 Mc. Various means of improving front-end selectivity and eliminating unwanted responses can be used in such cases, but perhaps the simplest is the series trap.

W4UMF, Arlington, Va., had such a bad time from Channel 11 that he used to wait until after the station went off the air to do any listening for 220-Mc. DX. With a 10-Mc. i.f. and a broad-band front end, there was practically nothing to stop the TV signal image from showing up every 15 kc. across the lower portion of the 220-Mc. band. To rectify this state of affairs, Tom made up the simple series trap shown in Fig. 7-23. With it connected directly at the antenna input of the converter, and tuned to Channel 11, practically all the TV buzzes disappeared.

At least two dividends came from this simple operation. Expecting to take some signal loss with the trap, W4UMF was surprised to find signals on 220 better than they were before the trap was installed! A quick check showed that the TV signal had been biasing off the mixer, reducing the response of the converter on all signals. Still better, at least a third of the TV oscillator birdies formerly encountered have now disappeared. Apparently, quite a few had been heterodyned in by the Channel 11 energy.

Constants given are for Channel 11, but the same method will work for other frequencies. The trap should be as high *L* and as low *C* as possible. Preferably, it should be shielded from the converter circuitry, to prevent unwanted coupling.

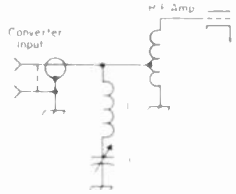


Fig. 7-23—Series trap used by W4UMF to reduce image from Channel 11 in his 220-Mc. converter. Constants given below are for Channel 11. For other frequencies the coil, L_1, should be made as high inductance as possible, with C_1 tuning near minimum.

C_1—1.5-5 pf. miniature variable.

L_1—6 turns No. 12, ⅜-inch diam., close-wound.

UPDATING THE 420-MC. PREAMPLIFIER

Nuvistors have been on the scene now for several years and many v.h.f. and u.h.f. radio amateurs have used them for converters and other equipment. I used one, a 6CW4, to update the 420-Mc. preamplifier that appeared for many years in the "V.H.F. Receivers" chapter of *The Radio Amateur's Handbook*.

The *Handbook* gives most of the mechanical details for the inductors and the construction of the preamplifier, but several changes are necessary when using the 6CW4 Nuvistor. The Nuvistor socket is positioned 2³⁄₁₆ inches in from the end of the trough and is oriented so that its plate connection, Pin 2, is in the proper position to connect to the end of the plate line, L_1. Ground Pin 4 directly to the side of the trough. A shielding plate between the input and output of the stage may be necessary in some cases but wasn't in our modification. The r.f. chokes are made with 8 inches of No. 28 enamel wire wound on 10,000-ohm or higher ½-watt resistors.

The power supply for the amplifier needs only to supply about 75 volts. Alignment and adjustment procedures outlined in the *Handbook* should be followed for the Nuvistor version.

—*Ralph Steinberg, K6GKX*

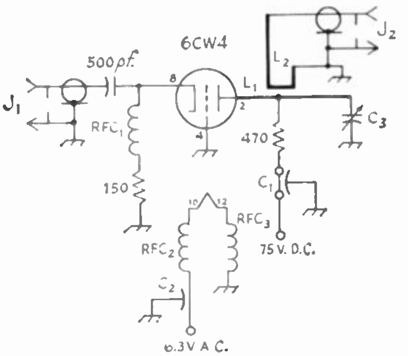


Fig. 7-24—Diagram of the 6CW4 420-Mc. preamplifier Resistors are ½-watt.

C_1, C_2—0.001-μf. ceramic feedthrough capacitors.

C_3—Copper tabs, ⅞ inch diameter.

J_1, J_2—BNC chassis connectors.

L_1—¼-inch tubing 7⅜ inches long.

L_2—Loop of insulated wire adjacent to L_1 adjusted for ¾ inch.

RFC_{1-3}—See text.

SOME NOTES ON HIGH-POWER OPERATION ON 144 MC.

Reading the article on v.h.f. r.f. chokes in November 1963, *QST* [1] prompted me to let you know of some troubles encountered with a 4X150A push-pull amplifier on 144 Mc. This amplifier was built exactly as described by WØMOX in *QST* for December 1961.[2] It operated perfectly in Class C, but when the bias was reduced for AB_1 linear service, a tuned-plate tuned-grid oscillation developed at around 110 Mc. This was the result of resonance in the Z-144 r.f. chokes used in both plate and grid circuits. The trouble was cured by replacing the grid chokes with 270-ohm 1-watt resistors.

Though the amplifier mentioned above and its predecessor described in February 1960, *QST* [3] are designed for current types of tubes, many builders want to use 4X150s, obtainable at low prices on the surplus market. This can be done, but some care should be exercised in the amount of power used with the older tubes. Most 4X150s will take a kilowatt c.w. input, if the amplifier is efficient and a large blower is used. I have even seen 4X150s run at 1 kw. on 220 Mc., plate modulated, but I had one arc over from plate to screen at 1750 volts. Fortunately, this broke down a feed-through bypass capacitor in the screen lead, preventing breakdown of the built-in screen bypass capacitor in the socket.

Users of 4X150s may want to build in some kind of protection against this sort of thing, if they intend to try running more than the maximum rated 1250 volts on the plates.

—*Alan Parrish, K1KKP*

[1] Tilton, "R.F. Chokes for the V.H.F. Bands," *QST*, November 1963.

[2] Breyfogle, "Top Efficiency at 144 Mc. with 4X250Bs," *QST*, December 1961.

[3] Tilton, "A High-Efficiency 2-Meter Kilowatt," *QST*, February 1960.

FINDING V.H.F. BALUN LENGTHS

The grid-dip oscillator provides a handy means for finding the exact length of a half-wave coax balun. Starting with a piece longer than calculated, short one end with a short loop and couple to the g.d.o. which has been set at half the desired frequency. Unravel the braid at the unshorted end of the balun a little at a time until a "dip" is indicated on the g.d.o. The second harmonic of the g.d.o. can be monitored on the station receiver for super accuracy. This method is useable up to the 432-Mc. band, since most g.d.o.s. go up to at least 216 Mc. Since the Q of the balun is high, coupling is easy and provides a positive indication on the g.d.o.

—*Henry H. Brundage, K0HEI*

INCREASED GAIN FOR "COMMUNICATORS"

I FOUND that in changing the 6BQ7A r.f. amplifier tube used in the Communicators I, II, and III, to a newly-introduced Amperex 6DJ8 there is an increased gain in the neighborhood of 5 db. and a noticeable decrease in noise. Of course, there is more to it than just changing the tube. The r.f. coils must be touched up for maximum gain. I am now using a 6DJ8 in my Gonset GC105 Communicator and getting excellent results.

Amperex also has a 6922 tube which is identical to the 6DJ8 except that the 6922 is gold-plated and is guaranteed for 10,000 hours!

—*Thomas Neuhaus, WB2CLN*

USING THE BC-459 WITH THE V.H.F. OVERTONE OSCILLATOR

ALTHOUGH using the BC-459 (7 to 9 Mc.) as the v.f.o. for a 50-Mc. transmitter may be old stuff to many v.h.f. men, it is possible that some newcomers to the World Above 50 Mc. may not realize how easy it is to couple one of these Command transmitters to the ever-popular overtone crystal oscillator.

Fig. 7-25 shows the method of coupling a BC-459 to the grid of a triode overtone oscillator. The oscillator portion of the circuit (components to the right of the dashed line) is identical to that used in simple transmitters described in the V.H.F. Transmitters chapter of recent editions of the *Handbook*. To the left of the dashed line, we see the coaxial line from the v.f.o., a 220-pf. coupling capacitor and the connections to the transmitter crystal socket. All connections at the transmitter end of the coaxial line should be as short as possible.

One interesting feature of the arrangement is that the overtone circuit takes on an entirely new look merely by replacing the crystal with the v.f.o. connections. The instant that the crystal is removed and a ground connection provided at the crystal socket, the circuit becomes that of a frequency multiplier. In this case the stage becomes a frequency tripler using 8-Mc. excitation for 25-Mc. output. Incidentally, the stages that follow the 12AT7 oscillator are also of *Handbook* design.

The required v.f.o. range for covering the entire 50-Mc. band is 8.222 to 9 Mc. Stable output throughout this range is obtained here at W9DRY by operating with only 105 volts applied to the oscillator and both the plates and screens of the amplifier tubes of a BC-459. The Heathkit v.f.o. also works well with the arrangement after the 7-Mc. range has been pulled up into the 8-Mc. region, but does not offer the advantage of oscillator-frequency calibration.

—*Ray L. Sherwood, W9DRY*

EXTENDING APX-6 FREQUENCY

IDEAS for extending the tuning range of the APX-6 transmitter have been proposed in the past and have included using a false cavity bottom and cutting the tuning plunger to a shorter length. I use a third method which is simpler than either of the above. Between the Veeder dial-plunger assembly and the three cavities is a plate. This plate is attached to the Veeder dial-plunger assembly by four flat-head screws. Four quarter-inch thick washers at each screw placed under the plate will raise the plate and, in effect, shorten the three plungers by about ½ inch. If ¼-inch washers are not available, thick nuts will serve just as well. This modification will also raise the frequency range of the receiver.

—*Jon Butler, WA4INJ*

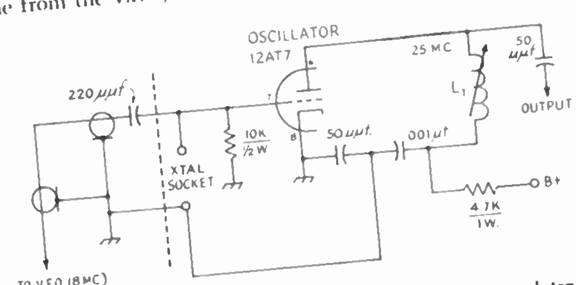


Fig. 7-25—Circuit diagram of a v.h.f. overtone oscillator driven by a Command transmitter. W9DRY uses a BC-459 (7 to 9 Mc.) as the v.f.o. and drives a 50-Mc. frequency multiplier with 25-Mc. excitation obtained from the 12AT7. L_1 is 24 turns No. 30 enam. closewound on a ⅜-inch slug-tuned form (National XR-91).

Hints and Kinks . . .

for the Antenna System

R.F.-ACTUATED TRANSCEIVER-AMPLIFIER T.R. SWITCH

The switching arrangement shown in Fig. 8-1 was inspired by the circuit used in the Heath HW-30 "Twoer." R.f. energy from the transmitter is applied to the diode, CR_1, is rectified, filtered, and applied to the coil of relay K_1.

When the relay closes, it automatically switches the antenna from the transceiver to the amplifier input. A spare set of contacts on the relay opens the cathode circuit of the amplifier during receive. On receive, the antenna is connected to both the amplifier and the transceiver, but I have not observed any loss of signal strength due to this.

The unit is built into a small Minibox that measures 3 × 2 × 2 inches. Neither parts placement nor wiring are particularly critical. By adding a 0- to 25-volt d.c. voltmeter to the circuit the meter can be used to measure relative output from the transceiver and will aid in tune-up. Switch S_1 allows for using the transceiver "barefoot."

—Harvey B. Rock, WA2BWQ

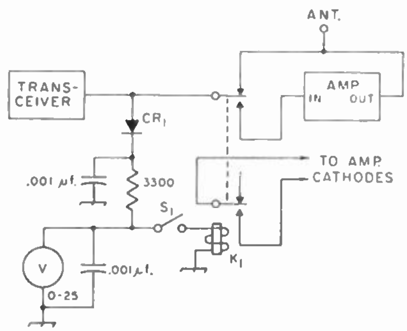


Fig. 8-1—Circuit for the transceiver-amplifier switch. Relay K_1 is a 12-volt d.c. coaxial type with auxiliary contacts.

REMOTE TUNING OF THE CUBICAL QUAD

A great help in receiving through QRM with a cubical quad antenna is being able to phase out interfering stations by adjusting the quad's reflector at the operating position. This may be done with receiving-type Twin-Lead and a 360-pf. variable capacitor.

Attach one end of the Twin-Lead to the junction of the reflector and the tuning stub and the other end to the capacitor which has been mounted at the operating position in the shack. Set the capacitor at half capacitance, and then adjust the stub for maximum front-to-back ratio as is normally done.

I can adjust for front-to-back ratio over the entire 21-Mc. band with this arrangement. The forward gain remains essentially the same regardless of the setting of the capacitor, but interferring signals from the back may be reduced an average of 30 db.

—Capt. J. R. Hagen

MORE ABOUT COPPERCLAD WIRE ANTENNAS

The wire deterioration referred to by W2IXH on p. 81 can be prevented by a practice used in the electrical industry. Wherever the copperclad contacts meet a stand-off, strain insulator or other support, and at points where bends are necessary, it is covered with a close-wound coil of soft wire or a special wrapping intended for the purpose. The soft wire coating is most practical for ham work. It is advisable to use a wire (for the wrap) that is either the same diameter or one size smaller than the antenna wire.

It is quite a bit of work to provide for this type of protection, but it's well worth the effort if you're building a large permanent system.

—Eugene Austin, W0LZL

FEED-LINE CONTINUITY AND SHORT-CIRCUIT CHECKER

When installing a beam of the split driven-element variety I always connect a 100,000-ohm, ½-watt resistor across the element at the antenna as shown in Fig. 8-2. Installation of this inexpensive component enables me to check continuity or shorts in the feed line at any time by measuring the resistance of the feed line with an ohmmeter. Any value over 100,000 ohms means a break somewhere in the feed line or a bad connection at the driven element. Any value less than 100,000 ohms indicates a short. Insertion of the resistor does not affect the performance of the antenna system.

—John E. Greve, W9DGV

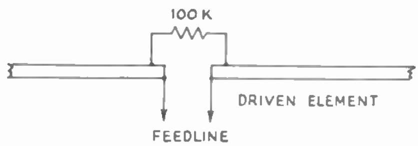


Fig. 8-2—W9DGV's feed-line checker.

PORTABLE ANTENNA MAST

The 40-foot vertical mast shown in Fig. 8-3 is extremely simple to construct and lightweight, yet has sufficient strength when properly guyed to support almost any Field Day antenna. The mast is constructed of 3-inch o.d. aluminum irrigation pipe cut into three sections each, approximately 14 feet long. The pipe is available from Sears, Roebuck and Company in 20- and 30-foot lengths and in diameters of 2, 3 and 4 inches and can be found listed in the Sears Farm Equipment catalog. The pipe joints are made by cutting a ¼-inch slot lengthwise through two 3-foot sections. These slotted sections are then compressed until they will slide into the full-sized pipe at the two joints. Eight sheet-metal screws at each top joint hold the sections and sleeves together.

Ground support for the mast is provided by a 3-inch diameter section of treated fence post forced a few inches into the pipe. Of course, the mast can be placed on a flat board or hard surface instead. A wood insert is forced into the top section to provide mounting for four guy blocks which are screwed through the tubing and into the block.

After the mast is assembled on the ground, it can be swung into position by one man while assistants stake and place the guys. Disassembled, the tower can be made up into a simple bundle that can be tied to the side of a car. If the mast is going to be used for Field Day activities, the joints should be coated with vaseline to facilitate assembly and disassembly.

—R. Bunce, K6QHZ

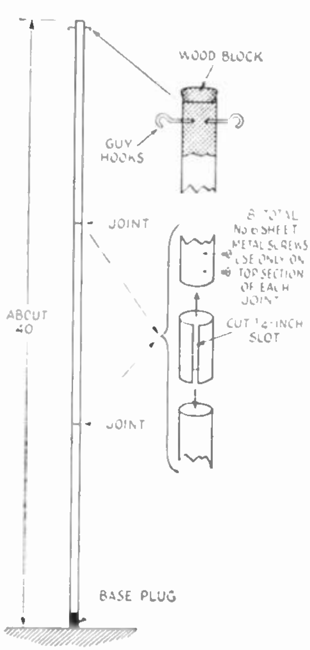


Fig. 8-3—K6QHZ's portable mast.

THICK-WALL FEED-THROUGH

I have been using coax feed lines for several years and have always used the 2-inch 83-1F coax feed-through connectors to bring the feed line through the house wall, window frame, etc. However, my present home, built around 1778, has extra thick walls that range from two to three feet in thickness and the window frames are over one-half foot in thickness! I devised the simple coax feed-through shown in the accompanying sketch in Fig. 8-4. It involves the use of two 83-1F connectors and a short length of coax with 83-1SP connectors attached to both ends. A hole, ⅞ of an inch in diameter, is drilled through the wall or window frame. The assembly, less one washer and 83-1F nut, is pushed through the hole. When the nut and washer are attached and tightened, the job is completed.

—Gilbert L. Countryman, W4JA

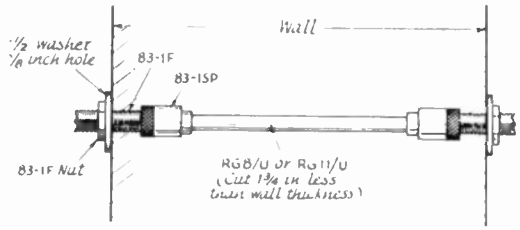


Fig. 8-4—W4JA's thick-wall feed-through.

A FLEXIBLE COAX ANTENNA

A novel but effective flexible coaxial antenna and feed line can be made from a length of coax cable and an insulator. It can be rolled up in a small space for use as an emergency-portable antenna or it can be hung permanently from a fixed support. Feed-line and radiating portions are all one piece so that there are no joints or soldered connections except at the transmitter end of the line where the plug of your choice is installed. Although a compromise antenna, it is simple to construct and is an easy solution to the portable antenna problem.

Select your coax cable and cut a length equal to about one-quarter wavelength at the desired frequency plus the length required for the feedline. Any of the popular coax cables such as RG-58/U, RC59/U or RG-8/U may be used. At one end of the cable, slice down and pull off the outer insulated cover (being careful not to damage the shield underneath) for a distance of one-quarter wavelength plus about 10 inches. Push back the exposed shielding to loosen it up, then fold it back over and down the feed-line portion of the cable. The shield will form the bottom section of the coaxial antenna. The shield will not reach down the cable for the entire length it was cut—thus the reason for cutting it 10 inches longer than necessary. Pull the shield down as tight as possible, measure a quarter wavelength at the desired frequency less 5 per cent, and trim off the excess shield. A few extra turns of tape should be applied to keep the shield from creeping up the cable. Now measure out on the insulated unshielded center conductor one-quarter wavelength less 5 per cent. Remove all of the insulation beyond this point. Attach a supporting insulator to the top of the antenna using the length of stripped wire. Now wrap the entire length of exposed shield with plastic tape, making it firm at both ends to prevent slippage.

The coaxial antenna can be rolled up and tucked away in the car. Merely connect it to the transmitter and attach the insulator end to a tree when using the mobile rig at a fixed location. A metal hook formed at the insulator will facilitate "hanging" the antenna.

—Melvin H. Dunbrack, W1BHD

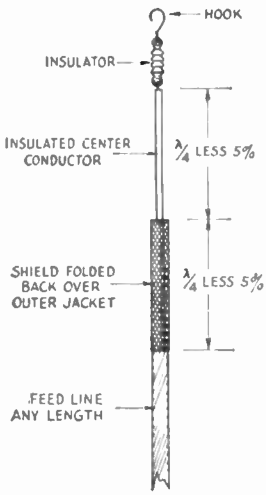


Fig. 8-5—Portable Coax Antenna made from common coax cable.

UNBALANCED TO BALANCED FEED FOR LOW-IMPEDANCE MULTIBAND ANTENNAS

In *QST* for June, 1956, W6EBY described a balun-type coupler for use between a coaxial feed-line and a balanced antenna such as a half-wave dipole. Although the system as described makes use of an individual antenna for each band of operation, it is perfectly practical to use the same method for coupling 75-ohm coaxial cable into the center of a balanced multiband trap-type antenna system.

Here at W3BRQ, we run a length of 75-ohm coax from the pi-network output tank to a balun located out on the roof in the general vicinity of the feed point for the multiband antenna. The balun, made from a pair of relatively inexpensive B & W type 3975 coils, provides a match between the long run of coax and a short length of 75-ohm Twin-Lead that connects to the center of the antenna.

—Tony Gitt, W3BRQ

COAX-FITTINGS NOTES

It has been found that a considerable amount of energy can be lost on v.h.f. when using the 83-1SP type connector out-of-doors. The fittings are not watertight and they put a slight impedance bump in the transmission line. I have shifted all my v.h.f. connectors over to the HN-82 constant impedance type. Not only do they eliminate the bump on the transmission line but they are also watertight.

STREAMLINING ANTENNA BOOMS

Hollow booms used in the construction of beam antennas frequently act as air scoops during high winds. This scoop or air-trap action can lead to free turning or other undesirable motion of the beam.

Booms made with round tubing can be streamlined to suppress wind-driven movement by inserting a rubber ball in each end of the tube. Most dime stores carry a large variety of rubber balls—the type children play with—and you can usually find a size that will force-fit into the ends of the boom.

—William C. Martin, W6PLK

REMOVING GUY WIRE AND GROUND STAKES

When you next run across a guy wire or ground stake that won't pull up after a few mighty heaves, put the automobile bumper jack to work. As long as the stake or rod has a clamp or other surface to which force may be exerted, it is fairly certain that it will move after a few strokes on the jack handle.

—Harry M. Engwicht, W6HC

NEW LIFE FOR SLUGGISH AR22 ROTATORS

During low-temperature periods, my AR22 antenna rotator would begin to slow down, and when the temperature dropped below zero it would stop altogether. After some investigating I found the trouble was due to a faulty 100-μf. capacitor in the control box. I removed the capacitor and replaced it with two equal electrolytic capacitors connected back to back, as shown in Fig. 8-6. (The original capacitor was nonpolarized.) I used two 400-μf., 450-volt photoflash capacitors, but any good quality type with the proper rating would suffice. After replacing the capacitor, the rotator functioned perfectly at all temperatures.

—E. Kirchner, VE3CTP

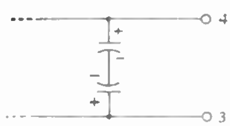


Fig. 8-6—Circuit showing connection to the electrolytic capacitors to the AR22 rotator.

ANOTHER DIPOLE CONNECTOR

A SIMPLE dipole connector, shown in Fig. 8-7 has excellent mechanical and electrical stability. The heart of the connector is a "U"-shaped piece of Plexiglas or metal. If plastic is used, it probably can be obtained from a hobby shop or a plastic-supply store. A piece of ⅛-inch stock about 2 inches wide and 6 inches long is needed. Heat the plastic by rotating it over a stove burner—either gas or electric. When it is soft enough to bend, grasp it with flat-jawed pliers and bend it into the U shape as shown in Fig. 8-7. Each side should be about two inches long.

One of the sides should be drilled to accommodate a coax receptacle. A small hole is drilled in the opposite side to take a machine screw and nut, which is used to attach the assembly to the insulator. After the proper electrical connections, the unit is ready for hoisting.

—Kent Williams, WA2VOL

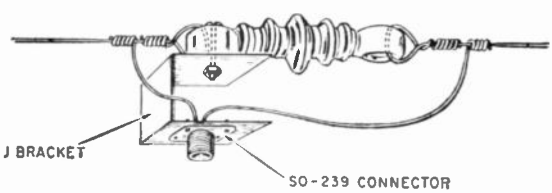


Fig. 8-7—WA2VOL's dipole connector.

MULTIBAND TANK AS A RECEIVING ANTENNA TUNER

RECENTLY, while spending a brief vacation at a new QTH, I found myself with a few idle minutes and no ham gear ready for operation. Because there was not sufficient time for setting up a complete station, I decided to settle for just plain listening-in. Scraps of 300-ohm Twin-Lead provided material for a hastily constructed folded dipole that resonated a megacycle or two above the 28-Mc. band and the receiver was soon in operation. At least, a few signals could be heard above the high noise level that prevailed.

It was soon reasoned that the receiver needed help in the signal-to-noise department so thoughts turned toward an antenna tuner. The first thing spotted in the junk box was a National MB-40 tuner and the idea of using it for antenna matching was born then and there. A three-turn link, wound in between the two high-frequency inductors of the tuner, was connected to the 300-ohm feeder and, of course, the regular input coil was connected to the receiver input terminals.

With the coupler in place and the receiver back in operation, I was pleasantly surprised at the increase in the number of signals that could be heard and at the boost in strength of the few signals that had been tuned in previously. A few quick checks indicated that the 28-Mc. signals came up about 3 S points when the tuner was employed. Similar tests at the lower frequencies showed a gain of 5 to 8 S points when the MB-40 was used between the aforementioned antenna and the receiver.

—Bob Barth, W1HMP

LONG ANTENNA FOR A SHORT LOT

MANY amateurs don't operate on the lower frequencies because the size of a city lot does not permit the erection of suitable antennas. The antenna described here permits operation on 80 meters even though space may be limited.

Fig. 8-8(A) shows the physical arrangement of the antenna. A wire 67 feet long extends from a pole (my pole is 25 feet high) to a connection on the antenna tuner. A second wire, also connected to the tuner, drops from the shack to a pair of stakes where it is supported a foot or so above the ground. This second wire, of some random length, is positioned directly under the top wire.

The circuit for this antenna arrangement is shown in Fig. 8-8(B). Capacitor C_1 resonates the antenna to the desired operating frequency while the inductance L_1 acts as a loading coil to compensate for the shortage in length of the lower wire. It also provides a means of coupling the antenna system to the transmitter. For operation on 40 meters the antenna should be connected as shown in Fig. 8-8(C). Capacitor C_1 should have a plate spacing similar to that of the plate tank capacitor in the transmitter.

—William G. Walker, W3NUG

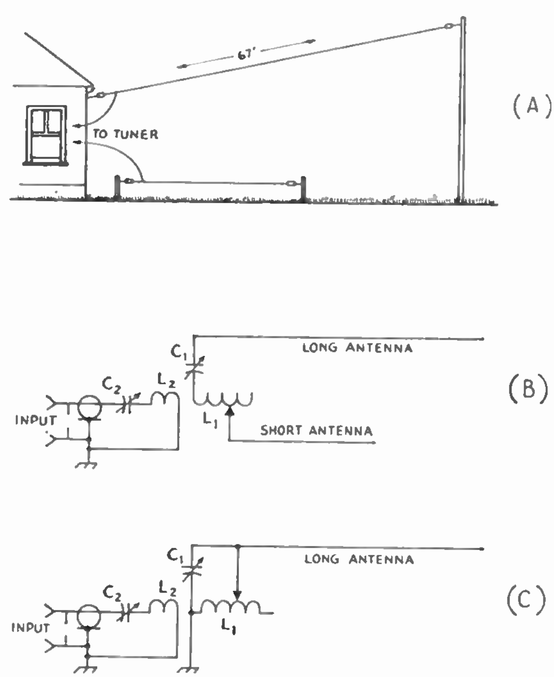


Fig. 8-8—A—W3NUG's low frequency antenna; B—circuit of the antenna tuner for 80 meters; C—circuit of the antenna tuner for 40 meters.

SIMPLE ANTENNA CHANGEOVER CIRCUIT

THE circuit shown in Fig. 8-9 uses a d.p.d.t. switch for transfer of the send-receive antenna. Notice that r.f. input terminal of the receiver is grounded when the switch is at the transmit position. This feature of the arrangement prevents receiver overload or hold over that might otherwise be caused by the transmitter output.

S_1 should be a switch of reasonably good quality such as a knife or rotary type. Ordinarily, a toggle switch would not be suitable for the application.

—Larry Emerson

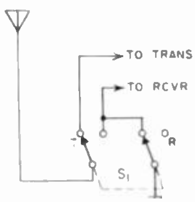


Fig. 8-9—The simple transmit-receive circuit used by ex-KN2OUI

PERIODIC INSPECTION FOR COPPERCLAD WIRE ANTENNAS

HERE is a tip, learned from bitter experience, that should benefit any of the gang who use surplus copperclad wire for their sky hooks. Antennas made from this material require inspection once a year or so if deterioration in advance of actual breakdown is to be detected. In my own case, I *had* a nifty 340-footer about 50 feet high that was made with surplus air-craft-trail wire obtained from a bargain 3000-foot reel. After about four years of service—without inspection—trouble started. Wherever the wire came in contact with stand-offs, strain insulators or other supports, and at points where bends were necessary, the copper coating had worn through and rust had eaten into the core, thus creating about half a dozen high-resistance joints that finally broke down.

—Wm. Plimpton, W2IXH

PLASTIC TUBING SPREADERS

OPEN-wire feed-line spreaders can be constructed from large diameter polyethylene tubing. I use 5/8-inch o.d., 1/2-inch i.d. tubing which is stocked by laboratory supply houses and sells for about 15 cents a foot. The tubing can be purchased for as little as 10 cents a foot in 100-foot rolls from Bel-Art products, Pequannock, New Jersey.

To make the spreaders, cut off the desired length of tubing; cut slits in each end with a sharp knife and pierce a hole at the bottom of each slit. If the hole is made smaller than the diameter of the feeder wire, the wire will be gripped firmly when pressed into place. No additional tying or fastening should be necessary.

—Dr. A. W. Golfman, WN2HDQ

SIMPLE GROUND PLANE

A GROUND-PLANE antenna capable of handling a full kilowatt can be constructed, using wire elements, for less than five dollars. The secret lies in the use of the familiar type SO-239 coaxial connector. Simply turn the connector upside down (the center terminal pointing up) and solder the vertical element to the terminal. See the sketch in Fig. 8-10. The four radial wires are soldered to the four holes in the connector and the feed line with a mating connector is plugged into the SO-239.

For v.h.f. ground planes, the antenna can be made self-supporting and can be mounted by attaching the feed line to a supporting mast Low-frequency models will require an insulator at the top of the vertical element. The antenna is then suspended from a tree. The radials will also require insulators and guy wires. The radials should "droop" at about 45 degrees in order to obtain a reasonably good 50-ohm match. The lengths of the elements can be found from the formulas:

$$\text{Vertical element in feet} = \frac{234}{f(\text{Mc.})}$$

$$\text{Radial elements in feet} = \frac{240}{f(\text{Mc.})}$$

—George Christakes, K9MDE

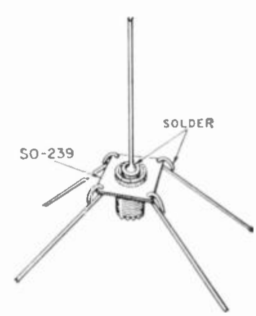


Fig. 8-10—Ground-plane antenna made from an SO-239 connector.

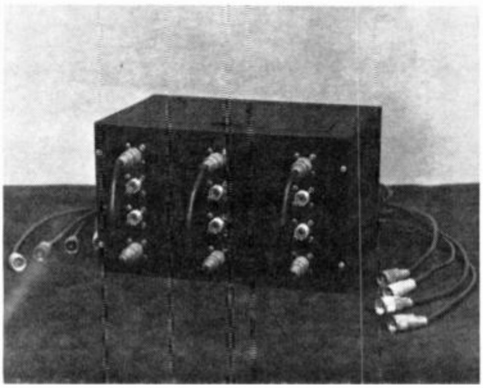
BURYING 300-OHM FEED LINE

I WANTED to try out a Windom antenna which requires a 300-ohm feed line. It's not unusual to bury coaxial feed lines, and so I decided to try to bury the 300-ohm line to preserve my neat antenna installation. I used some Homart Flex-O-Pipe, which is a polyethylene pipe designed for underground water lines, and ran the feed line through it. The pipe can be obtained from most Sears Roebuck stores. The 1/2-inch size is perfect for either the 300-ohm tubular or flat line. I inserted the feed line into the plastic pipe by first running a No. 12 leader wire through the pipe and then tying the wire to the feed line and pulling them both through. I am using about 60 feet of the underground feed line on 80 through 10 meters with success.

—Floyd Donbar, W8PA

PATCH PANEL

The patch panel shown in Fig. 8-11 does away with most of the nuisance involved in jumping bands or changing modes of operation. Four rows of coax fittings make up the connectors for the panel. The common fittings (antenna, receiver, and transmitter) are in the top row while the bottom three rows connect to the various receivers, transmitters and antennas. Several patch cords are needed to connect the desired antennas to the proper receivers and transmitters. These cords are lengths of coax with fittings at each end that will mate with the connectors on the board.



The unit shown in the photograph was constructed in a cabinet measuring 12 × 7 × 8 inches. This chassis provides considerably larger space than needed for the panel alone, but offers convenient housing for the t.r. switch and s.w.r. bridge. A low-pass filter and the s.w.r. bridge indicating meter can probably also be housed in the cabinet.

—*James C. Fine, K5JXF*

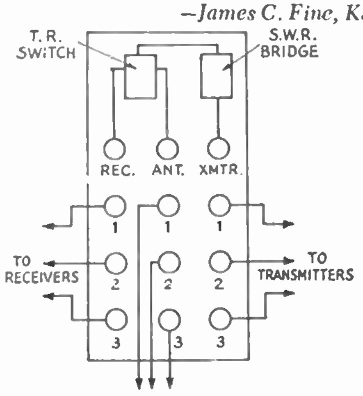


Fig. 8-11—Block diagram of K5JXF's antenna patch panel

HOMEMADE LIGHTNING ARRESTERS

Heavy-duty industrial fuses that have outlived their intended purpose may be quickly modified for use as lightning arresters. High-current (70 to 600 amperes) 250-volt cartridge fuses with copper blade terminals are best for the job, and it should be possible to obtain one or more of them from an electrician or the caretaker of an apartment house, a store or a factory.

Fig. 8-12 illustrates a blown fuse revamped for arrester duty. The fuse element normally supported between the copper blades has been removed and a copper strap soldered to the terminal at the left. Notice the gap between the right end of the copper strap and the adjacent fuse terminal. Maximum protection against lightning is afforded by a gap of minimum width. On the other hand, the gap must be wide enough to prevent the arrester from flashing over when transmitter power is fed to the antenna. It is advisable to start out with a real narrow gap and then, by clipping short sections from the strap, adjust for a width that will stand up with the amplifier operating at full input.

The end bells for the fuses are fastened to the main cartridge by either rivets or self-tapping screws and, of course, these must be removed before the fuse can be opened for modification. Have a wastebasket handy during the opening-up operation so that you'll have a place to dump the lime dust packed inside of the fuse. If rivets are used in the original assembly, these may be replaced with self-tapping screws when the bells are refastened to the cartridge.

To give the arrester a real chance to work, use a short heavy lead between the ground terminal and a good ground system (earth).

—*James A. Keesler, K8EXF*

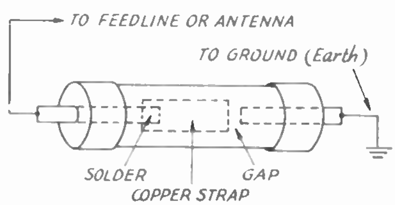


Fig. 8-12—Drawing of the homemade lightning arrester. A blown cartridge fuse and a small scrap of copper are the only materials required.

SOME NOTES ON GUYED TOWERS

Wind, Ice and Earthquake Loads

The loads acting on a tower are essentially the same as those acting on buildings and other structures and may be placed in three main classifications: live, dead and erection. Wind is by far the most critical live load. The design wind load is usually set up from references to U. S. Weather Bureau reports and maps for each locality. It varies from a recorded 132 m.p.h. in Miami to 49 m.p.h. in Los Angeles. Velocity is converted into pounds per square feet in accordance with accepted formulas, taking into account the increase of wind velocity with height. Wind tunnel tests have shown that the total wind load should be based on the projected area of 1½ tower faces on square towers. The wind on round members may be figured as two-thirds the load on flat members. Thus the load on a 3-inch rod will be equivalent to the load on a 2-inch flat bar or angle. No attempt, by the way, should be made to design a tower to resist a tornado as the chance of a direct hit is remote and there is no assurance that even a fantastically heavy structure will survive.

Ice load is another important live load. While its occurrence is not as frequent as high wind load, a heavy ice storm or freezing rain can be very disastrous to a tower. High winds seldom occur at the same time as heavy icing. On the other hand, fairly strong winds with light ice and moderate wind with heavy ice are common. Ice from ½ inch to 2 inches thick is the usual range used for design in the continental United States. However, ice with a thickness of 12 inches or more occurs in some isolated spots. Naturally, the presence of ice on tower members increases the projected area exposed to the wind and the weight of the ice adds to the dead load.

Earthquake load must be considered in some localities, particularly on the West Coast. This load acts horizontally and is a function of the weight or mass of the structure. Although earthquakes occur infrequently, their threat cannot be ignored.

Erection loads are also very important, especially in the case of guyed towers. Wind on the tower in some stages of erection can subject certain members to loads greater than they will receive in fully erected condition. Loads from large and heavy gin poles add to the burden of erection loads.

Dead loads include the weight of the tower members, antenna, transmission lines, ladders and platforms.

Safety Factor

The term "safety factor" is a much misunderstood and sometimes misleading term. Generally, the term is intended to mean the number obtained by dividing the failure stress of the material by the allowable stress. A more realistic definition of the term would be a relation between the elastic limit of the material and the allowable stress. The elastic limit of the material is that stress below which the material will not take a permanent set or deformation. If a material is repeatedly loaded above the elastic limit it will fail at a load far below the failure limit. A safety factor of 2½ for a guy wire indicates that the breaking strength of the guy is 2½ times the working load.

Guys

The guyed tower depends entirely on the guys to hold it vertical and, therefore, the design of the guys is of prime importance. For a tower with one set of guys, an angle of 45 degrees to the horizontal is good practice. Tall towers with multiple guys require a steeper angle in the top guy. One anchor can then serve several guys and the angle of the lowest guy will not be too flat.

Maintenance

Towers should be inspected at regular intervals, the length of time between inspections depending on weather conditions. If the tower is located in a section of the country where windy seasons have regular cycles, inspections should regularly precede these seasons. The first step in any inspection is a check of the tower connections. Almost all towers have bolted connections with some means of locking the bolts in place. During this climbing inspection the paint should be observed for rust spots. If the tower is galvanized, the coating should be inspected.

The condition of the guys should also be checked periodically. Practically all guys are made of galvanized strand and are very durable even without additional protective treatment. However, if signs of rust appear, protective treatment is a must.

—*New England Professional Engineer*

NOTES CONCERNING "A NOVICE THREE-BAND ANTENNA SYSTEM"

In regard to W1ICP's article in the October issue, "A Novice Three-Band Antenna System," instead of cutting the 99½ feet of 300- or 450-ohm line in the center, cut it 33½ feet from one end on one side of the line, and 33½ feet from the other end of the remaining side of the line (see Fig. 8-13). Now join A to A′ and B to B′ as illustrated, and there will be no need for splices or waste.

—*Dan Ditto, W0CMI*

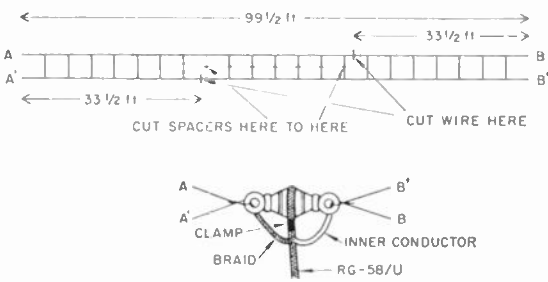


Fig. 8-13

OILING UNREACHABLE PULLEYS

To oil a pulley which is out of reach on a mast or tower, use a toy balloon. Fill the balloon with a half cup of fairly heavy oil. Tie the neck of the balloon to the pulley rope with light thread and slowly pull the rope until the balloon is pulled through the pulley, which will break the balloon and spill the oil on the pulley bearings. If it's possible, it probably would be better to attach the ballon to the antenna side of the pulley, since here it would be in a better position to spill the oil down on the bearings.

—*Glen Winger, W9KXG*

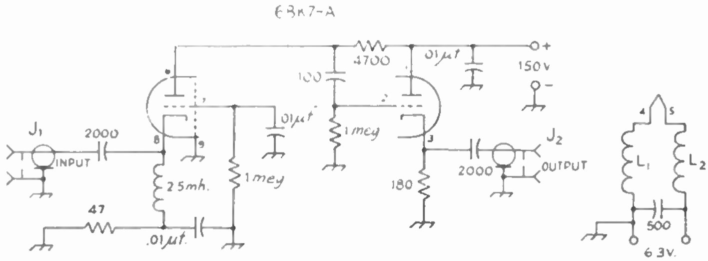


Fig. 8-14—Circuit diagram of W8EUJ's t.r. switch. Unless otherwise indicated, capacitances are in pf. Resistances are in ohms, resistors are ½ watt. L_1 and L_2 are each wound with 30 turns No. 24 wire to a diameter of 3/16 inch.

T.R. SWITCHES

Modification of my 100-watt station for fast break-in brought up the antenna switching problem. A t.r. switch seemed to be the best answer, so one was designed.

The simplicity of the unit built is shown by the circuit diagram, Fig 8-14. Since it could be added to existing control units, some other "120-watt table-top rig" amateur may be interested in the circuit.

A grounded-grid input stage (switched by grid rectification) *R-C* coupled to a cathode-follower output stage, provides a broad-band low-impedance t.r. switch suitable for use with coaxial cable. The unit has some gain as shown. If needed, for long lines or to make up for resistive isolation, more gain can be had by increasing the plate resistance of the first stage to 6800 ohms or more.

The 6BK7A tube is a good choice for this application. Designed for cascode operation, it has a good heater-to-cathode voltage rating. More important is an internal shield connected to Pin 9 which very effectively isolates the two triode sections. With no power to the t.r. switch the receiver sounds dead.

My model is a separate unit with its own booster-type transformer, selenium rectifier and other power supply components built on a 3¼ × 5-inch aluminum sheet chassis and housed in a 4 × 4 × 5-inch sheet-metal can. Construction is similar to B & W t.r. switch. I have no way of checking power-handling capabilities, but from the tube ratings this switch should handle as much power as the other units I have seen. A phono jack in the transmitter end of the low-pass filter provides a convenient point for connection to the r.f. line.

After installing this t.r. switch several interesting developments were noted. Hash from the final amplifier (parallel 807s) had to be eliminated. A clamp tube circuit was added to help the fixed bias cut plate current completely off. Zero-beating is a little more tricky, requiring less r.f. gain in the receiver. And finally, it is quite a surprise to learn how many hams pick my operating frequency to tune up on. I can hear them now!

—Charles E. Quick, W8EUJ

The t.r. switch shown in Fig. 8-15 is my adaptation of a circuit designed for another purpose and described by ZL4GP on page 48 of *QST* for July, 1955. Although the switch is only slightly more complicated than the simple unit developed by W9LSK (*QST*, May, 1956), it does operate without presenting a constant loss to received signals through the 3.5-30-Mc. range. In fact, the circuit shows some gain at these frequencies.

The switch is designed for low-impedance coaxial-cable input and high-impedance output. Because of the latter characteristic, it is important that the switch be built *into* the receiver with its output coupling capacitor connected directly to the secondary of the receiver input transformer.

—Carlo Winspeare, I1DAJ

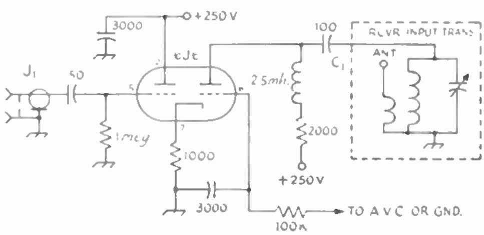


Fig. 8-15—Diagram of I1DAJ's simple t.r. switch. The switch is designed for low-impedance input (coaxial cable) and high-impedance output. Capacitors are in pf., resistances are in ohms, resistors are ½ watt.

USEFUL WASHERS

A heavy semihard rubber washer, ¾ inch thick, with one tapered side and one flat side (intended for closet-bowl drain use) makes a snug fit around two-inch pipe. It can be used to protect antenna rotators or the like from moisture and dust (see Fig. 8-16). The washers can probably be obtained from most hardware or plumbing-supply stores.

—Dr. George B. Bean, W5DVI/K5KUR

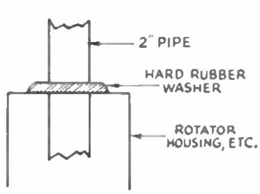


Fig. 8-16—Rubber washer protects rotator housing from moisture and dust.

ANTENNA ROTATOR HINT

When you're having trouble with commercial antenna rotators you should first check the capacitor that is usually located in the control box before climbing the antenna tower to check the rotator itself. This capacitor can cause intermittent trouble or can completely disrupt the rotator operation. It's worthwhile checking this component first—it may save some tower climbing!

—Walter Voelker, W3FLC

DUMMY LOADS

Mention of 100-ohm, 18-watt Globar resistors was made in the letter entitled "Dummy Loads," which appeared in the Technical Correspondence column, *QST*, April, 1959, page 47. Unfortunately, these units are not usually found at radio-parts supply houses. They are, however, supplied by RCA (stock No. 17217) for use as parasitic suppressors in commercial high-power transmitters and are available through regular RCA distributors. The 100-ohm, 18-watt size is convenient for ham use since two of them can be connected in parallel for a 50-ohm, 36-watt dummy load. The resistors measure about 4 inches long and 1 inch in diameter.

—Philip F. Robinson, W1CK

GUY ANCHORS

Guy anchors can be made from discarded automobile wheels. When buried a few feet they have a remarkable pull-out resistance, even in soft sand. When you're placing the wheel in the hole be sure to position it at right angles to the guy wire.

—Francis Le Baron, W1TQZ

WINDOW-GLASS PERFORATOR

When it's necessary to perforate window glass for antenna feedthrough insulators, use a steel BB pellet or small ball bearing and a common drinking straw. Insert the BB in the straw and, holding the straw about an inch away from the glass, give a hard blow. The pellet will hit and fall back on your side of the glass, while a conical-shaped piece of glass will chip and fall out the other side. The resulting hole is the same as that produced when kids and BB guns are mixed! If a larger hole is needed, it can be reamed to a larger size by careful honing with Carborundum cloth. With a little practice, holes can be placed side by side, an inch apart, without cracking the window pane.

—Dean Miller, W4TRQ/7

DIPOLE CENTER INSULATOR

The porcelain base from a common flange type light bulb fixture can be used for an insulator at the center of a dipole antenna. Take the fixture apart and discard everything but the base itself. Connect the antenna wires to the two small holes formerly used to mount the socket and run the coax feedline up through the large hole that originally enclosed the lamp base. The porcelain is very strong and should hold even the heaviest dipole.

—Dennis Marandos, K1LGQ

AN INEXPENSIVE 40- AND 80-METER ANTENNA

The antenna shown in the sketch in Fig. 8-17 is only slightly longer than a 40-meter doublet, yet it performs well on both 80 and 40 meters. The dimensions given a result of several trials of various lengths on both the 40- and 80-meter sections.

The loading coils are made from two lengths of ordinary ¾-inch plastic water pipe (outside diameter 1 1/16 inches) 10 inches long, close-wound with 197 turns of No. 18 Nyclad copper wire.

The center insulator was sawed from ¼ inch thick Plexiglas to the dimensions shown in Fig. 8-17. The top hole in the insulator supports the center of the antenna which is "hung" from the center post about 20 to 22 feet above the ground.

When fed with 50-ohm coax cable, my antenna had an s.w.r. of less than 2 to 1 over the entire 40-meter band and less than 2 to 1 over any 80-kc. segment of the 80-meter band. With the dimensions shown, the antenna will resonate at about 3850 kc. The change in frequency is approximately 50 kc. for each 1 inch on 40 meters and 50 kc. for each 5 inches on 80 meters. Changing one section has very little effect on the other.

—John Buchanan, K7CRO
(in "Solid Copy")

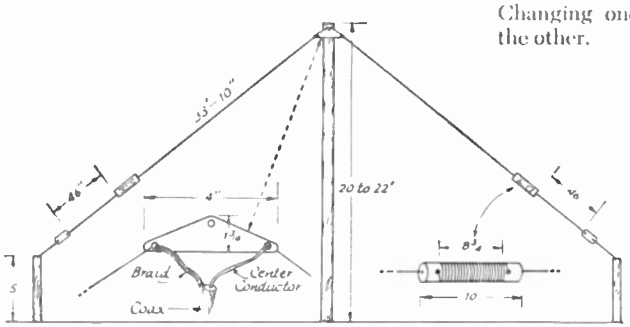


Fig. 8-17—K7CRO's 40- and 80-meter antenna. Details of the center insulator and the loading coils are also shown.

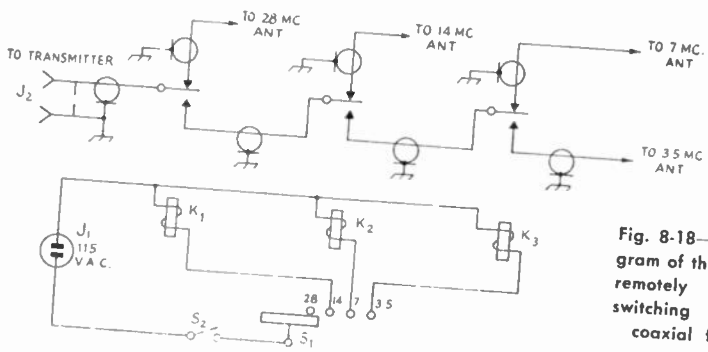


Fig. 8-18—Circuit diagram of the simplified remotely controlled switching circuit for coaxial feedlines

COAX CONNECTOR REMOVAL

To remove coaxial connectors such as the PL-259 from their cables, first take a knife and cut away any lumps of solder around the holes in the body of the connector. Next, drill out the solder in each of the holes with a No. 31 drill. Heat the center conductor pin with a soldering iron, give the cable a twist and a pull, and the connector will come off easily. The important thing to remember is not to use any heat on the body of the connector. If there is a reducer bushing in the connector—the kind used to modify the connector for small-diameter coax—use two pairs of pliers; one holds the connector and the other the bushing. Screw this out before starting the above process.

—M. J. Silvers, W4HUW

ANTENNA RAISING—NO CLIMBING

Beginners may have wondered how to get antenna wire up to the tops of trees or other high objects. One of the oldest and easiest ways is to connect a rubber ball to the end of a length of mason string. Throw the ball up and over the desired limb. Once a "string path" has been established, the antenna wire can be secured to the string and pulled over. Secure the wire to the tree base; the other end connects to the antenna. For trees over 25 feet use a bow and arrow. Connect some light fish line to the arrow and shoot the arrow over the target.

—Franklin L. Curcio, W2JYI

EMERGENCY COAX CONNECTOR

Faced with an immediate need for a connector to mate with an SO-239 connector, I found that an Amphenol 75-PC1M microphone connector had the same thread and could be easily modified to do the job. The only thing I had to do was solder a piece of heavy wire or thin tubing to the center conductor of the microphone plug so that it would make contact with the center conductor of the SO-239. The r.f. characteristics of this connector are probably not the best in the world, but the connection is a positive one and a good scheme to remember when nothing else is readily available.

—Drew Woloshyn, WA6NOZ

REMOTELY-CONTROLLED SWITCHING CIRCUIT FOR COAXIAL FEEDLINES

Owners of coaxial-fed antennas who contemplate use of the "cable-saving" selector circuit described by W9QUW may be interested in a simplified control and indicator circuit for the system.

The relay-controlled setups I've seen usually use a progressive shorting switch wired as shown in Fig. 8-18. This arrangement has only one antenna-selector switch and is extremely simple to wire. Pilot-lamp indicators become more or less an accessory with this circuit, since the selector-switch pointer knob indicates the antenna in use.

S_1, the selector control, may be a Centralab steatite wafer section type P1S, P1SD or PA-12. Phenolic Centralab sections that will do the job are the types P1, P1D and PA-43. A s.p.s.t. toggle switch, S_2, is used as the control head on-off switch. J_1 is a 115-volt chassis-type receptacle mounted adjacent to the selector switch.

Eugene Austin, WØLZL

STRENGTHENING THE "LIGHTWEIGHT" QUAD

For the benefit of those living in high-wind areas, the lightweight quad structure described in our article in the June 1964 issue can be strengthened materially, without adding noticeably to the weight, by making the vertical spreaders entirely of aluminum conduit. Two pieces of conduit will be required for each vertical spreader, since a standard length is 10 feet. Couplers for joining conduit sections are available at electrical shops. Suitable insulators must be provided, of course, at the points where the quad loops are attached.

As pointed out by WØAIW,[1] the horizontal spreaders should be broken into insulated sections, but these spreaders may also be strengthened by minimizing the lengths of the dowel sections, and increasing the lengths of the conduit sections to compensate.

—WA4FRY and K4AVU

[1] Bergren, "The Multielement Quad," QST, May, 1963.

ELECTRIC FENCE WIRE FOR ANTENNA USE

Many newcomers may not be aware that some supply houses and hardware stores carry ½-mile spools of "electric" fence wire. This 18-gauge wire is labeled as being 30 per cent copper and sells for approximately $9.00 per roll. The fact that it is light in weight and is quite strong (it has a steel core) should interest the long-wire antenna enthusiast. No specific claims for its efficiency as a conductor of r.f. are made at this time, but it is known that 1000- to 2000-foot open-wire TV feed lines have been successfully made with the material. Another added feature of the wire is that the stuff is almost invisible when erected at heights of 30 to 40 feet.

An antenna using electric fence wire has been suspended here at W4ZZ for the past several months and has taken some pretty stiff winds. This radiator is 420 feet long and is supported by a pair of trees located 440 feet apart.

Incidentally, because of the low copper content, the wire does oxidize quite quickly. It is therefore recommended that the wire be treated with plastic spray before it is erected.

—Gerrick B. Brown, W4ZZ

SEALING OUTDOOR ANTENNA CONNECTIONS

Erratic loading of the transmitter, or noises in the receiver, can sometimes be traced to eroded antenna connections. Some amateurs use candle wax to seal open antenna connections; however, this provides only a temporary seal. Constant beating by the weather will cause this type of seal to crack and allow moisture to enter the connection. What to do about it? Use that old piece of coax! Remove the outside jacket and shield from a piece of the cable. Strip about ½ inch of the insulation from the conductor. Holding the exposed piece of the center conductor with a pair of pliers, bring the flame of a match under the insulation at the other end of the cable. After a few seconds, the insulation will melt and start dripping off in a molten form. Hold the cable over the connection to be sealed and let the drippings fall onto the connection. When the joint is sealed, let it set for an hour or so. Now you have a sealed connection that even old man weather can't touch!

—David L. Cabaniss, W1TUW

STOP ROTATOR FREEZING

Amateurs who have experienced difficulty with beam rotators freezing-up in cold weather might be interested in my inexpensive solution to this problem. Position a 150-watt light bulb just below the rotator mechanism and enclose it with asbestos paper. Connect a heavy duty power cord to the lamp and to a power receptacle. When the temperature goes down and the rotator sticks, turn on the light bulb for about fifteen or thirty minutes. The rotator will then turn "free" again.

—John L. Spencer, KØIUC

BEAM ROTATOR

The photograph in Fig. 8-19 shows my antenna rotator; it is extremely rugged and can be built quite inexpensively. The heart of the unit is a transmission out of an old coal stoker. There are plenty of these available at junk yards and furnace dealers, especially where the trend has been to shift from coal to gas or oil heating.

The relative size of the transmission can be visualized by comparing it to the one-tenth-horsepower motor at the right. The assembly is mounted at ground level and is designed so that the entire mast revolves.

As a direction indicator I use 20 No. 47 pilot lamps mounted on a board in a circle. Outside, at the base of the mast and just above the stoker transmission, is a Plexiglas disk with brass machine screws mounted around its periphery. A commutator turns with the mast and wipes across the screw heads, lighting up the corresponding lamps in the shack. A 20-conductor cable, salvaged from the telephone company, connects the indicator lamps to the brass screws.

—James L. Peterson, K7NUP

Fig. 8-19—K7NUP's beam rotator.

FIELD-DAY ANTENNA MAST

Since not all Field-Day sites come equipped with trees of adequate height and spacing for antenna supports, here is a design for a lightweight, portable and easy-to-erect 40-foot antenna mast. The drawing in Fig. 8-20 gives most of the details. The carefully selected lumber should be free from knots and as straight as possible. The mast sections should be painted and then marked at the joints for identification when assembling. Guy wires are looped around the mast so that they can be removed easily and coiled for reuse. A four- or five-foot length of rope at the end of each guy wire facilitates fastening and adjustment.

The mast sections should be bolted together and guys attached before erection is started. When raising the mast, two helpers on the side guys should steady the pole while another holds the back guy. When the mast is in position, the stakes should be placed at equal angles about twelve feet away from the base.

Two masts, when disassembled, can easily be carried on top of a car since they weigh less than thirty pounds apiece.

—*L. A. Cundall, W2QY*

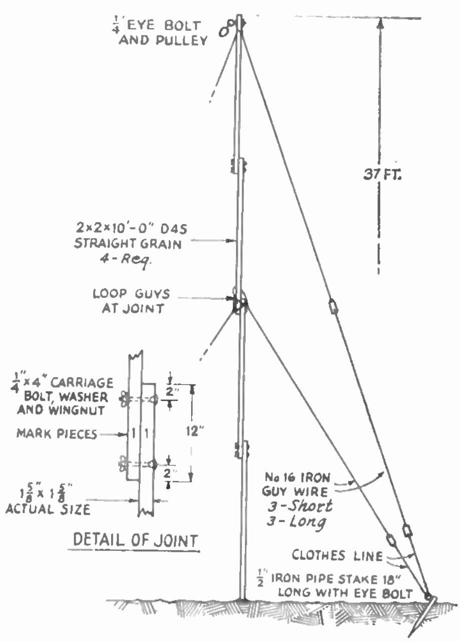


Fig. 8-20—Details of the Field-Day mast.

TEN-METER VERTICAL

The antenna shown in Fig. 8-21 is a very efficient, yet inexpensive and simple, omnidirectional antenna. The antenna is made of 1¼-inch aluminum TV masts, 8 feet, 2½ inches long. These masts are obtainable at local electronic-supply stores in 10-foot sections for under two dollars each. The two elements are separated ⅝ inch from each other by a center insulator made of nylon, polystyrene, bakelite, or even wood that has been boiled in paraffin. This center insulator should make a tight fit inside the masts. If necessary, put some slits on the ends of the masts, insert the insulator, and then clamp the section around the insulator.

The antenna is center fed by passing RG-59/U coax up through the inside of the lower section of the mast and out through a hole drilled in the center insulator. The outside shield of the coax is connected to the lower mast and the coax inner conductor is connected to the upper mast section. A 1½-inch brass bolt through each section of the mast serves the double purpose of providing a tie point for the coax and holding the mast firmly to the insulator.

The bottom of the mast is supported by a glass or plastic bottle. It will be necessary to drill a hole in the side of the bottle so that the coax can be fed through. A hole in the bottom of the bottle is also recommended to avoid any accumulation of water. It would also be advisable to cover the top of the mast with a small glass, plastic jar or cap, to keep water out of the mast.

For best results, the antenna should be mounted as much as possible in the open. The mast may be guyed, using nylon or plastic guy wire, or mounted directly to a chimney with an insulated chimney mount.

—*James P. Gillespie, W4LQC/W8BKK*

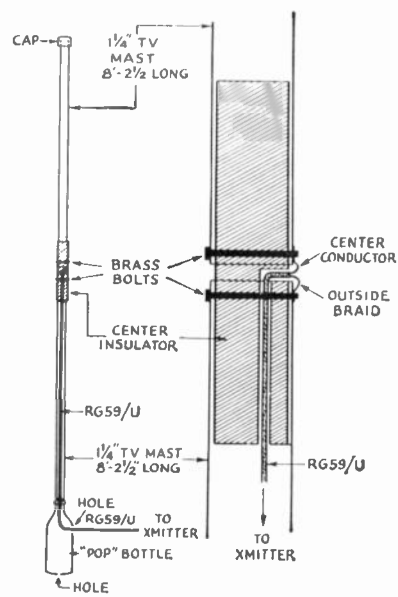


Fig. 8-21—This ten-meter vertical dipole is made from two aluminum TV masts.

SPARK-PLUG LIGHTNING ARRESTOR

A lightning arrester for open-wire feedline can be constructed by soldering two automotive spark plugs together. The bases of each of the plugs should be cleaned prior to soldering. Soldering is done with a torch since an iron probably wouldn't have the capacity to do the job. Once the plugs are connected, a length of No. 8 or 10 copper wire is soldered to the joint between them. Connect the lead-in to the electrode connector at the top of each plug. Ground the copper lead, gap the plugs for minimum space without shorting, and your lightning arrester is completed.

—Charley Lugar, W9CGJ

WINDOW FEEDTHROUGH

The problem of bringing transmission lines into the shack can be a sticky one, especially if one does not wish to drill window frames or walls, or to replace the panes of glass with plastic sheets.

My method is to make a sandwich out of any one of the foam materials used by upholsterers, and to bring the antenna feeders into the shack between two sheets of foam which have been cut to sufficient width, about an inch or so wider than the window opening. The other dimension should be great enough to provide a closure base for the window and screen or storm window. I have found this method to provide excellent weather protection if the windows are closed firmly and held down with a wedge or tack against the window frame.

—A. W. Smith, K3ZMS

DIPOLE CENTER INSULATOR

A plastic "barrier strip" makes an excellent center insulator for dipole antennas. The screw terminals are used for making electrical connection between the antenna and feed line and any extra screw terminals can be used for mounting coils, matching networks, etc. The antenna wires are connected to the holes at the end of the strip (these are the holes that are normally used for chassis mounting) to take the strain off the electrical connections at the screw terminals.

After everything is connected, the whole assembly should be dipped in varnish or sprayed with clear plastic spray. Also, it is a good idea to plug the open end of the coax feed line to keep water from running down between the shield and the center conductor.

—Joel Rose, W3AFY

SPLICING 300-OHM LINE

Tubular 300-ohm transmission line can best be spliced by using the method illustrated in Fig. 8-22. The joint so produced is both electrically and mechanically strong and does not adversely affect the r.f. qualities of the line. Measurements made at 100 Mc. on a line so spliced show negligible loss or line discontinuity.

To make the splice, first expose approximately one inch of each conductor by cutting away the insulation. Make a clean cut at right angles to the cable when removing the sections of

insert a three-inch length of ¼-inch o.d. insulating rod about half way into one of the cables. Now slide the second piece of cable over the other end of the rod until it butts against the first cable. Twist the conductors together as required and apply solder. The joints may now be clipped down to a length of ½ inch or so and then bent over and laid flush against the long sides of the line. A layer or two of good tape covered with a coating of varnish or plastic spray will protect the joint against weather.

Polystyrene rod is the best material for the plug, which provides mechanical strength for the splice. Of course, since the amount of solid dielectric is physically small, it will do no great harm to use bakelite rod in place of the polystyrene material.

—Henry Smith, W5DAI

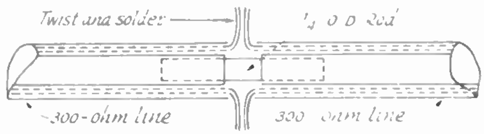


Fig. 8-22—W5DAI suggests this method of splicing tubular 300-ohm transmission line.

TWO-WIRE REVERSIBLE MOTOR

The circuit in Fig. 8-23 is used in my station to operate an electric windshield wiper motor which controls a loading coil in my attic. The system probably has greater possibilities in mobile applications for remote antenna resonating and matching.

A look at the circuit in Fig. 8-23 will show how the motor, B_1, is reversible even though only two control leads are used. A full-wave bridge-rectifier circuit using inexpensive semiconductor diodes, CR_1 through CR_4, keeps the flow of current in the field coil of the motor in the same direction regardless of the polarity reversal of the power supply. Since the reversing switch, S_1, can change the polarity of the current in the armature, the motor can be reversed depending upon the position of the d.p.d.t. switch.

The limit switches, LS_1 and LS_2, are added to stop the motor when the roller on the loading coil reaches the coil ends. A zero-center ammeter in the circuit will show when the motor is running and also its direction of rotation.

—George R. Cogswell, Jr., K2VRS/2

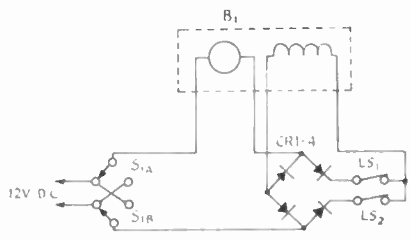


Fig. 8-23—K2VRS's reversible motor needs only two control leads.

LIGHTNING PROTECTION FOR VERTICALS

The sketch in Fig. 8-24 shows a vertical antenna mounted above and in line with a ground pipe, thus giving spark-gap protection during electrical storms. The top vertical portion of the antenna is supported by stand-off brackets and held to these brackets by U-bolts. A piece of rubber hose or other insulating material is placed around the antenna where the brackets and U-bolts connect.

The spark gap should be set as close as possible, but not so close that it will break down with voltages encountered from the transmitter.

—Luke McCloud, K2DDM

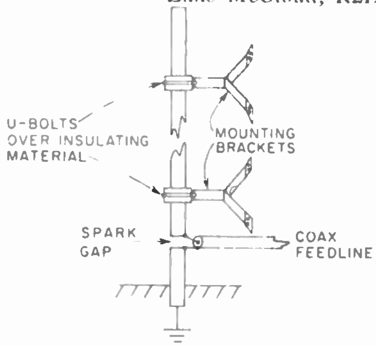


Fig. 8-24—Sketch showing the vertical antenna with lightning protection.

THREE-BAND ROTARY ANTENNA

The sketch in Fig. 8-25 shows a three-band antenna for use on 10, 15, and 20 meters. On 15 and 20 the antenna operates primarily as a dipole, but on 10 the outboard element acts as a director. The antenna is fed with 300-ohm or 70-ohm feed line. If possible, the feed line should be 38 feet 5 inches, 60 feet 4 inches, or 77 feet 5 inches long for optimum performance. The elements can be made of dural, aluminum or steel tubing and are insulated from the supporting structure with stand-off insulators. The boom and element supporters can be made of wood or aluminum.

—Jose Luiz S. V. Marinar, PY2BBP

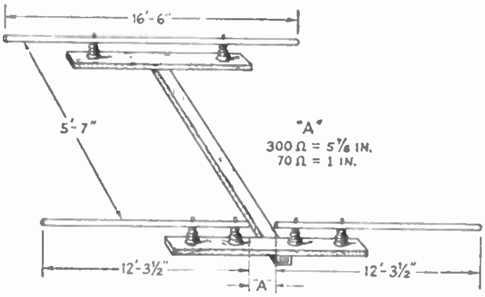


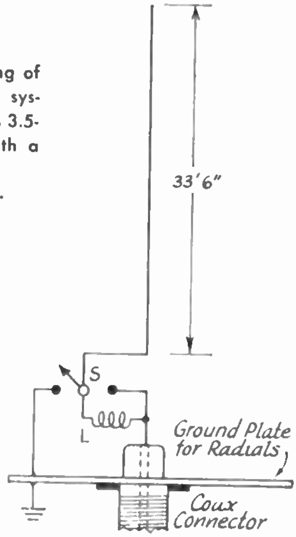
Fig. 8-25—PY2BBP's three band antenna.

THREE-BAND OPERATION WITH A 7-MC. GROUND-PLANE ANTENNA

Because of the growing popularity of the quarter-wave vertical, especially on 7 Mc., it may interest some of the gang to learn that this antenna can be made to do a fair job at 3.5 and 21 Mc. also. The method used to obtain 3-band operation here at W3NWA is shown in Fig. 8-25.

In the diagram, *L* is a loading coil used when the antenna is operated at 3.5 Mc. When the s.p.d.t. switch, *S*, is in the neutral position, it connects *L* in series with the radiator and the RG-8/U transmission line. In one of the closed positions the switch shorts the coil, permitting normal 7-Mc. operation of the system. The antenna will also take power at 21 Mc. when the loading coil is shorted out. In the third position, the switch connects the vertical to the grounded radial support to provide lightning protection.

Fig. 8-25—Drawing of the base-loading system which permits 3.5-Mc. operation with a 7-Mc. ground-plane antenna.



In the original installation, the Premax whip was adjusted to favor operation at the low end of the 7-Mc. band. The loading coil used to resonate the system at 3550 kc. consists of 22 turns, No. 12 enameled, 2½-inch diameter, 4 inches long. The coil was cut from a 10-inch length of commercial stock which had been temporarily installed intact and then tapped experimentally during the initial stages of testing. A grid-dip meter may be used to help resonate the coil, provided the feed point (the coaxial connector shown in Fig. 8-25) is connected to the grounded radial support.

A liberal application of Duco cement along the existing support bars for the air-wound coil will provide added strength to the assembly. One coil so treated has been exposed to the weather for an entire winter with no apparent ill effects.

In actual operation at 3.5 Mc., good reports have been received from all over the eastern part of the U. S. A., using 100 watts on c.w. Reports are consistently better than formerly received while using a random-length horizontal wire, probably due in part to the low-angle radiation from the vertical. The s.w.r., while not as low as on 7 Mc. (using the same RG-8/U feeder), is not high enough to cause trouble, provided operation is limited to a 100-kc. band centered on the frequency for which the loading coil has been resonated.

—R. E. Young, W3NWA

STACKED HALOS FOR OMNI-DIRECTIONAL COVERAGE

With the increased activity of emergency net operation on the v.h.f. bands, it has become quite evident that some type of omnidirectional antenna must be utilized in order to provide good signal coverage over a wide area. To solve the problem at my location, I have stacked two 6-meter halos ⅝ of a wavelength (12 feet for 50 Mc., 4 feet for 144 Mc.) and attached them to the side of my guyed tower that also supports a 5-element 6-meter beam (see photograph). Each halo was tuned after being mounted on the tower with the aid of an s.w.r. bridge. The feedline arrangement for stacking two halos is shown in Fig. 8-27(A). The 72-ohm feed line (RG-11/U) from each halo is parallel-connected at a coaxial "T" connector. This results in a feed impedance at the connector of about 36 ohms. A quarter-wave transformer (Q-section) made from a ¼ wavelength of 52-ohm coax (RG-8/U) (37 inches for 50 Mc., 12 inches for 144 Mc.) transforms the 36 ohms back to 72 ohms. A 72-ohm feed line (RG-11/U) of any length is attached here and goes to the transmitter. Of course, proximity of the tower and other factors tend to upset the balance and match of the system. But in my case, the s.w.r. was about 1.3:1 at resonance. Since

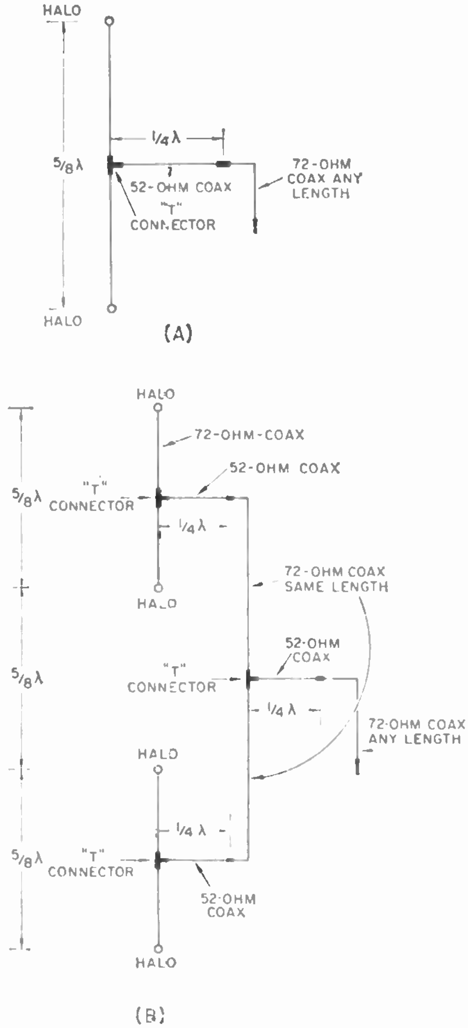


Fig. 8-27—Transmission-line hookup for stacking two (A) or four (B) halo antennas.

the halo is a relatively high-Q device, its bandwidth is rather narrow. Deviations of more than 150 kc. from resonance will cause the s.w.r. to rise above 2.5:1. If this antenna is intended to be used in net operations, however, this is not a major drawback as these operations are usually centered around a single frequency.

I use two commercially-manufactured halos that were intended for mobile applications and are not designed for super high power. For operation in the half-kilowatt or above range, the halo capacitors should be replaced with ones of larger voltage ratings and the plastic insulators replaced with porcelain ones.

More halos can be stacked as shown in Fig. 8-27(B). It is easier to stack the halos in pairs.

The above antenna is by no means the ultimate in a radiating system for DX work, but for omnidirectional coverage it does the job.

—Jack Layton, K2JKA

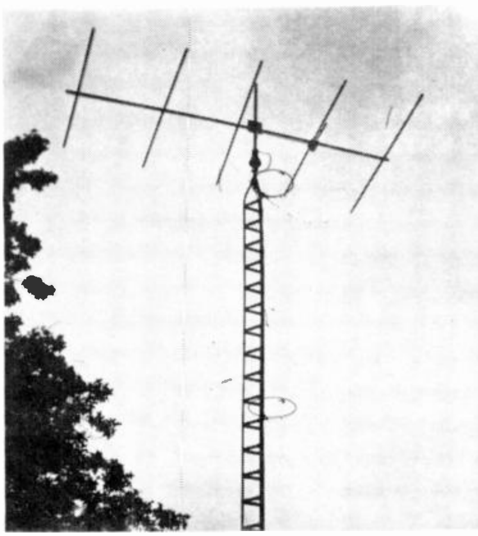


Fig. 8-26—K2JKA's stacked halos.

Hinks and Kinks . . .

for the Mobile/Portable

BONUS 24-VOLT POWER SUPPLY

There are still plenty of 24-28 volt relays available on the surplus market. However, there is a problem when it comes to using these relays in the 12-volt mobile station. I found that a simple addition to the 12-volt transistor power supply will give 24 volts d.c. without any additional transformer windings. Fig. 9-1 shows the primary circuit of a typical transistor power-supply transformer with the added parts, CR_1, CR_2 and C_1, which gives twice the battery voltage, E_b.

The rectifiers are chosen with sufficient current ratings to handle whatever load is desired. Of course, the total load on all outputs of the supply shouldn't be allowed to exceed the rated power of the transformer.

An additional feature is that the circuit gives some spike-limiting protection for the power-supply transistors because of the clipping action of the diodes and capacitor.

—*Ben Vester, W3TLN*

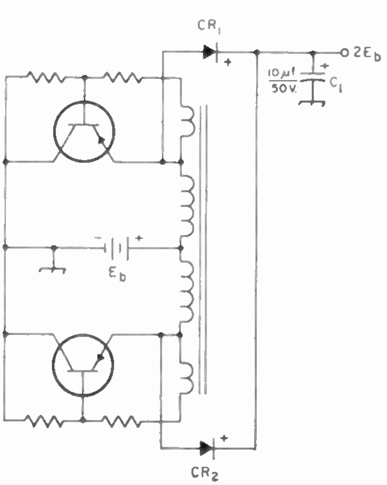


Fig. 9-1—This circuit will provide 24 volts d.c. when used in a 12-volt system.

FORMED PLASTIC WASHERS FOR MOUNTING MOBILE ANTENNAS

It is sometimes desirable to mount a mobile antenna on the fender or rear deck of a car where the body is not flat. Each such installation presents a problem of obtaining specially shaped washers to go between the car body and the antenna mounting surfaces which are always flat. The following method will provide a close-fitting and professional-looking job.

Two thermoplastic (Plexiglas or Lucite) washers about a quarter inch thick and the same diameter as the antenna base are first roughed out with a hack or jig saw. They must then be trued-up in a lathe so that the outside rim and the hole are round and concentric. The plastic washers are then placed in a pan of boiling water for a few minutes until they are soft enough to bend. One of the washers is then fished out of the water and immediately placed on the exact spot where the antenna is to be mounted and bent to fit the curvature of the car body at that point. The plastic ring can be handled either by wearing gloves or simply holding it with a dry rag. In a few minutes the washer will cool and set to the shape of the car body. If the underside is the same shape as the top surface, both washers may be shaped from the outside, which is easier.

The washers are then centered in a three- or four-jaw lathe chuck. They are easily centered by trial and error as extreme accuracy is not required here. The convex face of one washer is then turned flat and the concave face of the other one is made flat.

These two washers will now fit against the car body, one inside and one outside, with both external surfaces flat and parallel. The antenna can be mounted on them with a neat fit that would be very difficult to obtain any other way.

—*C. A. Thunen, W6ACT*

WINDSHIELD-WIPER MOTOR FOR TUNING WHIP LOADING COILS

An electric windshield-wiper motor, mounted adjacent to the base of a mobile whip, provides a convenient and inexpensive means of tuning a roller-type base loading coil. It is very easy to arrange for reverse rotation of the motor because the field winding is brought out to a switch. Wiper motors can usually be obtained from an auto junk yard for a dollar or two.

—*Johnny Johnson, W2ZYX*

MOBILE HINT: PRUNING LOADING COILS

A number of laborious mount-the-coil and dismount-the-coil operations associated with pruning a set of mobile antenna loading coils may be eliminated by using the following procedure.

After the first coil has been resonated with the aid of a grid-dip meter, carefully observe the setting of the meter and then remove the coil from the antenna. Next, connect the coil in parallel with a 50-pf. variable capacitor and, by tuning the latter, adjust the circuit to resonance at the exact frequency measured when the coil was mounted in the whip. The value of capacitance so arrived at is not of major importance, but it is equivalent to that effectively imposed across the coil by the antenna. Therefore, this external or test capacitance may be used to simulate antenna capacitance when other loading coils are being trimmed for resonance. In other words, coil adjustments may be made *on the bench* without involving repeated mounting tasks. The following precautions should be observed when using the system.

Couple the meter through a single-turn loop to the base of the antenna when grid-dipping a mounted coil. Couple the meter as loosely as possible when measuring an unmounted coil shunted with the test capacitor. Do not depend on meter dial calibration in either case because the oscillator frequency will probably pull some during measurements. G.d.o. frequency may be accurately checked by listening to the signal with a receiver of established calibration.

Hand-capacitance effects should be minimized while bench-testing an *LC* circuit by using a reasonably long insulated control shaft or tuning tool. A plastic housing over the capacitor will prevent accidental detuning after initial adjustment. Short leads between capacitor and coil are desirable and, of course, the *LC* circuit should rest on an insulated surface—not a metal work bench—while being adjusted.

—Art Fenster, W2EXH

MODIFYING COMMAND TRANSMITTER RELAYS FOR 6-VOLT OPERATION

WHEN modifying Command transmitters, many hams discarded the seemingly useless antenna relay—the one with two coils and no standard contacts. Fortunately, I saved mine and have since found a good use for the units.

The keying relay for the transmitter is ideally suited for mobile gear because of its compact size and pair of s.p.s.t. contacts, but it won't operate on 6 volts. However, the 300-ohm coil for this relay can be easily replaced with one of the 90-ohm coils from the antenna relay. To complete the transfer, it is necessary to reduce slightly the length of the core for the 90-ohm winding, and this job can be quickly done with a hack saw and file. Removal and relocation of the coils is a simple task because each is held in place with a single flat-head screw.

The modified relay really works on 6 volts and draws only 70 ma. or so from the battery. And, the compactness involved is enough to catch the eyes of any mobile fan.

—K. M. Isbell, W6BOQ

TRANSISTOR AUTOMOBILE REGULATOR

THE circuit in Fig 9-2 was developed to reduce regulator noise in my mobile radio station. Although my regulator is a German Bosch for my Mercedes 190D,[1] the circuit can probably be adapted for use in standard American regulators. The 2N677 transistor switches the heavy current, a job formerly done by the relay contacts in the regulator. Now the relays switch only a few milliamperes which control the base circuit of the transistor. The heavy lines in Fig. 9-2 shows connections already built into the original regulator. The connections to the cutout relay and the voltage and current relays are not disturbed. The transistor can be mounted on the regulator cover, which acts as the transistor's heat sink. Capacitors and resistors are mounted inside the regulator case. A new *F* terminal is necessary for this modification, as the original **F** (field) connection on the regulator is not used.

The 2N677 transistor can probably be replaced with a less expensive unit but the circuit shown does accomplish its objective of eliminating regulator noise. The regulation provided by the modified unit is as good as the original system, as indicated by the dashboard voltmeter and ammeter. The diagram in Fig. 9-2 is for negative ground systems only.

—Erwin Aymar, W4HS

[1] W4HS has found one way to cure ignition noise; the 190D is diesel powered!—*Ed.*

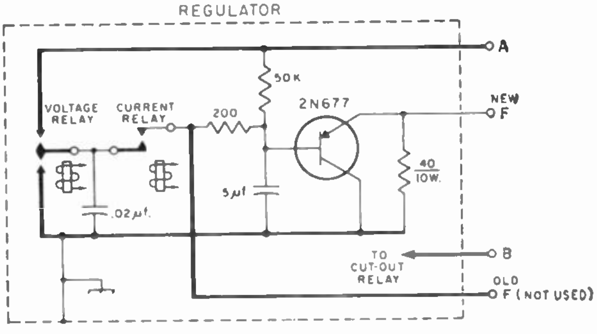


Fig. 9-2—Transistorized regulator reduces regulator noise.

12-VOLT POWER IN A 6-VOLT CAR

Most mobile equipment available today is designed for 12-volt operation. Since I drive a Volkswagen, which has a 6-volt power system, I came up with the following idea that enables me to use a 12-volt-powered s.s.b. transceiver, shown in Fig. 9-3.

I mounted a 12-volt battery under the left rear seat of the car and enclosed it in a plastic battery box, such as is sold for marine applications. (See Fig. 9-4) A battery trickle charger is attached at night, and an overnight charge twice a week gives me about an hour or so of operating time each day on the way to and from work.

Since the battery is entirely independent from the car's electrical system, electrical interference is kept at a minimum.

—John B. Johnston, K3BNS

Fig. 9-3—The Heath HW-22 s.s.b. transceiver is powered by an HP-13 transistor power supply.

Fig. 9-4—The auxiliary 12-volt battery is mounted under the left rear seat in a plastic battery box.

CAR-BATTERY REMINDERS

Always keep battery terminals clean and tight, because corrosion reduces the charging current supplied to the battery by the charging system.

Periodically check system voltage with a voltmeter to make sure the generator is developing sufficient voltage. Look for excessive voltage drops caused by loose or high-resistance cable.

Check specific gravity with a hydrometer once a month and recharge the battery if necessary. Add distilled water to the battery as required.

Measure the charging voltage after the regulator has come up to operating temperature. Too high a setting of the voltage regulator is damaging to the radio, light bulbs, ignition contacts and transistor power supplies. Too low a setting will allow the battery to become discharged. Consult your garage for the proper charging voltage.

—W1TS

PLASTIC SHIELD PROTECTS MICROPHONES FROM WIND NOISE

An idea recently published in a *NASA Tech Brief*[1] should be of interest to radio amateurs for their possible use in mobile, portable or Field-Day applications. The idea is to protect microphones from wind noise by the use of a shield fabricated from foamed polystyrene, as shown in the sketch in Fig. 9-5. The shield, made in the shape of a teardrop, consists of two longitudinal sections which are easily slipped on or removed from the microphone. Foamed polystyrene is used as the material for the shield because of its extremely low specific acoustical impedance, low density, and good rigidity.

Tests with the shield showed wind-noise attentuation ranged from 19 db. in a 4-m.p.h. wind to 14 db. in a 20-m.p.h. wind. The attenuation of sound waves ranged from 1 db. at 300 cycles to 12 db. at 9 kc. For further information about this idea, inquiries may be directed to Technology Utilization Officer, Marshall Space Flight Center, Huntsville, Alabama 35812, Refence: B63-10579.

[1] The *NASA Tech Brief* is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the NASA space program.

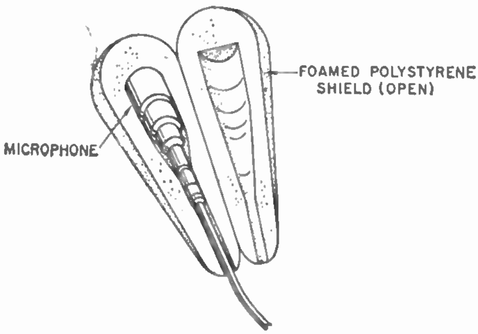


Fig. 9-5—A foamed polystyrene shield protects microphones from wind noise.

BETTER DIAL ILLUMINATION FOR THE SUPER-12

THOSE who use the Gonset Super-12 mobile converter know that the dial illumination is marginal. A substantial increase in illumination of the dial can be obtained by gluing a small piece of white card behind the lamp to act as a reflector. Also, attach white cards on the inside of the cabinet, both on the top and front surfaces above the glass dial window.

—Richard Shongut, W2QFR

SIMPLE INTERFERENCE CURE

I HAD all sorts of radio interference in my mobile receiver. After trying the standard methods for curing the interference, I wrote the car manufacturer, the receiver manufacturer and even the ARRL for help. Nothing they suggested helped. Finally, after much experimentation, I found the answer. The car's ammeter leads were dressed near the receiver, and by simply moving them a few inches away I completely eliminated the interference. I suggest that all those who install ammeters in their cars try to keep the leads away from the mobile receiver, antenna lead, etc.

—Richard Shongut, W2QFR

ENGINE IDLING TIP FOR MOBILE OPERATORS

MOBILE operation while "standing still" usually necessitates an increase in the engine's idling speed in order to keep the car's charging system in operation. Doing this by holding the accelerator pedal with one's foot is tiring after a while or setting the carburetor idling control for high idle r.p.m. causes cars with automatic transmissions to "creep".

Since the carburetor jets on most cars are adjusted for optimum fuel-air mixture at higher than idle speeds, the mixture is usually too rich for efficient idling. If your car has vacuum windshield wipers, simply detach one end of the vacuum hose that runs to the windshield wiper motor. This leans the mixture and results in an increase in engine idling speed without using additional fuel. If this type of mobile operation is commonplace, install a "Tee" fitting in the vacuum line, and connect the third leg to a control valve of some sort. If your car doesn't have vacuum operated windshield wipers, there is usually a vacuum line running to the distributor.

—Paul R. Buckwalter, WA2EHD

12 VOLTS FROM 6-VOLT AUTOMOBILE SYSTEM

THE circuit in Fig. 9-6 depicts a reliable method for obtaining 12 volts d.c. from a car that has a 6-volt system. The second battery should be of equal ampere-hour capacity and in about the same electrical condition as the original car battery. Domestic house-entrance service wire of number 2 size will suffice for the leads, and a high-ampere toggle switch, such as the Cutler Hammer No. 8905K662 (35 amp., 15 volts) can be used for the charging switch, S_1. The switch should be mounted so that it can be conveniently manipulated while in motion. For positive ground systems, reverse the polarity of the batteries. The reliability of this system is excellent, as I have used the scheme for about five years in my Volkswagen.

—Vic Ortegren, W6WFR

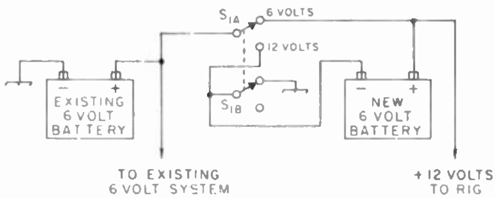


Fig. 9-6—Method for obtaining 12 volts from a 6-volt system. S_1 should have a high current capacity.

MOBILE BURGLAR ALARM

TO protect my mobile equipment from theft, I mounted a normally closed push-button switch behind the equipment. When the equipment is installed the switch is open and is connected in parallel with the car horn button, so that if the equipment is removed the spring return push-button will complete the horn circuit and discourage the thief from any further tampering!

—Lynn Kuluva, KØIMI

BLACK-MAGIC INTERFERENCE REDUCER

I WAS having a great deal of trouble using my mobile station because of a tremendous amount of ignition noise from my car. After trying several cures, I accidentally found that the noise was almost completely eliminated by connecting a lead from the bumper to the chrome ring that surrounds the driver's side tail light. There is, of course, nothing mysterious about this scheme. It is mentioned here to point out how one must try almost everything when it comes to eliminating mobile interference. Grounding pieces of metal that could be acting as antennas is only one method. Other things that can be tried during a noise-reduction session are: grounding the exhaust pipe at both ends and even at several spots along its length; grounding the engine hood to the body at several spots; and grounding the engine block to the body at several spots. Conventional methods of noise suppression using suppressor resistors and coaxial feedthrough capacitors should also be used, along with bonding and grounding operations.

—J. C. Michaud, K2UBE

FAST MOBILE BAND CHANGING

Is your mobile antenna one of those with the center load coil that has to be changed whenever you change bands? If so, you can save yourself some time, trouble, and expense by having just one standard coil in the center, cut for the highest 80-meter frequency you want to use. To hit the other bands, you merely clip parallel inductances to this coil. W3NF and I worked this out last summer and found it works fine. Although any kind of form will do, we used old Master Mobile coil forms which are about an inch in diameter and kept cutting and trying until we found a point at which the two coils in parallel provided the necessary inductance to load the transmitter on the other bands. We secured the wire on each coil form by giving it a heavy coat of dope or varnish and fastened battery clips to the wire ends so it could be clipped to the main coil.

The loading doesn't change much over the entire band on 40 and 20 meters. On 80 meters, it is necessary to use capacity loading atop the coil to load at frequencies lower than that for which the coil is cut. We found that a good way to do this is to use strips of metal strap held with clips and fastened to the top of the coil. Quite a lot of loading may be required at the low frequency end of 80 meters and it may be necessary to use two straps—otherwise you'll have a mighty long piece of strap flapping around!

—W1NJM

MOBILE BIAS SUPPLY

Figure 9-7 shows the circuit of an inexpensive regulated mobile bias power supply that can be constructed in just a few hours. The transformer, T_1, is a common 6.3-volt center-tapped filament transformer. For 12-volt operation, a 12.6-volt filament transformer can be substituted. The 1000-ohm resistor in series with the base is to limit the peak current applied to the base. Output from the rectifier, CR_1, is about 80 volts negative, which is dropped through the 50,000-ohm resistor to provide a constant current source for the zener diode regulator. The zener diode, CR_2, regulates the voltage and gives the desired bias value. The author has been using this supply now for almost a year without any breakdown or malfunctioning.

—Burton C. Winkler, Jr., W1ZHY/2

MOUNTING MOBILE EQUIPMENT

A convenient place to mount mobile equipment is below the instrument panel, as shown in Fig. 9-8. The mount is constructed from aluminum angle stock and a piano hinge, both of which should be available from the do-it-yourself counter at most hardware stores. This scheme makes a rigid mount, yet equipment may be removed easily by pulling out the pin in the piano hinge.

—Robert T. Paige, W5TBC

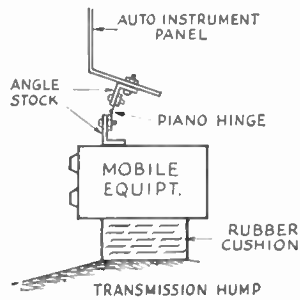


Fig. 9-8—W5TBC's mobile mount.

EMERGENCY POWER—CHEAP

There is a fine fire-tower location not far from the summer place of K1GBC in Tolland, Mass., and Pete wanted some means of running low-powered v.h.f. gear up there without the risk of a dead car battery. Portable a.c. generators cost money, so he looked around for a ham approach to the problem.

The solution was suggested by a Heathkit MP-10 Power Converter that had been used to power the K1GBC Communicator in mobile work for some time. Why not run this off the output of a car generator, instead of from a 12-volt battery? A 1955 Chevrolet generator was located in a junk yard, and this was hooked up to a 1-horsepower gas engine from a discarded power mower. This combination delivers around 200 watts a.c., more than enough for the purpose Pete had in mind. The total weight of all three units is less than the smallest commercially-available gas-engine generators—and the total cost was a fraction of the going price for portable generators.

—W1HDQ

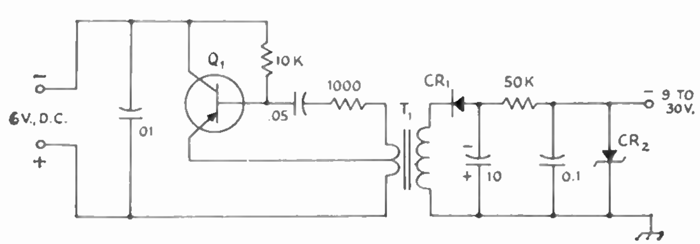


Fig. 9-7—Circuit of the regulated mobile bias supply. All capacitances are in µf. All resistors ½ watt.

CR_1—Silicon rectifier (Starkes Tarzian M150).
CR_2—¾-watt zener diode. [Motorola ¾M6.8Z (6.8 volts); ¾M10Z (10 volts); ¾M15Z (15 volts); ¾M20Z (20 volts); ¾M25Z (25 volts); ¾M30Z (30 volts).]
Q_1—2N307 or equivalent.
T_1—6.3-volt c.t. filament transformer.

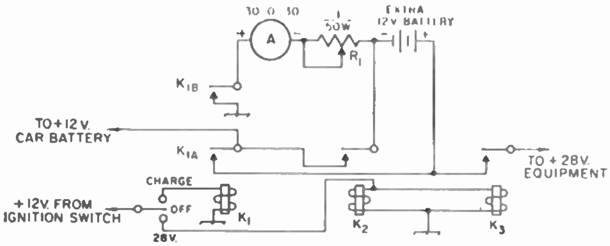


Fig. 9-9—W8MNX's circuit for 28-volt mobile operation.
K_1—D.p.s.t. 12-volt relay, 15-amp contacts (Advance PG/2X/12VD).
K_2, K_3—Dynamotor starter relays, 12-volt coil (Advance ES/1A/12VD).
R_1—1-ohm, 50-watt rheostat.

28 VOLTS FOR MOBILES

A lot of war-surplus equipment applicable for mobile use is available, but this equipment usually requires 28 volts d.c. for operation. There have been many systems described in the past for obtaining 28 volts for use in automobiles, but none of them satisfied me.

The circuit in Fig. 9-9 uses two readily available and inexpensive dynamotor starters, a 10-amp. relay and an extra 12-volt battery. Features of the circuit are: the auxiliary battery may be switched completely out of the circuit; there is no danger of shorting the battery through relay sequence or stuck relay contacts; charging the extra battery is selective and the charging rate is adjustable and monitored; the 28-volt equipment cannot be operated unless the ignition switch is turned on.

The purpose of the 1-ohm rheostat is to limit the current from the auxiliary battery in the charging condition. If a heavy load is applied to the car battery, the rheostat will limit the current from the extra battery to a level that will not harm the low current contacts on K_1.

The dynamotor starting relays are also war surplus, although others are available new, but at a much higher price. I have used this circuit now for over eight months with satisfactory results.

—*John G. Gilliam, W8MNX*

PUSH-TO-TALK CONTROL OF MOBILE CHARGING RATE

Many of the newer automobiles with automatic transmissions have, coupled to the shift lever, a pair of contacts which prevent operation of the starter solenoid whenever the transmission is in the "drive," "low," or "reverse" condition, but which close when the shift lever is placed in the "park" or "neutral" position. It is convenient to wire a d.c.-operated solenoid through this safety contact and the transmitter push-to-talk relay contacts, with the solenoid arranged to open the throttle lever on the carburator slightly when energized. When parked, this has the effect of allowing the engine to idle normally during the receive condition, and increasing engine speed for charging purposes by any desired amount while the transmitter is on the air, offering an improvement in the automotive system voltage regulation and reducing noise (both electrical and acoustic) over that which would exist if the engine were operated with an open throttle during both transmitting *and* receiving periods. When the car is in motion, the safety contacts on the shift lever disable this control system to prevent interference with the driver's control of engine speed.

—*Richard A. Schomburg, W7WUM*

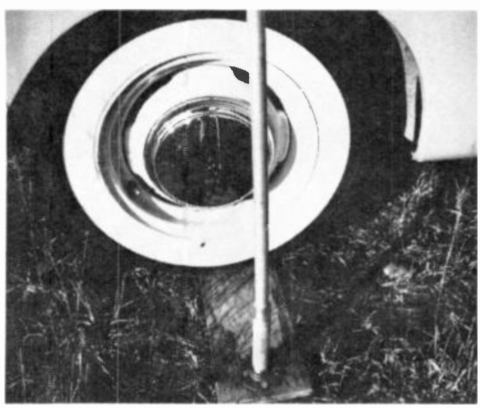
FARM CATALOG ITEMS

The Farm Catalogs of Sears Roebuck and Montgomery Ward offer many items of interest to the amateur. In addition to the electric fence wire (see Hints & Kinks, *QST*, January, 1960) the catalogs list a variety of gasoline-engine-driven 117-volt a.c. generators. Another item of interest to the mobile ham is a 117-volt generator driven from the engine fan belt and designed for use in cars and trucks. Then there is the aluminum irrigation pipe for antenna masts and booms.

—*T. James Barnes, K9TFJ*

PORTABLE MAST HOLDER

The accompanying photograph shows the arrangement used by K1CCL for supporting an antenna mast on portable location. A pipe flange is attached to the piece of plywood. A short length of pipe which will mate with the threads of the flange is also necessary. To use the mast holder, place the board on the ground and drive the car up on it so that one of the wheels is on top of the board. Screw the pipe into the flange and insert the mast in the pipe. The entire assembly can be carried in the trunk if the mast is made up of attachable sections. This scheme will work with most v.h.f. antennas and probably would also take care of a lightweight low-frequency beam.



MOBILE MOUNT

The accompanying sketch and photograph show my mobile mount; it does not require drilling holes or making modifications in the car. Although this mount was designed for the KWM-2 and the P & H Spitfire, the idea can be used to build one to fit almost any of the popular transceivers. The frame is of 1¼-inch aluminum angle, which can be the Reynolds do-it-yourself type available at most hardware stores, and can be put together with nuts and bolts or taken to a welder for a more permanent job. The "three-leg-suspension" is the secret of the mount's stability and is designed to stradle the car's transmission hump. Due to its low center of gravity, the mount and equipment will stay put even when you're making "tight turns" in the car. Three rubber crutch tips placed over the mount's legs will help protect the car mat and give additional stability.

—Henry Kampe, W9OKM

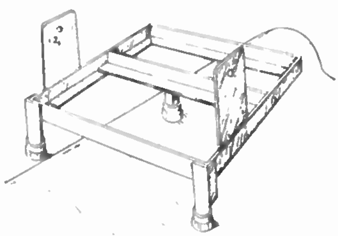


Fig. 9-10—W9KCM's mobile mount does not require drilling holes in the car.

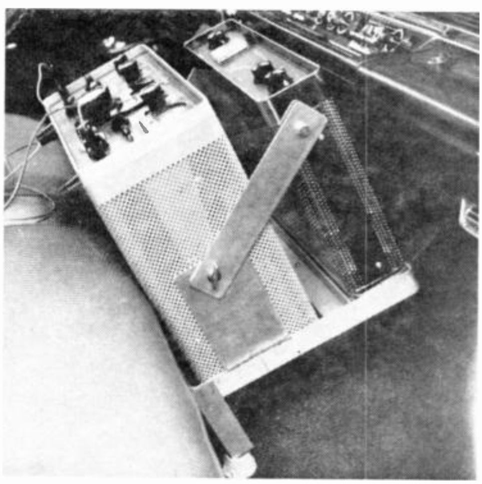


Fig. 9-11—The mobile mount straddles the car's transmission hump.

EMERGENCY SOLDER

Before setting out on Field Day or a long trip in the mobile station, prepare a few pieces of emergency solder. Melt some solder on a soldering iron and then flick the iron to throw the solder off. Catch the melted solder on a flat surface, such as a sheet of aluminum, and then peel it off. The resulting solder is extremely thin and will easily flow under the flame of a match. To solder a joint in an emergency where no iron is available, apply flux, wrap the thin solder around the joint and then heat with a match or lighter. The result is a good electrical connection made without benefit of a soldering iron.

—Bill Phillips, K8EJL

PROTECTING MOBILE RELAYS

Old voltage regulator boxes make excellent relay enclosures for mobile applications. The boxes are weather-tight, are easy to mount, and usually have a hole or two in the bottom for bringing leads in or out of the box. Discarded voltage regulators can probably be obtained at local garages.

—Rathbun B. Griffin, W1VON

TRANSISTOR SQUELCH CIRCUIT

I built the transistor communications receiver described by Priebe,[1] installed it in my car as a mobile receiver, and used it to monitor the local mobile radio club frequency. For convenience, I decided to add a squelch to the circuit.

The squelch circuit, shown in Fig. 9-12, is quite simple, yet effective. Basically, it is a d.c. amplifier which supplies the current to the a.f. driver section of the receiver. When transistor Q_1 is conducting (no signal), the voltage at its collector is practically zero, and the audio driver section of the receiver will be inoperative. However, when an incoming signal causes the a.v.c. voltage to drop, the resulting bias on Q_1 cuts off the transistor so that the collector voltage of Q_1 will rise up to the supply voltage, and the a.f. driver stages will become operative.

The squelch threshold point is controlled by the potentiometer R_1.

—Don C. Springer, KØPOX

[1] Priebe, "All-Transistor Communications Receiver," *QST*, February, 1959.

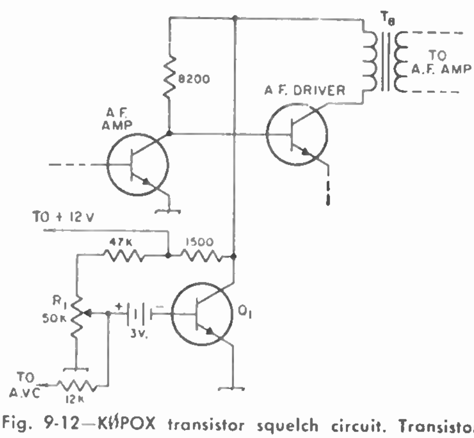


Fig. 9-12—KØPOX transistor squelch circuit. Transistor Q_1 is a 2N94 or equivalent.

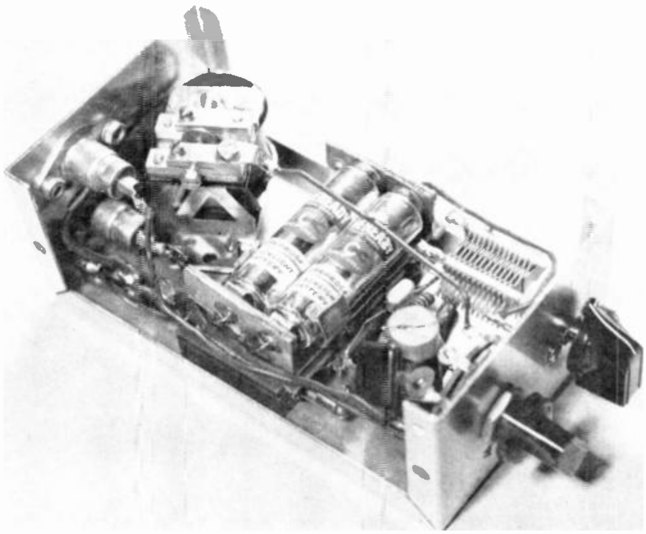


Fig. 9-13—WØOMN's mobile transistor converter.

MOBILE TRANSISTOR CONVERTER

The mobile converter shown in Fig. 9-13 is a modified version of the one that appeared in "Hints & Kinks," *QST*, June, 1959. One outstanding feature of this unit is its ability to tune 75 meters, 40 meters, the CHU, WWV and the 4507.5-kc. CAP frequency with just one 3200-kc. crystal! The various frequency relationships are as follows:

Frequency (kc.)	*Crystal Frequency* (kc.)	*B.C. Receiver Setting* (kc.)
3800–4000	3200	600–800
7200–7300	6400 (3200 × 2)	800–900
7335 (CHU)	6400	935
5000 (WWV)	6400	1400
4507.5 (CAP)	3200	1307.5

As shown in the second column, the second harmonic of the 3200-kc. crystal is used on 40 meters, CHU and the WWV frequency. With the values shown in Fig. 9-13, C_1 is almost at full capacity on 75 meters, with 40 meters coming near minimum capacity. The CHU frequency is just above the 40-meter setting. Capacitor C_2 is adjusted for optimum performance after the converter is connected to the b.c. set. Be sure to touch up the b.c. set antenna trimmer, too. The converter and its power supply are shown in the photograph and were constructed in a Bud CU-3006-A Minibox. All of the components, including the relay, are contained in the box. One note of caution: If this unit is used with a medium- or high-power transmitter, some sort of protection should be set up to prevent r.f. damage to the transistor. This could be accomplished by using a zener diode across the input circuit, or a spare set of contacts on K_1 to short the antenna terminals during transmit.

—C. F. Williams, WØOMN

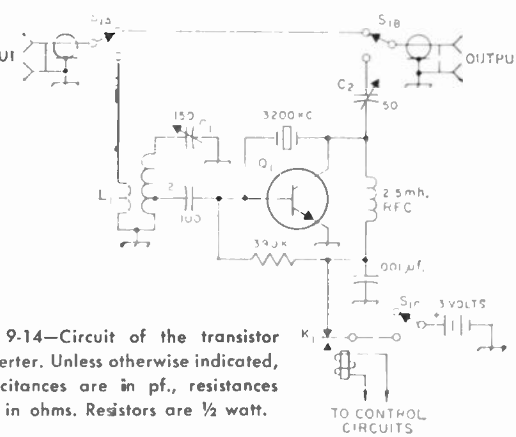


Fig. 9-14—Circuit of the transistor converter. Unless otherwise indicated, capacitances are in pf., resistances are in ohms. Resistors are ½ watt.

C_1—140-pf. variable capacitor (Hammarlund APC-140).
C_2—50-pf. trimmer capacitor.
K_1—S.p.d.t. relay.
L_1—25 turns No. 28 enam., ½-inch diam.
L_2—43 turns No. 28 enam., ½-inch diam., spaced 1/16 from L_1. Tap 6 turns from cold end.
Q_1—2N233 *n-p-n* transistor.
S_1—Three-pole two-position rotary switch (Centralab 2007).

UNUSUAL MOBILE LOG

An unusual and useful mobile log for long trips is a common road map. I keep my mobile contacts logged on a road map at the location where the contact was made. This properly locates our position, which is required by regulations, and often provides conversational material for the contact. The information is transferred from the map to the regular mobile log at the end of each day.

—Leonard M. Norman, W6JLY

IMPROVED PUSH-TO-TALK CIRCUIT FOR MOBILE OPERATION

Many mobile operators who parallel the receiver-disabling and antenna relays with the push-to-talk control experience trouble with momentary receiver overload each time the transmitter is turned off. This is caused by dynamotor "coasting" which keeps the transmitter energized for a brief period after the receiver has been activated. There is a somewhat simple solution that requires no *bleeding* of the dynamotor.

The control circuit used here at W3HXY has the antenna and receiver changeover relays connected in parallel with the *input* terminals of the dynamotor. After the push-to-talk control has removed input voltage from the dynamotor, the "coasting" action causes the generation of approximately 6 volts (12 volts with a 12-volt system) across the input terminals. By wiring the relays—antenna and receiver—directly across the input terminals, the relays remain energized until the dynamotor has coasted to nearly a full stop. Thus, the receiver does not come *alive* until after the transmitter signal has *died* away.

—Roy W. Shetter, W3HXY

INCREASING VIBRATOR LIFE IN THE ELMAC POWER SUPPLY

Users of the Elmac M-1470 power supply may have noticed excessive sparking in the vibrator. This may be eliminated with a resulting increase in vibrator life by simply changing the buffer capacitors C_{16} and C_{18} from their original value of 0.1 μf. to 0.5 μf. These capacitors should have a 600-volt rating.

—Harry Stewart, W8PSV

THEFT-PROOFING MOBILE EQUIPMENT

The sketch in Fig. 9-15 shows how I theft-proofed my Cheyenne and Comanche mobile equipment. Two 2½×¼-inch eyebolts are used—one attached to the floor of the car, the other to the bottom of the equipment. Any kind of equipment support may be used. The eyebolts are aligned so that when the equipment is installed, a padlock or combination lock can be inserted through the eyebolts and locked.

—Francis L. Neubauer, K3OKF

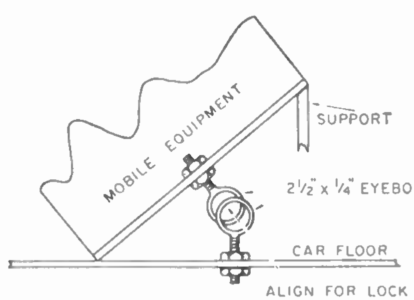


Fig. 9-15—K3OKF's theft-proofing scheme

STIFF MOBILE MOUNT

The accompanying photograph shows my double spring mount which almost completely eliminates antenna side-sway at high speeds. Even the front-to-back motion of the antenna is minimized, yet it does allow some give, in case the antenna strikes a tree limb or other object. The two springs are mounted side by side between two steel plates to which the antenna and bumper mount are attached.

—Thomas H. Earnest, W5UFO

(This is, no doubt, the original Unidentified Flying Object.—*Ed.*)

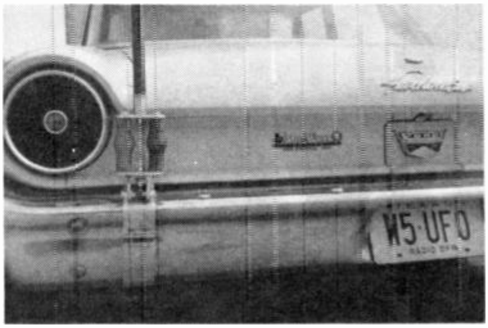


Fig. 9-16—W5UFO's stiff spring mount.

MOBILE HINT: A PENCIL WHEN YOU NEED IT

Ever hunted for a pencil while mobiling? Keep one on the top surface of the dashboard. A piece of magnet from an old speaker will stick to any convenient location on the dash. And an ordinary wooden pencil with about 3 wide-spaced turns of baling wire or equivalent (not copper) around the shaft will cling to the magnet. For long trips a piece of scratch paper can be placed beneath the magnet, which will hold the paper firmly enough for quick operation notes.

—Harold A. Thomas, W5HJM

REDUCING NOISE IN TRANSISTORIZED AUTO RECEIVERS

Some models of the transistorized car broadcast receivers are plagued with motor noise interference. Motorola has recognized this problem and has made available a high temperature high capacitance electrolytic that connects directly to the ignition coil. The unit bears part number AK-300, has a capacitance of 1000 μf. and nets for less than $2.00.

—Donald S. Middleton, WØNIT

REDUCING CHARGING CIRCUIT INTERFERENCE

If you are beset by regulator hash in your mobile station, the following method will in many instances remove most, if not all, of the offending interference. I incorporated the method in my automobile which uses a Leece-Neville alternator but it should also be equally effective in a conventional charging system.

Construct two filters by connecting a 10-ohm resistor and a 0.5-μf. capacitor as shown in Fig. 9-17. The capacitor can be the type normally sold by automobile parts suppliers as a generator by-pass capacitor. The resistors should be connected as close as possible to the capacitor, taped at the junction and secured to the capacitor with plastic tape. Anchor the filters to any metallic portion of the car body, preferably as close to the regulator as possible. The two filter leads are fed into the regulator box where one is connected to the upper section of the voltage regulator bracket and the other is connected to the upper portion of the current regulator bracket. These filters will not affect the functioning of the regulator.

In addition to the regulator filters, a tuned filter in the field lead will aid in the reduction of interference. It is constructed by winding a self-supporting coil, L_1, of 8 turns of No. 10 enameled wire about 1 inch in diameter. Connect a 100-pf. variable capacitor across the coil and bypass the filter with a 0.005-μf. capacitor and a 10-ohm resistor. Insert the filter in series with the generator field lead and tune the capacitor for minimum interference.

Other schemes can be used to reduce any remaining residual ignition of regulator hash, such as inserting 0.1-μf. disc ceramic capacitors from the tail lights, from the license plate lights and from the dome lights to ground. Also, grounding the muffler and tail pipes in several spots will sometimes help. If the receiver's antenna or power leads pass in close proximity to the regulator, generator or high-voltage ignition components, try moving them away or encasing them in a grounded shielded jacket.

—Maurice I. Sasson, M.D., W2JAJ

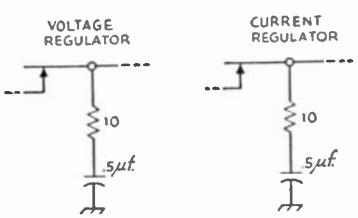


Fig. 9-17—Filters on the voltage and current regulators to reduce radio interference.

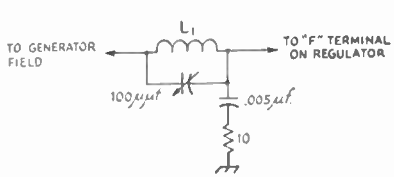


Fig. 9-18—Tuned filter placed in the generator field lead. See text for information on L_1.

NOVEL VENTILATING SYSTEM FOR MOBILE UNITS

ADEQUATE cooling for some of those compact under-the-dash units can be provided for—without blower—simply by running wiper hose to the wiper line or to the manifold. Frequently, enough air will be drawn in through crevices around the cover, shaft openings, etc., of a unit to make unnecessary the drilling or punching of any special ventilation holes or louvers.

—Harry E. Adams, W9JX

PORTABLE SPRING VERTICAL

SINCE I do quite a bit of traveling, I am always looking for information on portable antennas. Recently, while strolling through the toy department of a drugstore, I noticed a "Slinky" spring. This is a springy coil that children use as a toy. I took one home, measured its length and I found that it contained about 65 feet of wire. I tacked one end of the coil to the shack ceiling and connected the other end to the center conductor of a piece of coax, grounding the coax shield. The spring vertical loaded up on 20 meters and I made many successful contacts. By adjusting the height and using a coupler, the spring could probably be made to load satisfactorily on several bands. When you're finished with the antenna, merely fold it into a neat 4-inch package!

—Pat Flanagan, K5TRB

MOBILE LOGGING TIPS

THE job of keeping an accurate log of mobile contacts is sometimes a problem and even a hazard. I have found an effective solution to this problem in the use of a colored china-marking pencil (grease pencil) for keeping a rough log on the metal dash cowling of the car. The information can be copied later in the official log book and the grease pencil scribbling wiped off with a rag. The markings are easily removed and don't seem to harm the dash finish. An extra coat of wax on the dash will make removal of the scribblings even easier.

—William Vandermay, W7DET

LOG keeping and mobile operation just don't go hand in hand. To simplify the job of keeping a log while in motion, I use a "Magic Slate" sold in most toy stores. This pad consists of a sheet of plastic material covering a gray backup sheet. When the pad is written on with a special pencil furnished with the pad, characters stand out in a vivid black. However, when the plastic cover sheet is lifted and separated from the gray backing the writing disappears. The action of writing and erasing can be done over and over again. At the next convenient stop the information can be transferred from the temporary log to the official log.

—R. Bruce Campbell

Hints and Kinks . . .

for Test Equipment

A BAND-EDGE MARKER

A FOOL-PROOF band-edge marker can be made very simply by using quartz crystals and a neon bulb. When the v.f.o. tunes across the frequency of either crystal, the neon bulb will flash, indicating the edge of the band. Crystal Y_1, can be chosen for the low edge and Y_2, for the high edge of the band. However, it is well to remember that if too many crystals are connected in parallel the holder capacity will pass a signal of any frequency.

The pick-up for the radio frequency voltage can be a short-piece of wire placed near a hot tank circuit in the v.f.o. or exciter. Of course, the r.f. field must be strong enough to provide sufficient voltage at the terminals of the neon bulb to light it.

—John Grindon, W0UVX/9

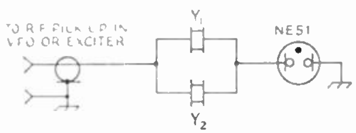


Fig. 10-1—Diagram of the band-edge marker.

AUDIO FREQUENCY TEST SIGNAL WITHOUT AN AUDIO OSCILLATOR

IF AN audio generator is not available when next needed, or should the one on hand deliver inadequate or badly distorted output, try the system used here at W2ZZG.

A good sine wave, as indicated by an oscilloscope, is obtained by feeding the v.f.o. signal into a communications receiver operated with the b.f.o. turned on. Audio output for test purposes is taken from the last stage of the receiver, and the amplitude of the signal is regulated by the audio gain control. Signal frequency is varied by regulating the b.f.o. control.

Naturally, the stability of the v.f.o. and the receiver play an important part in determining the stability of the audio test signal. Furthermore, coupling between v.f.o. and receiver should be tight enough to mask out any noise that leaks into the front end of the receiver, but not so tight as to overload its r.f. amplifier. By experimenting with the input coupling, and by keeping the r.f. gain *down* in the interest of linearity, it is usually possible to end up with an audio output signal that looks quite good on the face of a scope.

Although the equipment used here is not calibrated in terms of audio frequency, the frequency of the test signal can be intelligently estimated. In any event, the signal obtained is a lot more favorable for many jobs than is the frequently interrupted WWV signal used by some as a source of audio.

—Arthur H. Pedley, W2ZZG

IMPROVISED R.F. SNIFFER

CONVENTIONAL vacuum tube voltmeters can be used for antenna coupling and tuning adjustments simply by switching to the a.c. voltage range and plugging a loop of wire into the a.c. input jacks. The loop acts as an r.f. pick-up and the induced r.f. is rectified by the diode in the a.c. circuit.

—Frank D. Witmer

MODULATING THE GRID-DIP OSCILLATOR

THE g.d.o. can be made more useful by adding tone modulation. The tone will help to identify the g.d.o. signal and distinguish it from any others that may be present during a test. Also, the modulated signal is useful during receiver alignment. The circuit for a neon-bulb tone modulator is shown in Fig. 10-2. Few parts are required and they are small enough to be tucked into spaces inside the g.d.o. case.

Switch S_1 disconnects the modulator from the g.d.o. power supply. The existing switch on the g.d.o. can be removed and replaced with a multiple contact unit in order to conserve space. Resistor R_1 in the circuit is the existing grid resistor of the g.d.o. R_2 is about ¼ the value of R_1. In order to change the pitch of the tone, juggle the values of C_1 or R_3.

—F. T. Swift, W6CMQ

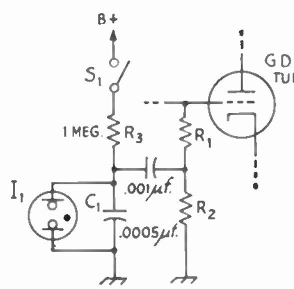


Fig. 10-2—Circuit diagram of the g.d.o. modulator. See text for information on R_1, R_2. I_1 is a neon lamp.

INCREASING DUMMY LOAD DISSIPATION

Dissipation ratings of dummy loads, such as the one shown on the cover of *QST*, March, 1960, can be increased many times by immersing the loads in a bath of oil. Transformer oil or quenching oil used in heat treating steel are good types for the purposes.

My dummy load consists of a coax fitting mounted on the metal lid of a glass jar with the non inductive resistors suspended in about a pint of oil.

—David Smith, K2CDY

V.T.V.M. FIELD-STRENGTH METER

To use a v.t.v.m. as a field-strength meter, set the meter to a low a.c. range and place the test leads in the shape of a dipole. Although most meters fall off in sensitivity in the r.f. range (except, of course, when using an r.f. probe), a relative field-strength reading can usually be obtained by this method.

—Frank Reid, K4VHJ

USING A TV RECEIVER TO CHECK GRIP-DIP METER CALIBRATION

I recently completed a kit-type grid-dip oscillator and wanted to check oscillations at the high-frequency end. The unit was designed to oscillate up to 250 Mc.

It occurred to me that the home TV set might be used to check frequencies up to 216 Mc. (Channel 13). So I turned on the grid-dip unit and the TV set. The grid-dipper was rested on top of the TV set and Channels 2 through 13 were turned on in succession. For each channel the grid-dip frequency dial was appropriately set, using the correct plug-in inductance.

It was observed that both sound and picture were distorted when the grid-dipper was tuned through the appropriate range of frequencies for each channel. It is not necessary for a station to be operating in order to perform a quick check on any channel. As long as any kind of raster can be seen, the disturbance caused by the grid-dip oscillator will be readily seen.

This simple test actually serves two purposes: first, it shows the presence of oscillation from about 50 to 216 Mc. Second, it indicates the accuracy of dial calibrations of the instrument tested.

This same method can be used to check other types of oscillators operating in to 50- to 216-Mc. range.

—Paul Goldman, K2GKU

Editor's Note: Frequencies of oscillation below 50 Mc. can probably be checked quite accurately by the above method as long as the oscillator output contains harmonics falling in the TV range. The BCI and TV chapter of *The Radio Amateur's Handbook* lists the frequencies of the picture and the sound carriers may be determined.

USING THE HEATHKIT AM-2 REFLECTED POWER METER AS A MODULATION MONITOR

This simple modification to the Heathkit Reflected Power Meter makes it possible to use the instrument as a modulation monitor. The only additional part required is a closed-circuit jack. The modification consists of inserting the closed-circuit jack in the lead that comes from the center lug of the potentiometer, as shown in Fig. 10-3. This lead should go to the contact on the jack that mates with the tip of the headset plug. The switch terminal of the jack goes to the plug side of the meter. When the headset is removed from the jack, operation of the power meter returns to normal. When the meter is used for a modulation monitor, the potentiometer controls the audio level in the headphones.

—Emil P. Sulkosky, K1HSR

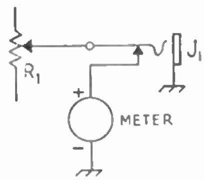


Fig. 10-3—Circuit showing modifications to the power meter. The meter and R_1 are the components already existing in the unit. J_1 is a closed-circuit jack.

MORE SWEEP VOLTAGE FOR THE ELECTRONIC EYEBALL

The article "The Electronic Eyeball" in *QST*, January 1959, stirred my desire to build a panoramic adapter. After building the unit, I found that I could not get enough sweep voltage from the 12AX7 tube for full linear horizontal deflection.

I gave the problem some thought, thumbed through tube data and then decided to use a 6U8 in place of the 12AX7. The results were gratifying. I had almost twice the linear sweep voltage that I had before. The new circuit for the oscillator-amplifier is shown in Fig. 10-4. The only additional voltage required is 150 volts regulated for the screen of the pentode section.

—Donald C. Hanna, VE2CD

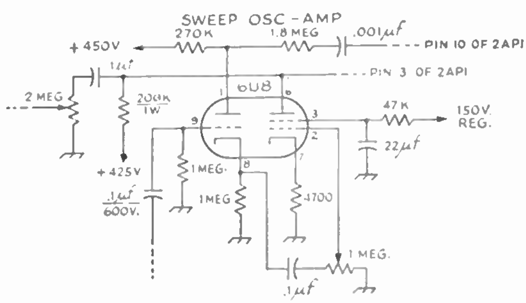


Fig. 10-4—Modified sweep circuit for the Electronic Eyeball. All resistors are ½ watt unless otherwise specified.

V.H.F. FIELD-STRENGTH METER

Transmitters with less than one watt output require very sensitive field-strength meters for measuring output, and the circuit in Fig. 10-5 shows the schematic for one I use with my portable six-meter flea-power rig. A small pickup antenna is usually sufficient for close-range measurements, but a dipole can be used for supersensitivity. Almost any r.f. transistor can be used in the circuit. However, sensitivity falls off when the inexpensive audio types are used. Switch S_1 is wired so that the meter terminals are shorted when the unit is switched off, thus protecting the meter movement.

—Howard J. Hanson, W7MRX

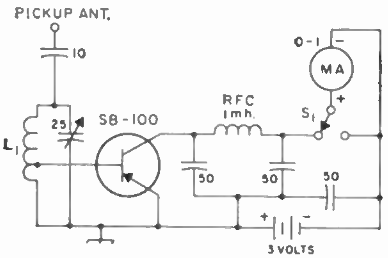


Fig. 10-5—Transistor field-strength meter. Capacitances are in pf., resistances are in ohms, resistors are ½ watt. L_1—6½ turns No. 20 enam., ½-inch. diam., spaced diameter of wire. Tap 2 turns from cold end. S_1—S.p.d.t switch.

SHIELDING DUMMY LOADS

While checking a new rig I connected a dummy load (a 25-watt lamp) to the transmitter. During the checks I heard an out-of-town station calling CQ. I was still using the dummy antenna on the transmitter but since I was tuned up on his frequency I gave him a call just for fun. Not only did I make the contact but I also received a good report!

A later check with a field-strength meter indicated an extremely strong r.f. field around the lamp. I applied several coats of conductive paint (Television Tube Coat, General Cement No. 49-2) to the glass envelope around the lamp, leaving a small ¼-inch circle to allow observation of lamp brilliance. After this coating, the field-strength meter gave only a slight reading a few inches from the dummy load. Now, the lamp makes a good dummy antenna.

—Harrison A. G. Stone, K2LIF

V.T.V.M. POWER SUPPLY FOR THE G.D.O.

Here is a possibility of turning the tables that some amateurs may not have thought of. Since a vacuum-tube voltmeter can be used as the indicator for a homemade grid-dip meter, it is only logical that the power supply for the v.t.v.m. be used to furnish power for the g.d.o. Seems fair enough doesn't it?

—Luke McCloud, K2DDM

LECHER WIRES

Although Lecher wires are not new, they still make a convenient and accurate device for measuring the wavelength of v.h.f. and u.h.f. radio waves. Conventional Lecher wires are constructed with one end electrically open and with a pickup loop on the other end.[1] In actual operation, the Lecher wires and an external indicating device, such as a low current flashlight bulb and loop of wire, are coupled to a transmitter under test. A shorting bar across the Lecher wires is slid along the wires until the lamp gives a sharp dip in brightness. This point is marked and the shorting bar is moved along again until a second dip is reached. The distance between these two points is measured and is equal to half the wavelength.

This method works well with a multistage transmitter but often in the u.h.f. ranges the transmitter consists of a single oscillator, and tight coupling between the Lecher wires and the oscillator will sometimes pull the oscillator off its normal operating frequency. This loading effect can be overcome if the Lecher wires are loosely coupled to the transmitter as shown in Fig. 10-6. Here the wires are coupled to the transmitter by a pickup loop, but because of the sensitivity of the system can be placed far enough from the transmitter to prevent pulling. The basic operation of this system is similar to the older method except that the indication appears in the form of a meter dip rather than a dip in light-bulb intensity. To calculate the frequency in megacycles after the two "null" points have been determined, use the following formula:

$$F\ (\text{Mc.}) = \frac{5906}{length}\ (\text{in inches})$$

or, if the length is measured in meters, the formula is:

$$F\ (\text{Mc.}) = \frac{150}{length}\ (\text{meters})$$

The only important construction point to remember is that the Lecher wires should be at least a wavelength long and entirely air insulated except, of course, where supported at the ends.

—Donald R. Wesson, K4HCZ

[1] "For the Junior Constructor—A Lecher Wire System for U.H. Frequency Measurement," *QST*, October, 1941.

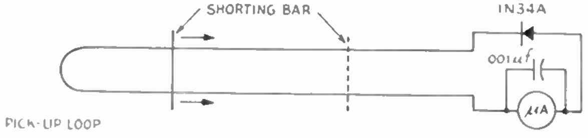


Fig. 10-6—Lecher-wire wavelength measuring device. The wires are made of No. 16 copper and should be spaced about 1½ inches apart. They should be at least one wavelength long.

CRYSTAL TEST OSCILLATOR

The circuit shown in Fig. 10-7 was circulated among MARS members recently. It will oscillate with any good crystal having a fundamental frequency bewteen 3 and 20 Mc. No tuning is necessary. The output is sufficient to be heard in a receiver or to be measured with a frequency meter.

The transistor, Q_1, shown in Fig. 10-7 is very inexpensive. Other p-n-p types may be used, such as the 2N1178 through 2N1180, or the 2N1742. The transistor may be wired in the unit or mounted in a socket. If a socket is used, the device can also be used to check the oscillating ability of different transistors.

The 9-volt battery, BT_1, is the type made for pocket transistor radios. For the best stability, all of the capacitors, except the 0.01 μf., should be silver micas.

During testing, overtone crystals will oscillate on their fundamental. This will be about ⅓ the marked frequency for crystals up to 50 or 60 Mc., and ⅕ that of the marked frequency for crystals marked above 60 Mc.

With a little care, the parts for this unit can be mounted on a 1½ × 2-inch piece of electronic pegboard, such as the Vector Terminal Board type 32AA9, and the whole works squeezed into a Bud. CU-3016-A (4¼ × 2¼ × 1½-inch) Minibox.

—William L. Smith, W3GKP

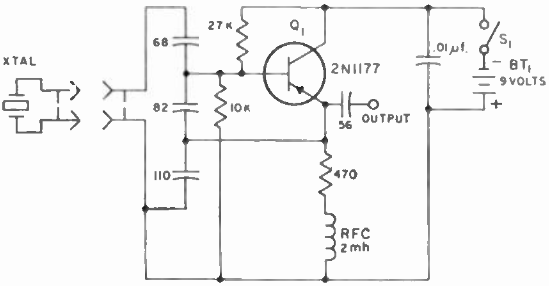


Fig. 10-7—Crystal test oscillator. Unless specified otherwise, capacitance is in pf., resistors are ½ watt. S_1 is an s.p.s.t. toggle switch.

GRID-DIP OSCILLATOR CALIBRATION AT V.H.F.

Some of the wide-range g.d.o.s fall off in accuracy at v.h.f. and can vary quite a few megacycles in the 144- and 220-Mc. bands. One method to calibrate the g.d.o. at these frequencies is to place it a few feet away from a TV receiver and tune it until it zero beats the sound portion of the program. The table below shows the sound carrier frequencies of the v.h.f. channels. To prevent erroneous calibration due to images, move the g.d.o. as far as possible from the TV receiver to eliminate any weak false signals. The intervals between channels can be filled in by interpolation using the original g.d.o. dial markings. In the 88- to 108-Mc. range, the same procedure can be used with an f.m. tuner as a receiver.

Channel No	Sound Carrier
2	59.75
3	65.75
4	71.75
5	81.75
6	87.75
7	179.75
8	185.75
9	191.75
10	197.75
11	203.75
12	209.75
13	213.75

—Samuel M. Bases, K2IUV

FREQUENCY SPOTTER

The 100-kc. crystal calibrator used in many receivers for calibration purposes can also be used to spot specific frequencies such as net frequencies. Plug in the desired crystal in place of the 100-kc. crystal, and turn on the calibrator—and tune it in. Usually, the harmonics of the "new" crystals are quite strong. Band edge crystals can also be substituted for generating a series of markers.

—Julian Greenbaum, W1LIG

GRID-DIP METER CALIBRATION

The grid-dip meter isn't intended for extremely accurate measurements, but it is frustrating to find that the oscillator frequency does not always conform to what the calibration scale indicates. There is a simple solution which is not usually mentioned in the g.d.o. instruction books.

The outside rotor plates of the oscillator tuning capacitor are slotted, and by bending these leaves in certain combinations it is possible to add or subtract capacitance anywhere along the tuning curve. If the capacitance is increased in the area that engages at the high-frequency end, then the entire scale will be moved to a lower value unless there is a corresponding reduction of capacitance (outward bending of the plate) in the area that comes into action as the low-frequency end is approached. The g.d.o. coils are wound and checked to a standard so if one coil is made to track properly the others will fall into line also.

Some g.d.o.'s use the Colpitts oscillator circuit so only one section of the split-stator capacitor needs to be worked on since the capacitors are in series across the coil. The calibration problem isn't serious at low frequencies where the station receiver can be used to check the g.d.o. frequency. But on the higher frequencies for which there are usually no frequency monitoring devices, it is nice to know that you can depend on the g.d.o. dial.

—Edson B. Snow, W2BZN

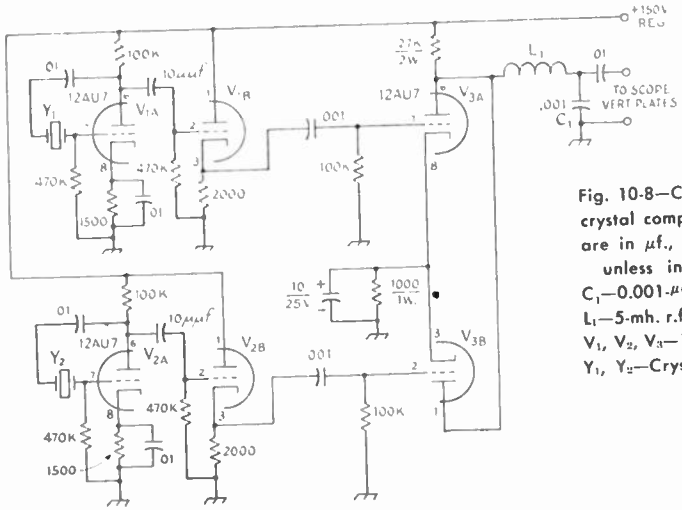


Fig. 10-8—Circuit diagram of the crystal comparator. Capacitances are in μf., resistors are ½ watt, unless indicated otherwise.
C_1—0.001-μf. ceramic capacitor.
L_1—5-mh. r.f. choke.
V_1, V_2, V_3—12AU7 tubes.
Y_1, Y_2—Crystals to be compared.

CRYSTAL FREQUENCY COMPARATOR

When working with high-frequency crystal filters, a means of measuring the relative frequency of the crystals is necessary. The method described here allows accurate measurement of frequency difference down to a few cycles. The diagram for the required unit is shown in Fig. 10-8. The circuit consists of two identical crystal oscillators, V_{1A} and V_{2A}, with cathode followers, V_{1B} and V_{2B}, for isolation, and a mixer (V_3). The sum frequency from the mixer is filtered out in the filter network, L_1C_1, while the difference frequency (which is usually an audio frequency) is fed to the vertical plates of an oscilloscope. An external calibrated audio oscillator is fed to the horizontal plates of the scope and adjusted until the trace shows a single loop figure. The difference frequency is indicated by the frequency of the audio-frequency generator.

When constructing the unit, place the oscillators at opposite ends of the chassis with the mixer located in the chassis center. To make certain of electrical similarity between the two crystal oscillators, transpose the crystals. If the oscillators are identical, the scope pattern should be the same.

—Warren H. Clark, W6COK

WWV ON THE NATIONAL NC-300 RECEIVER

The 10-Mc. signal transmitted by WWV may be received on the Type NC-300 receiver as follows:

Clip a 330-pf. capacitor from the stator of the high-frequency oscillator section of the main tuning gang (front section) to the chassis. Set the antenna trimmer to minimum capacitance and tune across the 40-meter band until the 10-Mc. WWC signal is heard.

This is a somewhat unconventional method of using the receiver, but it provides an economical and simple means of beating a crystal calibrator against WWV for insurance of accuracy.

—Robert J. Murray, W1FSN

USING THE GRID-DIP OSCILLATOR

To check the relative activity of crystals, clip a crystal holder across the coil terminals of a grip-dip oscillator. Plug in the crystal to be checked and if the indicating meter comes up to about the same reading as it would if a coil had been used, the crystal is good. If the meter shows only a slight rise, the crystal may need cleaning and is not very active. If there is little or no reading, the crystal is inactive. The station receiver can be used to check the approximate oscillation frequency of the test crystal.

—Phillip F. Robinson, W1CK

—···—

A grid-dip oscillator can be used for many crystal tests around the shack. It can be used to find the frequency of unknown crystals or as a stable crystal-controlled signal generator for receiver alignment, band-edge markers, or stable b.f.o. Of course, the grid-dip oscillator can be used in grinding or etching crystals to measure conveniently and quickly the frequency and relative activity of the crystal. Since the tuning capacitor in most grid-dip oscillators is in shunt with the crystal, increasing its capacity will "pull" the crystal slightly. Thus, it is possible to find the range of pulling of a particular crystal for its use in a frequency standard or as an oscillator in f.s.k. teletype work. Always take the g.d.o. along to the surplus store when you are shopping for surplus crystals—it may prevent your picking up a dud!

—F. T. Swift, W6CMQ

Editor's Note: The above applications are suitable only with grid-dip meters having a Colpitts oscillator circuit.

BAND-SPOTTER WAVEMETER

A FREQUENT infraction of the rules governing amateur operation is harmonic radiation outside the amateur bands. The device described here is a series of fixed-tuned absorption wavemeters tuned to the various harmonically related amateur bands. With the transmitter operating, the units are advanced toward the transmitter tank circuit (See Fig. 10-10) until one of the indicating lamps begins to light. If more than one lamp lights up, it indicates that harmonic energy is present and should be suppressed.

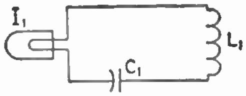


Fig. 10-9—Band-spotter wavemeter. The indicator lamp I_1 is a No. 47 pilot lamp. C_1 is ceramic or mica.

Band	C_1(pf.)	L_1	Length
80	100	45 turns No. 28 enam.	5/8 in.
40	47	29½ turns No. 26 enam.	½ in.
20	25	20½ turns No. 24 enam.	½ in.
15	20	18 turns No. 20 enam.	11/16 in.
10	10	15 turns No. 22 enam.	½ in.
7.5	10	10 turns No. 22 enam.	½ in.
6	10	9 turns No. 22 enam.	9/16 in.
5	10	6½ turns No. 22 enam.	½ in.
3	5	5½ turns No. 20 enam.	½ in.

Each unit of the wavemeter is built into a plastic tube, such as a pill container, that measures about 9/16 inch o.d. and 2 inches long. A coil is wound on one form and a capacitor is connected as shown in Fig. 10-9. A second plastic case with its bottom cut off to form a tube is held in position while the two leads from the tuned circuit are soldered to the pilot lamp (See Fig. 10-11). Make the leads as short as possible. Cut the plastic cap that comes with the container so that the pilot lamp will make a tight fit when it is inserted in the cap. After the unit has been checked for resonant frequency, the containers are cemented together and the cap containing the lamp is installed. Each of the individual units are then spot-cemented together to form a single multiple unit.

Fig. 10-10—Band-spotter wavemeter.

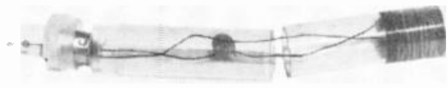


Fig. 10-11—View showing make-up of one of the tuned circuits.

Remember, these units are harmonic band spotters only, and are not to be used as frequency meters. Be careful when using the wavemeter around high-voltage circuits in the transmitter.

—Lee F. Worthington, K4HDX

LINK-COUPLING TO THE GRID-DIP METER

ALTHOUGH this idea may be "old stuff" to many, it was a new and handy stunt here.

In putting some new coils in a bandswitching transmitter, it was found desirable to check their frequency coverage. Unfortunately, there was no way to get at the coils with the meter without disassembling the rig. The solution was link-coupling. I made a flexible link out of a piece of 300-ohm Twin-Lead about 15 inches long with a single-turn loop at each end. The exploring end has a loop about two inches in diameter and the other end has one just big enough to slip over the coil of the grid-dipper. By opening up a small crack in the shielding, it was possible to maneuver the inner end of the link into position against the coil to be measured and the meter then performed just as though it were coupled in the usual manner.

Twin-Lead is ideal for this purpose as it is stiff enough to be manipulated readily from the outside but can be bent at any angle necessary to reach the most difficult location. On the lower frequencies, two or more turns at each end of the link may be needed to provide sufficient coupling.

—Cyrus T. Read, W9AA

RECORDING OSCILLOSCOPE TRACES WITH A GREASE PENCIL

THE grease pencil recording technique won't replace the oscilloscope camera, but it does provide a very satisfactory means of making permanent records of many of the waveforms observed on the ham shack oscilloscope. The procedure is to carefully trace out the waveform, marking on the face of the c.r.t. with a grease pencil (China-Marking Lead). Then place a sheet of paper on the face of the c.r.t. and transfer the grease pencil markings to the paper by briskly rubbing over the traced region with your fingernail. The record obtained will be a mirror image. If a real image is desired, use the same technique to transfer the mirror image to a second sheet of paper.

—Donald F. Hemenway, W1SQP

MEASURING-CUP BAND SPOTTER

It is not necessary to build or buy an elaborate frequency meter for most amateur purposes, especially when the transmitter is crystal-controlled. Much simpler means can serve the purpose just as well. For example, you could hardly want a simpler circuit than that shown in Fig. 10-14. And as the photographs show, the construction is equally simple. Assembled in a 15-cent measuring cup, this gadget will go a long way toward filling the initial frequency-measuring needs of the Novice licensee. It will also serve the old-timer in many ways when he builds or adjusts transmitters in any ham band from 3.5 to 14 Mc. The cost of the entire unit is less than five dollars, and this figure can be reduced by over fifty per cent if you happen to have a suitable tuning condenser in your junk box.

The measuring-cup wavemeter is nothing more than a tuned circuit covering 3.4 Mc. to 15 Mc. with a flashlight bulb in series with it to serve as a resonance indicator. When the coil in the wave-meter is coupled to a transmitter delivering anything from a few watts of r.f. up to a kilowatt and the capacitor is tuned so that the wavemeter is resonant at the frequency of operation, the lamp will light. The unit is calibrated so that the frequency at which the power is being generated is read directly from the dial.

Construction of the wavemeter is extremely easy. The measuring cup is used to provide support for the tuning capacitor and the calibrated dial, incidentally providing a mounting for the indicator lamp and a handle for the entire unit.

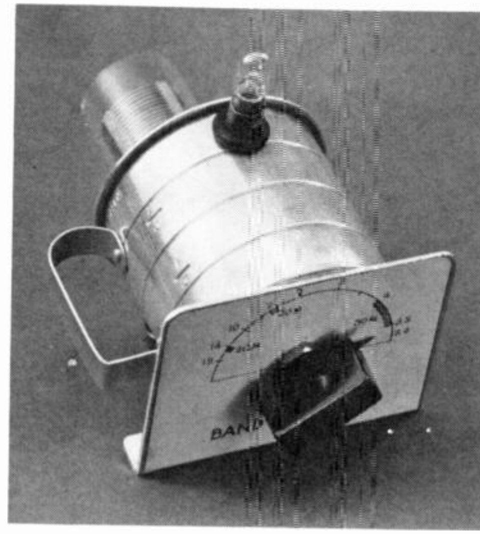


Fig. 10-13—One of the handiest "tools" in ham radio is the absorption wavemeter. This unit, built around an aluminum measuring cup, is designed to fit the requirements of the Novice licensee or old-timer. Construction is simple—the entire assembly is held together with one nut.

The lamp is insulated from the cup by mounting it in a grommet-lined ½-inch hole drilled at the top where it will not interfere with the rotation of the plates of the tuning capacitor. The calibration scale is pasted to the face of an aluminum bracket measuring 3½ inches wide and 2⅞ inches high, with a ½-inch lip bent under the cup to form a mounting "foot." This prevents the gadget from rolling off the desk or shelf when stored.

The coil is cemented inside a Quartz-Q coil form 1⅝ inches in diameter and 1⅞ inches deep (Millen 46100). Thus the coil is protected from

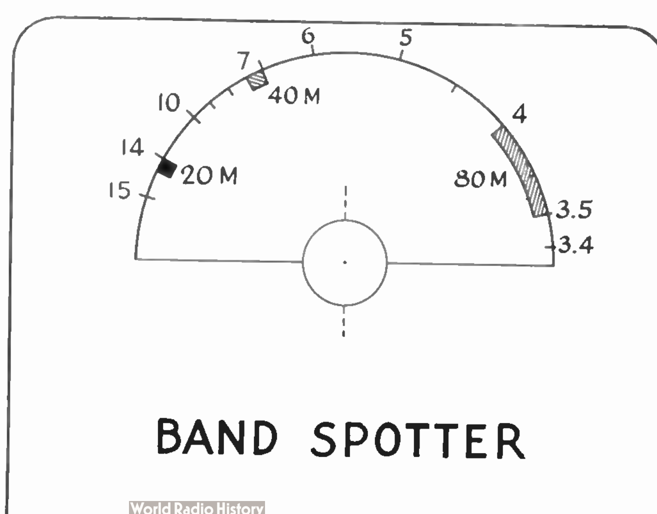


Fig. 10-12—Actual calibration of the wavemeter. This drawing may be cut out or traced and pasted to the face of the aluminum bracket provided the parts listed below Fig. 10-14 are used in the construction.

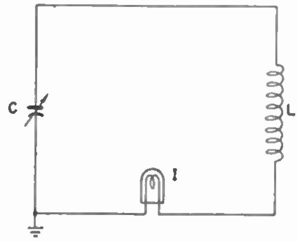


Fig. 10-14—Circuit diagram of an absorption wavemeter covering the 3.4- to 15-Mc. range.

C—300-pf. variable (National ST-300).

L—22 turns No. 20 wire, 1-inch diam., 1⅜ inches long (B & W Miniductor No. 3015).

I—60-ma. dial lamp (pink bead) mounted in bayonet-type bracket (Johnson 147–630).

damage and the operator is protected from the high voltage in the transmitter. The form is mounted ⅞ inch behind the rear rotor bracket of the tuning capacitor by a machine screw and a spacer. The 6-32 screw fits one of the tapped holes that bolt the ceramic spacer bar to the bracket. An insulated tie-point is slipped under one of the rear stator connectors of the capacitor to serve as the junction point between the tuned circuit and the indicator lamp. One wire from the lamp goes directly to the rotor terminal on the rear of the capacitor, the other to the insulated tie-point. The coil is connected from the stator terminal of the capacitor to the lamp at the insulated tie-point.

If you use the same parts we specify in Fig. 10-14, and wire the unit with approximately

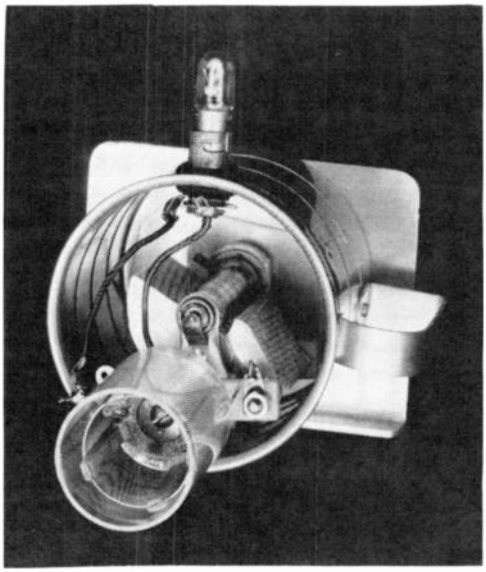


Fig. 10-15—Rear view of the measuring-cup wavemeter. The coil is mounted on the rear of the tuning capacitor inside a protective Quartz-Q form. Also shown is the method of mounting the resonance-indicating lamp in a grommet-lined hole through the side of the cup.

the same lead lengths shown in the photographs, you will be able to use the calibrated dial scale reproduced in Fig. 10-12. It can be cut out and pasted on the aluminum bracket, or traced onto another sheet of paper. If other parts are used, the wavemeter can be calibrated by using a grid-dip meter in conjunction with a calibrated receiver.

Using the meter is also easy. Assume for a minute that you have tuned up your transmitter, but are not sure that its output frequency is in the desired band. With the transmitter turned on, hold the wavemeter so that the coil is within a few inches of the plate tank coil of your output stage. Turn the tuning dial slowly until the indicator lamp lights, showing that the wavemeter circuit is tuned to the same frequency as the transmitter output. Don't get too close to the tank circuit or you may burn out the indicator lamp.

The same procedure may be followed for any tuned circuit in which power is flowing. Whenever the wavemeter is tuned to the same frequency as the power in the tuned circuit, it will absorb some of that power and then dissipate it in the form of light in the indicator. If the stage you are checking has a plate milliammeter, you can observe the effect of the wavemeter on the tuned circuit to which it is coupled. As the wavemeter is resonated, the plate-meter reading will increase slightly as the wavemeter loads the circuit and takes power from it to light the indicator lamp.

This little gadget cannot be expected to be without its limitations. There are some things that it cannot tell you. For example, its calibration is not accurate enough to permit its use as a frequency meter for close-tolerance reading. It will tell you, however, whether your output is in the 3.5-Mc. range, in the 7-Mc. range (as it would be if you happened to tune up on your second harmonic), or somewhere in between (as it might be if the amplifier was unstable and oscillating by itself). It is for this reason that we call it a *band spotter*, rather than a frequency meter. In the case of a crystal-controlled transmitter, you can be reasonably certain of avoiding off-frequency notices if your crystal is actually in the band, provided that you are sure the output is in the band you think it is. This gadget enables you to be sure.

—Richard M. Smith, W1FTX

ADDITIONAL USES FOR THE S METER

Using the S meter of the station receiver with external leads for certain measurements is not new, but the value of the trick is certainly enhanced when the available meter is of the microampere type. While the fact does not seem to be too widely known, several types of Hammarlund receivers carry a 200-microampere, unit, including the HQ-129X, SP-400X and military equivalents. A meter of this rating is ideal for g.d.o., v.t.v.m., f.s. measurements, etc. In the case of the SP series, the meter is rather easily removed and replaced.

—*Otto L. Woolley, W0SGG*

GRID-DIPPER CALIBRATION

Good grid-dip meter accuracy over all the coil ranges is sometimes difficult. I have found that a gimmick capacitor, such as C_1 shown in Fig. 10-16, connected across the plug-in inductor for each range affords an effective means of calibrating the coils individually. A high degree of accuracy can be obtained this way for special segments of the coil ranges, such as the amateur band frequencies. The gimmick capacitor consists of two leads, each connected to a coil terminal, and twisted together. A communications receiver can be used as the frequency standard.

—*Dick Kelly, K5SOD*

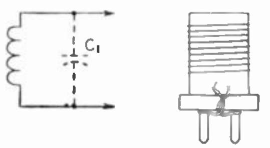


Fig. 10-16—A gimmick capacitor allows for calibration of grid-dip meters.

CAPACITOR CHECKER

The capacitor checker shown in Fig. 10-17 can be constructed in a few minutes and requires only a few parts. Good capacitors will show a single flash from the neon indicator. Small-value units will give a less brilliant flash than large-value ones. If the lamp glows steadily, the capacitor is shorted. If there is no indication at all from the lamp, the capacitor is open.

With electrolytic capacitors, the lamp will glow brightly at first and then, as the capacitor charges, will grow dimmer until finally the lamp will go out. If the indicator flashes more than once per second, the electrolytic is too leaky. Flashes at the rate of about one per second or longer are normal. Be sure to observe polarity when checking electrolytic capacitors. Caution: do not use this checker to test capacitors rated at less than 150 volts working. The isolation transformer T_1 may be left out of the circuit, but care should be taken when checking capacitors connected to other equipment that may be grounded or connected indirectly to power lines.

—*Paul Mezzapelle, Jr., WV6NLJ*

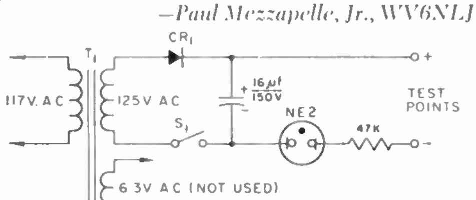


Fig. 10-17—Simple capacitor checker.

CR_1—50-ma. semiconductor diode.

S_1—S.p.d.t. switch.

T_1—Power transformer, 125 volts, 15 ma.; 6.3 volts, 0.6 amps. (Stancor PS-8415).

OSCILLOSCOPE CIRCUIT

Many homemade oscilloscopes do not include sweep, sync, or amplifier circuits. Sometimes, however, these circuits are necessary for ham measurements, and they can be added readily to an existing scope which contains its own power supply. Fig. 10-18 shows a simple circuit that includes vertical- and horizontal-amplifier and sawtooth-oscillator circuits. The only power necessary other than heater is 300 and 400 volts at about 25 ma.

—*C. O. Williamson, W8HQZ*

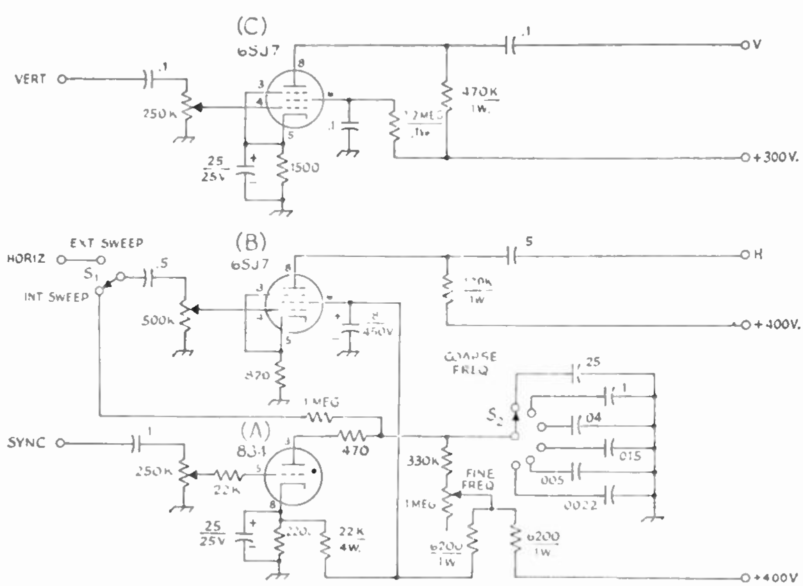


Fig. 10-18—Oscilloscope circuits—(A) sawtooth oscillator, (B) horizontal amplifier, and (C) vertical amplifier. All capacitances are in μf. Those marked with polarity are electrolytic. Resistors are ½ watt unless otherwise indicated. Terminals V and H are connected to the vertical and horizontal plates of the cathode-ray tube.

Hints and Kinks . . .

for Equipment Construction

CERTIFICATE AND QSL HOLDER

A new plastic material called Holdit Plastick, manufactured by Eberhard Faber, Inc., of Wilkes-Barre, Penna., and available at most five-and-ten-cent stores, can replace the old-fashioned tacks, tape, staples or paste usually used to hold certificates and QSLs to the wall. The material looks and feels like ordinary window putty. When ready to use it, roll it into small balls, place one on each corner of the object to be mounted, and press firmly to the wall. It will not stain either surface, apparently lasts indefinitely, and will not dry out. Holdit can also be used to seal tubes, vials, and bottles of radio chemicals, or it can be stuck to the corners of radio equipment to act as feet to keep the cabinet from scratching the surface it is sitting on. Plastick can be used over and over again and will not scar or mar the surface it has been attached to.

—W1YYM

BLOWN TRANSISTORS

Don't throw away burned-out transistors as, in some cases, they can still be used as diodes. Try the emitter-base or base-collector connections as the diode.

—Pekka Pyykko, OH1NE

CONNECTING STANDARD WIRE

The problem of mechanically connecting stranded wire to terminal strips without stray strands shorting to adjacent terminals has always been bothersome to me. Tinning the stranded wire beforehand is also a problem, since the stiffened wire is then hard to manage. I form the wire by dividing its strands roughly into two bundles and then forming these either into a ring or fork shape. The lead is then soldered. This makes a neat terminal lug that is also handy for barrier-type terminal strips where some commercial terminal lugs won't fit.

—Dennis McManus, K3OGD

MINIDUCTOR TAPS

There have been many Hints & Kinks on methods of soldering taps to small close-wound coils such as the Miniductors. I have found that the easiest method is to use Minnesota Mineing's Fibre Glass Electric Tape available at most hardware or electrical suppliers. Cut off two short pieces of the tape and slip one on each side of the wire to be soldered and fold down. Now the tap can be soldered to the wire without damaging the surrounding turns. Solder will not stick to the tape nor will it burn. After making the connection the tape can be pulled free.

—Charles L. Mosher, W9JLN

CONVENIENT CHASSIS TIE-DOWN

My transmitter is built on a 17-inch wide chassis which barely clears the 17⅛-inch opening in the cabinet. I wanted to install some kind of bracket on the rear of the chassis so that once the chassis was installed in the cabinet it could be clamped down. Because of the clearance problem I could not mount the bracket on the chassis before installing it. If I waited until the chassis was in the cabinet I could not get the mounting hardware into the chassis to attach the bracket. The solution was to use a small hinge as shown in Fig. 11-1. It is attached to the chassis and folded up. When the chassis is in place inside the cabinet, the hinge is dropped down into place and bolted to the cabinet.

—Capt. William J. Starr, WA4DQS

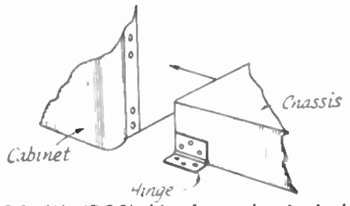


Fig. 11-1—WA4DQS's hint for a chassis tie-down.

SOAP-BOX HANDLES

When my mother came home from the market the other day, I noticed that there were nice metal handles on the extra large size of Dash washing detergent. I removed the handles from the box and attached them to some portable radio equipment of mine. The handles aren't bad looking and they make it much easier to carry the rig!

—Jon D. Nagy, WB2GFY

TAPPING HOMEMADE COILS

One neat and simple method of providing taps on hand-wound coils is to twist a small loop in the wire. After the loop has been cleaned and tinned, the winding may be continued.

—Harold Morris, W4VUO

NO-SCAR EQUIPMENT MODIFICATION

Many times a simple one- or two-tube modification can make a vast improvement in the performance of a piece of equipment. However, there are some equipment owners who would like to make such modifications, but the prospect of drilling holes in their gear discourages them when they think of the resale value of the equipment.

One way to get around the problem is to use breadboard-type sockets, such as the Eby Above Chassis type 12, which are available from most of the large mail-order houses. These sockets are top-of-the-chassis mounted and require only a couple of tiny holes for mounting. If the prospective modifier is particularly squeamish about drilling holes in the store-bought equipment, he can fasten the sockets to the chassis with glue!

The wiring to and from the socket is routed through existing holes or slots in the chassis, or a small hole can be drilled in some out-of-the-way place to bring wires to the top side of the chassis.

The photograph in Fig. 11-2 shows part of a modulator in the Johnson Navigator. Notice that terminal strips have been mounted on existing screws that holds one of the tube socket to the chassis. The two tubes are mounted horizontally with respect to the chassis, just above the driver tube. Only two 5/64-inch holes were required to mount the two tubes, since the other two were already part of the original construction.

When it is time to swap or sell the modified equipment, the extra circuits can be removed very easily. There will be little or no evidence of modifications left behind. The technique outlined here is particularly suitable for audio and power-supply circuits, but care should be exercised when trying to do extensive modifications involving r.f. circuitry. Some applications will require particular attention to shielding and lead dress.

—Richard C. Kelly, K5SOD

FRUITCAKE CHASSIS

Fruitcake mixes are sometimes sold in small thin-walled steel boxes. These containers make ideal cabinets or chassis for miniature equipment. I am using one for a control box in my mobile station and another to house a capacitor checker. These particular boxes measure 2¾ × 3⅛ inches.

—Walter C. Scales, K4RZJ

BEESWAX SUBSTITUTE

The usual method of treating homemade wooden insulators and antenna feeder spreaders is to boil the wood in beeswax. However, beeswax is no longer an easy item to obtain. One inexpensive substitute is "plumbers wax seal" which is available at most plumbing supply houses. It is usually supplied in rings and one ring is more than enough for treating two or three dozen 1½ × 1½ × 3-inch insulators.

—Allen Breiner, W3ZRQ

SENSITIVE METER PROTECTION

To protect sensitive instruments from damage while transporting or handling, connect a shorting wire across the meter terminals. In the case of a v.o.m., switch the meter to the lowest current range and short out the test leads. If the meter pointer is set into motion by vibration or shock, a small current will be induced in the meter which tends to oppose the original movement of the pointer. This electrical damping will keep the pointer from swinging freely and damaging the instrument.

—Richard Niessen, K2SRA

COMPACT COIL FORMS

Inexpensive double-slug TV-type i.f. coil forms may be halved to provide single-slug forms for compact construction.

—Beld V. Foldesy, W6HCI

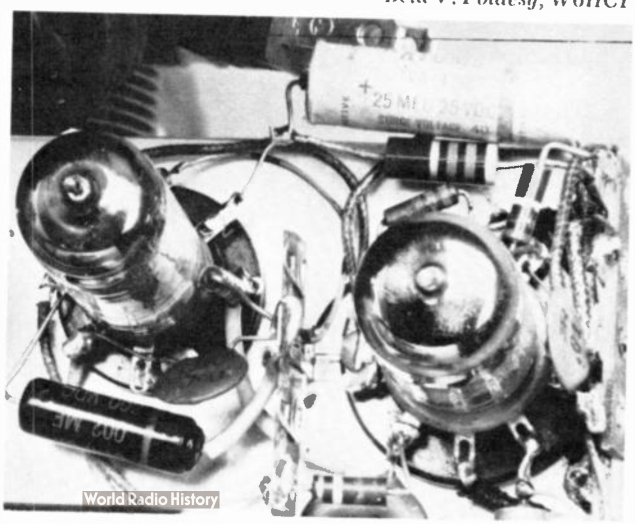


Fig. 11-2—No-scar modifications can be made to existing equipment by using the above-chassis tube sockets shown in the photograph.

HINTS ON WINDING COILS ON SMALL POLYSTYRENE FORMS

In winding a coil of large wire on a small-diameter polystyrene or bakelite form, the process can be simplified by first winding the coil on a smaller-diameter form with a few more turns than is necessary. The coil is then removed from the small-diameter form and worked onto the larger form. Once it is properly in place it can be doped on the form, and the result is a form coil which will not be as subject to change as one that is wound only for the finished diameter. This method also has the advantage that no holes in the coil form are necessary for fastening ends of wire.

—Jack Hill, WØZWW

FAST ETCH FOR COPPER-CLAD BOARDS

When etching copper-clad boards for "printed circuits" the etching process can be accelerated by using the following mixture as an etching solution. One part of concentrated sulphuric acid, one part nitric acid (70 percent concentration), and one part water. The complete process of etching takes about two minutes with 0.015-inch copper! Of course, extreme caution should be taken when handling the above chemical components and, remember, the gases released from the etching process are dangerous, too.

—Jim Carlson, WB6EED

CABLE RETAINER

An inexpensive wiring harness retainer suitable for holding down cables to wood or metal surfaces is now available. The device was originally used to hold wiring harnesses in General Motors cars. It is only necessary to drill a hole which will accept one of the protruding tips of the strap and plug this tip into the hole. The strap is then wrapped around the cable and snapped into place by the remaining tip. There are several holes in the strap so that various sizes of cable can be accommodated. For wood mounting, cut off one of the tips and secure the strap to the wood with a wood screw and flat washer. The retainer can be obtained from almost any General Motors dealership for about 15 cents each. The GM part number is 3750535.

—Donald R. Klobe, K8JQN

CABLE TWISTER

When making up two or more wires to form a twisted cable, place the ends of the wires in the chuck of a portable electric drill. Secure the other ends to a fixed object and turn on the drill. It doesn't take long to wind the wires. In fact it's better to operate the drill in spurts so as not to overtwist them!

—Alfred Bogdanoff, K2HIR

CRYSTAL SOCKET

There is nothing new about using a tube socket for a crystal socket. However, the old style octal wafer socket is sometimes overlooked as a satisfactory crystal socket for four FT-243 crystals. The sketch in Fig. 11-3 shows how two crystals are mounted on top of the socket and two are plugged into alternate pins on the bottom of the socket.

—Lew North, W4GEB

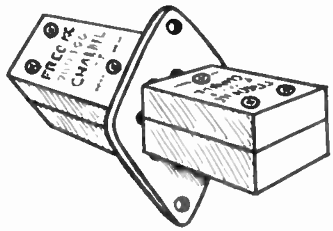


Fig. 11-3—A four-way crystal socket using an octal wafer socket.

CABLE MARKERS

Wires and small cables can be conveniently marked with jewelers' ring tags. These are the labels that jewelers use to mark the price of rings and other jewelry. They are available in several styles, including gummed paper and snap-fastening plastic, and come in several colors. The labels can probably be obtained from a jewelry store at no cost since they usually have large numbers of them on hand.

—Merritt F. Malvern, W2ORG

INEXPENSIVE FLEXIBLE SHAFTING

I found that an old discarded automobile speedometer cable can double as a short length of light-duty flexible shafting for remote tuning applications. Cut the cable to the proper size and solder the necessary fittings to each end. It is also a good idea to clean the cable assembly before using it, and an application of graphite will help to lubricate it.

The use of speedometer cables is not recommended for long runs since the shafting becomes somewhat "springy", resulting in unwanted backlash.

—John F. Micsak, W2PRR

COLOR CODING LEADS

The eight wire leads in my beam antenna installation terminate at a small metal box mounted at the top of my antenna mast. All the wire leads are of one color, and a system of color code identification was made by employing an inexpensive package of assorted colored pipe cleaners. Short lengths of about one inch were simply bent around each strip lug, twisted tight, and then snipped off flush. The operation is fast, neat and practical. The colored pipe cleaners are usually stocked by five and dime stores.

—William Staiger, W7IN

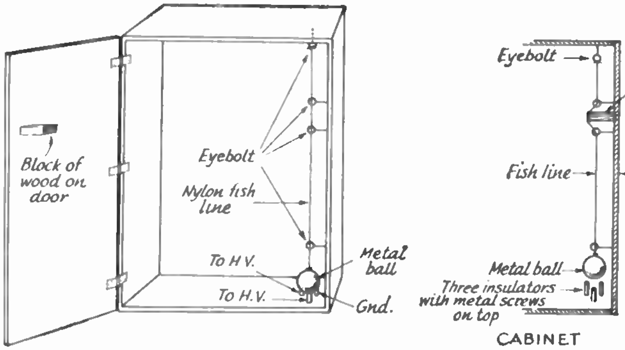


Fig. 11-4—W8MTI's safety switch.

BALL INTERLOCK SWITCH

The sketch in Fig. 11-4 shows a safety device for shorting the high-voltage circuit of a power supply when the access door is opened. This system is used quite often in commercial broadcast transmitters and has appeared from time to time in ham publications.

When the door is opened, the wooden block is withdrawn, allowing the string to straighten out. The metal ball, which is attached to the string, drops down on three standoff insulators. Metal contacts at the top of the insulators are connected to ground and to the high-voltage circuits. When the ball drops down, the high-voltage circuits are grounded.

This system has a back-up safety feature: If the string breaks, the ball will fall into place and short the high voltage. If this happens, it will be up to the power-supply fuses to turn off the supply.

—Harold E. Davis, W8MTI

BLACK CRACKLE BRIGHTENER

Discoloration and mars on black crackle finish can be covered up by painting the finish with black shoe dye. The dye does not fill in the crackle regardless of the number of times it is applied. The dye does not rub off, however, so be careful to keep it clear of surfaces that you do not want covered!

—Don Hutchin, K3DMZ/Ø

CABLE LACING MATERIAL

The vinyl jacket covering on popular types of coaxial cable can be used for cable lacing. Strip the covering off the coax by cutting a long, straight line down the length of the cable. Open the tube and snap it over the wire or cable you wish to cover.

—Gary Guenther, KØPQW

OIL CAN SHIELDS

The economy minded experimenter will be interested in learning that Mobil Oil is using aluminum cans for packaging their oil. After a cleaning and with one end removed, an aluminum can makes a good shield for transmitter coils or other components that are too large for the usual sized shields.

—Eugene Austin, WØLZL

BEARING OILER

To reactivate a noisy or sluggish electric clock, blower or other device with a sealed rotor or bearing, heat the unit in a moderate oven. Then, while it is cooling, place a few drops of oil around the output shaft or gear. The contracting air inside the sealed compartment will inhale the oil through the bearing and restore normal operation.

—Charles Kram, Jr., W5TFZ

MAKING FARADAY SHIELDS

The construction of Faraday shields can be simplified by using materials included in etched-circuit kits. The desired shield is drawn on a piece of copper-clad phenolic using the special etch-resistant ink. Etching solution is then used to remove the unprotected copper, leaving the shield ready for easy mounting.

Incidentally, most mail-order houses list the kits under the *printed circuit* heading of their catalogues.

—W1CUT

MORE ON HEAT-RADIATING TUBE SHIELDS

Having read WA2KWM's Hint & Kink in February *QST*, I have decided to clarify the process for treating the HX-30 tube shields.

The correct procedure is to heat the shields in a gas flame until they are red hot, and then quench them in a salt-water solution. It may be necessary to repeat this procedure two or three times until the shields turn a dull, dark gray. Care should be taken to make sure the shields make a good ground contact with the socket fingers, when reinserted.

Care should also be exercised in substituting other tube shields for the ones supplied for the tubes that drive the 6360 final amplifier. This is particularly true for the 6AK6. If the internal dimensions of the shield are different than the original ones, the different shield-to-plate capacitance will necessitate retuning these stages.

Of course, it is worth noting that "shiny" tube shields always run hotter than do dark ones and thus reduce tube life. This Hint & Kink can be applied to shields on most any equipment.

—Sheldon L. Epstein, K9APE/2

for Equipment Construction

CHANGING RESISTOR VALUES

It is possible to change the value of fixed composition resistors for experimental purposes and low power applications. All that's necessary is to notch the resistor with a file or grinding wheel. Connect an ohmmeter to the resistor during the grinding and stop the operation when the resistance reaches the desired value. Of course, the original resistor must always be lower in value since this method increases the resistance. It also decreases the power rating to some extent. The only limitation to this process is the physical size of the resistor.

—R. C. Benson, W1IIAC

ANOTHER USE FOR OCTAL TUBE SOCKETS

When breadboarding transistorized circuits, mount the transistor through the center hole in an octal socket and use the pin connections on the socket for tie points. In fact, this arrangement makes for a good permanent mount for transistors in the finished product!

—Peter A. Franke, K2LTC

REMOVING GLASS FROM METER CASES

Oftentimes it becomes necessary to remove the glass face of a meter, either for repairs or for recalibrating the scale. A convenient way to do this is to bake the meter with an infrared heat lamp. This expands the bakelite or metal case but not the glass, allowing the latter to drop out "easy like."

—Ed. A. Kirchhuber, W2KJY

REPUNCHING SOCKET HOLES WITH ACCURACY

I often find it necessary, after having selected a punch and knocked out a hole in a chassis, to make this hole larger so as to accommodate an electrolytic capacitor or tube socket of larger dimensions. An easy, quick and accurate way of accomplishing this feat is to keep on hand a knockout from each of your various punches. Then, say, you punch a three-quarter-inch hole and find a larger hole necessary. All you need to do is re-fit the three-quarter-inch knockout, place the larger punch in the starting hole and punch away.

This method is particularly successful with screw-type punches, such as the Greenlee. Try it on a piece of scrap and see for yourself how simple it is.

—Thomas B. Moseley

BALL-POINT TEST PROBES

Convenient test probes can be made from those slim ball-point pens. First, remove the tip and then solder a lead to the metal shaft. Run the lead back through the plastic barrel and reinsert the tip. Since the tip extends only a fraction of an inch below the plastic barrel, it is easy to use in restricted spaces without danger of shorting against nearby components or wires.

—Richard W. Roberts, K9IIFR

NEW PANELS FOR OLD

Aluminum or steel panels that have been discarded because of heavy scratches or small holes may be repaired by placing a sheet of Con-Tack adhesive plastic sheet over the panel. The Con-Tack plastic sheet is designed for covering kitchen tables and shelves and comes in several designs and colors suitable for radio panels. Twenty-five cents worth of the material will usually cover an average sized panel.

Don Hutchin, K3DMZO

PANEL BUSHING FROM POTENTIOMETERS

Don't discard those old burned-out potentiometers. Throw away the carbon element and case but save the shaft and threaded bushing. It can be used as panel feedthrough bushing for ¼-inch shafts.

—Ira L. Simpson, W3LKS

DECAL NOTE

After applying decals to a panel, cabinet, etc., they should be "fixed" to insure their permanency. Using a small camel's-hair paintbrush, or cotton swab, apply a small amount of acetone fingernail polish remover or lacquer thinner to the decal. Use just enough of the solvent to dissolve the clear decal backing.

—Malcolm F. Crawford, WA2IPC

MOUNTING AIR-WOUND COILS

Since I did not have a cone insulator I was unable to mount an air-wound coil the accepted way. I dug into my junk box and found a collection of empty plastic boxes in which screws, bolts and ceramic capacitors come. After removing several of the box tops I sandwiched them together and fixed them to the chassis with a machine screw and bolt. Then, with model airplane glue I cemented the plastic bars on the coil to the plastic base material. The sketch in Fig. 11-5 shows the arrangement.

—Eugene Cope, WA6DUW

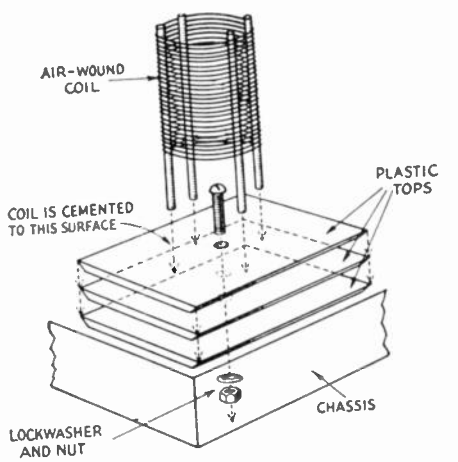


Fig. 11-5—Sketch showing WA6DUW's method of mounting air-wound coils.

ICE-CUBE BURN CURE

ONE of the weekly news magazines recently reported on a new method of treating burns—apply ice. We had occasion a few days ago to test the treatment when we grabbed a soldering iron by the wrong end along toward the end of a long session at the workbench. Long "sear" marks were left on the thumb and index finger, while the middle finger had a red welt raised instantly along the inside edge. We applied ice cubes to the burns for the next hour, and then bandaged them lightly with a medicated salve overnight. Result—the "sear" marks disappeared, while the red welt changed first to a blister and then to a streak of hard skin. Eighteen hours after the burn, there was no tenderness. In this one case, at least, the ice treatment really worked.

—W1IKE

CLEANING SILVER IDEA

I SOMETIMES need to use silver-plated parts from the junk box which are badly tarnished. I have found that the finish can easily be restored by a 5- or 10-second immersion in the "silver dip" cleaning solutions obtainable in jewelry or department stores. The dip should be followed by a detergent wash, hot-water rinse and careful drying. This treatment is very effective for parts with hard-to-reach contact surfaces, such as wafer switches, coax connectors, cavities, etc.

—George Scheicher, W9NLT

NEON LAMP FIRING VOLTAGE

I HAVE noted that neon glow lamps, when used in voltage-regulation applications, show a different voltage plateau if the leads are reversed in the circuit. For example, an NE-83 gave me 64 volts (at 4 ma.) when connected one way and 76 volts (at 4 ma.) when reversed. When using neon lamps for VR applications, it would be wise to try the lamp in the circuit both ways and choose the hookup that gives the voltage closest to the desired value.

David H. Atkins, W6VX

CHANGING CONTROL TAPER

IF it is desired to make a log taper control out of a linear taper control, place a resistor, R_2, between the wiper teminal and one end of the control, R_1, as shown in Fig. 11-6. The value for R_2 can be calculated using the following relationship: $R_2 = \frac{1}{2} R_1$.

—Dennis Reed, K1VGZ

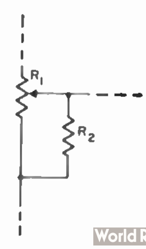


Fig. 11-6—A linear taper control, R_1, becomes logarithmic when resistor R_2 is added as shown.

SHIM-STOCK HOLE CUTTER

IN the course of constructing v.h.f. and other amateur equipment, I have always had difficulty in drilling holes in thin copper ribbon or braid used for grid and plate leads. It is practically impossible to use a conventional drill and it is difficult to grind a special tip for the job. I recently solved the problem by purchasing a 49-cent hand punch, such as those used by conductors to punch railroad tickets. This tool makes a nice, clean hole even in the thinnest stock.

—Edward C. Schaefer, W8SQU

ETCHING METAL PANELS

DECAL labels on radio equipment often wear and peel off quickly, particularly on test equipment subjected to constant use. Etched labels, on the other hand, provide permanent identification of control knobs and dials.

To etch a steel panel, pour hot paraffin over the area to be labeled. When cooled, letter the label into the paraffin with a sharp pointed instrument, scraping the metal clean to form the letters or numerals. Neat lettering can be insured by using a lettering guide from a stationary store. Remove any wax shavings with a fine brush and place a drop of hydrochloric or nitric acid on each letter with a medicine dropper. Several applications of acid may be necessary to obtain the desired depth. When etching has been completed, wash the panel with cold water and peel off the remaining wax. The etched characters can be filled with paint or nail polish.

The necessary acids can be obtained in small quantities at most drugstores, but are highly corrosive and should not be brought in contact with the skin. Containers should also be properly labeled and have tight plastic or rubber caps.

—Joe A. Rolf, K5JOK

MOUNTING POWER TRANSISTORS

IF circuitry requires that power transistors be electrically insulated from their heat sink, anodized aluminum washers will make good insulators. Small sheets of anodized aluminum are available from almost any radio-supply house in the form of dial plates used for identifying controls on audio amplifiers. After drilling the anodized plates, be sure to clean and deburr the holes.

—Melvin Leibowitz, W3KET

INEXPENSIVE CONTROL KNOBS

I HAVE found that electricians' solderless wire connectors can be screwed onto control shafts and used as knobs. These connectors are usually black in color and come in several different sizes. Almost any electrical supply house or hardware store carry the item which sells for only a few cents each.

—Roger M. Corey, W1IHNG

KNOBS FOR MINIATURE SHAFTS

In this age of miniaturization many variable capacitors and controls are coming through with smaller than ¼-inch diameter shafts. These sizes run either ⅛ or 3/16 inch. It is sometimes difficult to obtain knobs that will fit the shafts. One answer to the problem is the use of rubber grommets to act as knobs. The smaller grommets, the type with ⅛-inch diameter inner hole, can be slid over the end of the shaft making an inexpensive knob. Some of the smaller size rubber "feet" for equipment can also be used as knobs.

—W1ICP

LINE CORD HOLDER

When storing test equipment and electric tools, it is always a problem to keep the line cord from unwinding after it has been wrapped around the unit. I found a gadget in the local five-and-dime store which solves the problem. Called a Magnetic Cord Grip, and made by General Electric Company, it is designed for house appliances and holds the plug end of power cords to the side of the appliance. The line plug is inserted into the Cord Grip; then the cord is looped around the appliance or test equipment and held in place by the magnet. The Cord Grip has a set of prongs which mate with the 117-volt wall socket so that it is not necessary to remove it when plugging in the line cord to the wall socket.

—Jonathan S. Lee, W9MWR

TRANSFORMER WINDING NOTES

Those amateurs who don't have a TV transformer to guide them in winding a power transformer[1] may use the following tips for designing their own transformers.

There should be six turns of wire per volt r.m.s. per square inch of core. In other words, for every volt across a winding, divide by the number of square inches of cross section of transformer and multiply by 6 to determine the number of turns. Allow one third of the "window" area for primary wire, one third for secondary wire, and the rest for insulation and packing. Determine primary-wire size from the wire tables by dividing allowed primary area by the number of turns. Calculate length of primary wire by multiplying the number of turns by the average length per turn. The same is done for the secondary wire length. The average length will be longer, of course, since the secondary is the outside winding.

The power the transformer can dissipate in heat is ¼ watt per square inch of outside surface area. The area is found by direct measurement or by the formula $2.5L^2 + 3.6LH$, where L is the length of the laminations and H is the height of the stack.

—Frederick Cunningham, K1AJZ

[1] McCoy, "Tailor-Made Volts," QST, Feb. 1964.

RACK MOUNTING HEAVY EQUIPMENT

The sketch shows a method of mounting heavy equipment in standard panel racks to avoid the necessity of fumbling for the right hole while supporting the equipment with one hand. Place the mounting screws in the proper holes but from the rear of the rack. The screws should protrude far enough in front to support the panel and to allow a nut to be placed on them. The head of the screws should be jammed hard against the rack and a lock washer used to prevent it from turning when the nut is tightened on the front. For better appearance, use "acorn" or oval-head nuts.

—Llewellyn Melbert, W1FSH

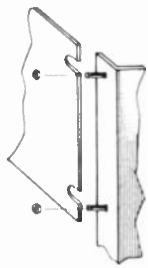


Fig. 11-7—W1FSH's method of mounting heavy rack equipment.

MOUNTING FEET FOR EQUIPMENT

While I was searching for rubber mounting feet for home-built equipment, I came across some small rubber bumpers normally used as commode seat bumpers. They are carried by most hardware stores, average about a dime apiece, and come complete with a recessed screw. The wood screw can be replaced by a machine screw when mounting on a metal cabinet or chassis. The bumpers measure about ⅞ inch in diameter, ⅜ inch high and have a ⅜-inch hole.

—Warren Rudolph, W4OHM

TOOTHPASTE-TUBE KNOBS

Try using the lid from a toothpaste tube as an attractive knob. Select a rubber grommet with an outside diameter that will fit tightly inside the toothpaste lid and at the same time will fit tightly over the control shaft, so that the combination will not slip. There are many styles, sizes, shapes and colors of toothpaste lids available.

—Larry W. Cannon, K0SFV

MORE ON EQUIPMENT FEET

The "Hint & Kink" in November QST describing some No Scratch Equipment Feet reminded me of my own efforts along this line. I have my solution to the problem: simply drill ¼-inch holes in each corner of the project's bottom plate and pop in some ¼-inch rubber grommets!

—Anthony L. Pinto, WA2YJX

NO-SCRATCH EQUIPMENT FEET

A problem often encountered in home-built equipment is that of finding suitable legs or feet to prevent the scratching of desk tops or other equipment. The drawing in Fig. 11-10 shows a solution to this particular problem. Plastic furniture leg tips have recently been placed on the market in a variety of sizes and colors. A convenient size for ham use is the ¼-inch white tip.

To use these tips, cut four ¼-inch-diameter bushings ⁵⁄₁₆ of an inch long. The inside diameter of the bushing should be large enough to accept a No. 6 machine screw or self-tapping sheet-metal screw. Appropriate holes should be drilled in the proper locations on the bottom of the equipment. A machine screw and nut or a self-tapping sheet-metal screw secures each bushing to the equipment. After the bushings are in place, simply slip the tips over the bushings.

—Lowell E. Robertson, K6QXQ

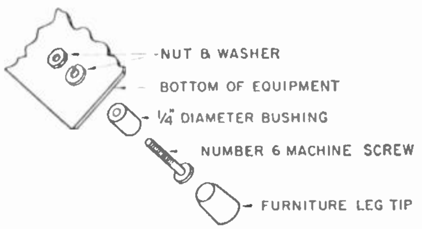


Fig. 11-10—K6QXQ's no-scratch equipment feet.

CHASSIS AND PANEL LAYOUT

A common practice in the machine-shop and sheet-metal industries is to coat the metal to be fabricated with a blue-colored alcohol base dye, known as "layout blue." The dye enables the worker to scribe accurately the dimensions of holes, bending lines, etc. Once the item is fabricated, the layout blue is removed with either paint thinner or a commercial vapor degreaser.

I recently discovered that the common felt-tipped "Magic Markers" available in most stationery, five-and-dime, or drug stores will work exactly like layout blue. Using the marker pencil, it is possible to color areas where drilling, punching, bending, etc., is required. Scribe lines as required and proceed with the fabrication. When finished, remove the ink with common nail-polish remover. This technique lends itself to more professional and accurate chassis and panel work.

—Robert F. Aberle, W2QPP

CABLE LACING CORD

Dental floss makes an ideal substitute for lacing cord and is available in most drug-stores in several sizes, the most useful being approximately ¹⁄₁₆ inch in width. However, the smaller sizes are useful with miniature ca

FLUSH-MOUNTING TRANSFORMERS

In mounting flush-mounting power transformers, it is often difficult to spot the four mounting holes accurately. If the chassis has been covered with paper in the manner customary for layout marking, the mounting holes can be spotted accurately after the rectangular core hole has been cut by using a ball-point refill which will pass through the core-bolt holes of most transformers.

—W1TS

BREADBOARDING TRANSISTORIZED CIRCUITS

After trying many different ways of bread-boarding transistor experimental circuits, I discovered a practical and economical method of doing it. I use an old-fashioned wooden breadboard, or any suitable piece of wood. However, instead of conventional terminal strips or tie points, I simply hammer in ordinary copper tacks wherever a terminal is needed.

—John Oriel, WA2LED

FIVE-AND-DIME SPACERS

Hollow plastic cylinders of various lengths are sold in five-and-dime stores and are packaged in many different colors and lengths. These spacers are called "Indian beads" and make marvelous bushings for mounting terminal strips, sockets and other parts above a chassis or panel. The beads normally sell for about 25 cents a package.

—Merritt F. Malvern, W2ORG

PLUGGING PANEL HOLES

To cover up unwanted holes in a panel, place the panel face up on a thickness of cloth padding and pour molten lead solder into the hole. After the solder has cooled, beat both sides with a ball-pen hammer so that the solder plug expands and makes a snug fit. Also, peen the edges of the plug so that they protrude slightly over the surface of the panel. Now grind the plug flush with the panel with an abrasive wheel and finish off with fine sandpaper. A coat of paint will restore the panel to a factory finish. This method has been used to fill holes up to ½-inch diameter in steel and aluminum panels.

—Jay F. Helms, W6HHT/2

TUBE TESTING HINT

The number of do-it-yourself tube testers appearing in the supermarkets and drugstores these days can prove a blessing to the amateur whose personal tube tester is outdated. These self-service testers cover all the latest TV and radio tubes, and are quite accurate if one knows how to interpret their readings.

I tested an old 5U4 rectifier that someone had discarded and left at a tube-testing machine and found that it checked "no good" even though the filament lighted up. I took the tube home and checked it on my personal tube tester, and found that the tube tested "O.K.", except that the filament emission was down about 50 per cent. Suspecting that the store tester was biased to exaggerate the condition of the tubes, I tested several tubes I had around the shack and compared the readings on the self-service tester with those on my home tester. Results showed that the U-test-em machines are biased to give a "no good" reading on a tube that is about 50 per cent down on emission, but on the other hand is quite accurate on tubes that are up to snuff. This action of the store tester will sometimes eliminate a tube that really isn't completely useless.

—Harry K. Long, W7CQK

TRANSISTOR PROTECTION

To prevent burning out of transistors because of incorrect power-supply polarity, place an ordinary crystal diode in series with one of the power leads so that current will flow only in the proper direction. If the power supply is accidentally connected backwards, the diode will protect the transistors. Of course, the diode should be capable of carrying the total circuit current.

—Charles Curran, K2DQD

REMOVING HOT TUBES

There is nothing new about this idea but even so it bears repeating. A simple method for removing hot tubes from "hard to get at" places is to wind a rubber band around each of the jaws of an ordinary pair of pliers. This makes an excellent tool for gripping and removing the tubes.

—W1ICP

MORE ON MINIATURE KNOBS

W1ICP's Hint & Kink in *QST*, October, 1963, prompted me to suggest a similar hint used at my station.

Most toothpaste and similar tubes today are supplied with a colored fluted cap. Such a cap, when fitted with a metal bushing, makes a neat miniature knob for mobile or similar equipment.

Quarter-inch bushings are usually obtainable from junk boxes or surplus gear whilst smaller bore bushings can be made from easily drilled brass stock. Fitted with an Allen grub screw and cemented inside the toothpaste cap, the completed item makes an attractive and effective knob. A selection of caps of similar design but different colors makes for quick identification of the various controls.

—H. N. Kirk, G3JDK

S.L.F. DIAL READOUT WITH AN S.L.C. TUNING CAPACITOR

In developing a receiver where the local oscillator must tune 5.0 to 5.5 Mc. on all bands, and must also serve as a heterodyne v.f.o. for a multiband transmitter, I desired to have the 0 to 500 logging scale on the Eddystone dial read directly in kilocycles. Since the tuning capacitor in the receiver was a straight-line-capacitance unit, I evolved the method shown in Fig. 11-11 for achieving straight-line-frequency dial calibration.

An aluminum disc is attached to the main tuning shaft. A second variable capacitor is mounted nearby and connected in parallel with the main tuning capacitor. A lever is fixed to the second capacitor shaft and arranged to ride on the edge of the disc under tension provided by a light spring.

If material is removed from the disc, the plates of the second capacitor will open and the v.f.o. frequency will increase. When the disc is filed to form a cam, the second capacitor acts as a continuously variable trimmer controlled by the main tuning shaft.

The compensating system is adjusted by setting circuit padding capacitors to produce a frequency slightly low at all dial positions, and then filing the disc to bring the frequency up to the dial readings. This process is not as laborious as might be assumed from a glance at the photograph. The main tuning shaft turns through 180 degrees, not 360 degrees, and only half of the disc must be formed into a cam. Also, when the second capacitor is of relatively large value, such as the broadcast unit used here, the motion of its shaft for a given frequency correction is small and the amount of material which must be removed from the disc is correspondingly minimized.

—William L. Hale, K8JIX

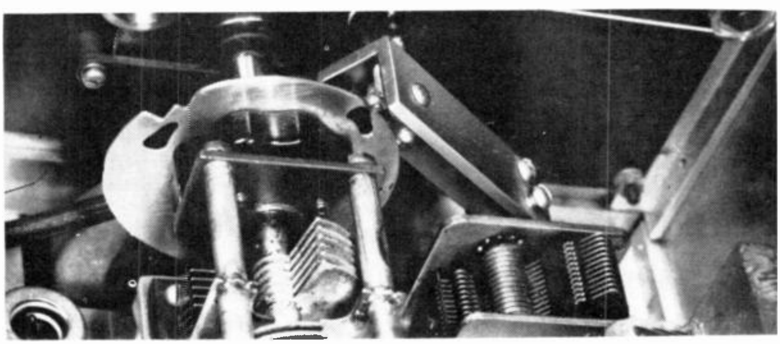


Fig. 11-11—The cam on the capacitor shaft at the left works against the spring loaded lever arm which is attached to the variable capacitor at the right.

TEMPORARY COAX CONNECTOR

Terminating coax to a conventional coax connector is time-consuming and irritating when you are experimenting with different lengths of coax. The sketch in Fig. 11-8 shows a method for making temporary connections. A binding post is soldered to the center terminal of a PL-259 coax connector and is used to terminate the coax center conductor. A hose clamp holds the shield of the coax.

—Henry E. J. Smith, W5DAI

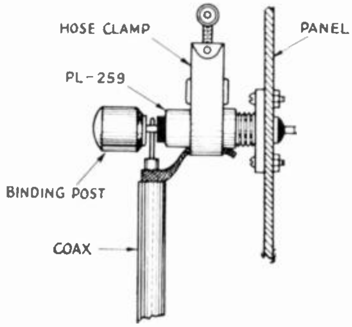


Fig. 11-8—Temporary coax connector.

IS YOUR STATION UNDERWRITERS' LAB APPROVED?

The National Electrical Safety Code, Pamphlet 70, Standard of the National Board of Fire Underwriters, deals with electric wiring and apparatus. The Code was set up to protect persons and buildings from the electrical hazards arising from the use of electricity, radio, etc. Article 810 is entitled "Radio Equipment." The scope of this article, Section 8101, says, "The article applies to radio and television receiving equipment, and to amateur radio transmitting equipment, but not to the equipment used in carrier-current operation." Without reading further, most amateur stations comply with these safety rules, not because they are required to do so, but because of the inherent nature of the ham to provide great safety factors in most of his equipment. It is to the one in a hundred, where the safety factor is doubtful, that these articles will be helpful. It will be seen later that not only do these articles satisfy the Underwriters' Code but, when fulfilled, some are measures that one would take to TVI-proof his rig. So it's a matter of killing two birds with one stone.

The Board of Fire Underwriters sets up the code as a minimum standard for good practice. Most cities adopt the code, or parts of it, either entirely or with certain amendments which may apply to that particular city. It is up to the city to enforce these rules. When a violation is reported, periodic checks are made by an inspector until a correction is made and to insure against future recurrence.

Antenna Systems Sections 8111-8115

"Antenna-counter-poise and lead-in conductors shall be of hard copper, bronze, aluminum alloy, copper-clad steel, or other high-strength, corrosion-resistant material. Soft-drawn or medium-drawn copper may be used for lead-in conductors where the maximum span between points of support is less than 35 feet. Outdoor antenna, counter-poise and lead-in shall not be attached to poles or similar structures carrying electric light or power wires or trolley wires of more than 250 volts. Insulators shall have sufficient mechanical strength to safely support the conductors.

"Outdoor antenna, counter-poise and lead-in shall not cross over electric light or power circuits and shall be kept away from all such circuits so as to avoid the possibility of accidental contact.

"Where the proximity to electric light and power service conductors of less than 250 volts cannot be avoided, the installation shall be such as to provide a clearance of at least two feet. It is recommended that antenna and counter-poise conductors be so installed as not to pass under electric-light or power conductors.

"Splices and joints in antenna and counter-poise spans shall be made with approved splicing devices or by other means as will not appreciably weaken the conductors. Soldering may ordinarily be expected to weaken the conductor; therefore, soldering should be independent of the mechanical support.

"Metal structures supporting antennas shall be permanently and effectively grounded."

Antenna Systems — Receiving Stations Sections 8121–8124

"Outdoor antenna and counter-poise conductors for receiving stations shall be of a size not less than in the following table:

Material	*Minimum Size of Conductor When Maximum Span is . . . Less than 35 feet*	*35–150 feet*	*Over 150 feet*
Aluminum alloy, hard-drawn copper	19	14	12
Copper-clad steel, bronze or other high-strength material	20	17	14

"Lead-in conductors from outside antenna . . . shall be of such size as to have a tensile strength at least as great as that of the antenna conductors (as in the table).

"Lead-in conductors attached to buildings shall be so installed that they cannot swing closer than two feet to the conductors of circuits of over 250 volts, or less; or ten feet to the conductors of circuits of more than 250 volts. . . .

"If an electric supply circuit is used in lieu of an antenna, the device by which the radio receiving set is connected to the supply circuit shall be specially approved for the purpose."

Antenna Systems — Transmitting Stations
Section 8131–8135

"Antenna and counter-poise conductors for transmitting stations shall be of a size not less than given in the following table:

Material	Maximum Size of Conductors When Maximum Open Span is . . . Less than 150 feet	Over 150 feet
Hard-drawn copper	14	10
Copper-clad steel, bronze or other high-strength material	14	12

Lead-in conductors shall be of a size as specified in the table, for maximum span lengths.

"Antenna and counter-poise conductors for transmitting stations attached to buildings shall be firmly mounted at least three inches clear of the surface of the building on non-absorptive insulating supports such as treated pins or brackets, equipped with insulators having not less than three-inch creepage and air gap distances.

"Entrance to buildings . . . except where protected with a continuous metallic shield which is permanently and effectively grounded, lead-in conductors for transmitting stations shall enter buildings by one of the following methods:

"a. Through a rigid, non-combustible, non-absorptive tube or bushing.

"b. Through an opening provided for the purpose in which the entrance conductors are firmly secured so as to provide a clearance of at least two inches.

"c. Through a drilled windowpane."

Transmitting Stations
Section 8192

"Transmitters shall comply with the following:

"a. Enclosing. The transmitter shall be enclosed in a metal frame or grille, or separated from the operating space by a barrier or other equivalent means, all metallic parts of which are effectively connected to ground.

"b. All external metallic handles and controls accessible to the operating personnel shall be effectually grounded. No circuit in excess of 150 volts should have any parts exposed to direct contact. A complete dead-front type of switchboard is preferred.

"c. Interlocks on doors. All access doors shall be provided with interlocks which will disconnect all voltages in excess of 350 volts when any access door is opened.

"d. Audio amplifiers. Audio amplifiers which are located outside the transmitter housing shall be suitably housed and shall be so located as to be readily accessible and adequately ventilated."

How many hams have transmitters unenclosed or without interlocks or both?

The author has purposely visited over a dozen ham shacks and there are some who do not comply with various provisions. Of course, no particular station will be shut down because the antenna lead-in is No. 16 instead of No. 14, or because the speech amplifier is not totally enclosed. The National Electric Code is only a minimum standard, and compliance with its rules will assure less operating failures and hazards, and greater safety.

A copy of the pamphlet is available by writing the National Board of Fire Underwriters in your city, or at 85 John Street, New York 38, New York. Ask for pamphlet No. 70.

Other parts of the Underwriters' Code deal with power wiring and, in addition to the requirement of the use of U.L. approved materials and fittings, have the following to say of direct interest to amateurs:

"All switches shall indicate clearly whether they are open or closed.

"All (switch) handles throughout a system . . . shall have uniform open and closed positions.

". . . supply circuits shall not be designed to use the grounds normally as the sole conductor for *any part* of the circuit."

The latter means that wire conductor should be used for all parts of the power circuit. Dependence should not be placed on water pipes, etc., as one side of a circuit.

—I. F. Wolk, W6HPV

COAX-TO-TERMINAL-STRIP ADAPTER

The accompanying sketch shows how I added a coaxial connector to the antenna terminal of my RME 4350 receiver. This method eliminates the need for drilling a hole in the receiver's chassis to mount the connector. Remove the head from a 6-32 screw and solder the screw to the center conductor of the coax connector. The connector is then screwed into the terminal strip with a section of small tubing inserted as shown in the sketch. Another 6-32 screw is inserted through one of the holes in the connector flange and is screwed into the other antenna terminal. Also connected to this screw is a lead that is attached to the ground terminal on the terminal strip. Almost any terminal strip can be used with this scheme since spacing between the lugs seems to be a standard ⅜-inch, which is just the right measurement to line up with the holes in the SO-239 connector.

—Dr. L. M. Salinger, K5MSQ

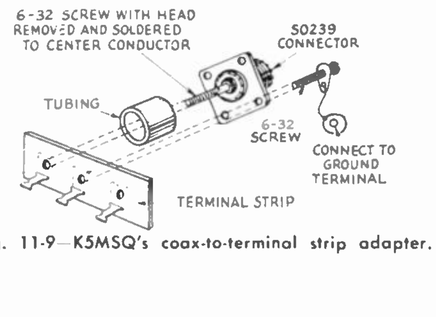


Fig. 11-9—K5MSQ's coax-to-terminal strip adapter.

REMOVING HERMETICALLY-SEALED CRYSTALS

A recent article, "Grinding Surplus Hermetically-Sealed Crystals," *QST*, March, 1963, showed a technique for changing the frequency of hermetically-sealed crystals. In building filters and VXOs for various bands, I have had occasion to open up and modify a number of these crystals. Since the technique used is different from that used by W5EIM, it may be of interest to others.

Instead of using a gas stove, on which I didn't have the finesse to avoid overheating the crystal, I made a little attachment for the soldering gun which heats only the crystal can around the region of the soldering bead which seals it. A piece of No. 12 or 14 wire is formed tightly around the crystal can as shown in Fig. 11-12. The ends of the wire are bent so that they can be plugged into a solder gun, a Weller 8100 in my case, where the tip normally goes. The gun is turned on and the copper wire is tinned thoroughly before use. A little solder is fed in between the crystal can and the wire each time it is used in order to aid the heat flow in the can.

For raising the crystal frequency, I use the solution recommended by Newland, "A Safe Method for Etching Crystals," *QST*, January 1958, and simply dunk the plated crystal, leads and all, into the bath. This seems to maintain the crystal characteristics better than the grinding I've tried. For example, in moving crystals which had good VXO pulling characteristics, the etching process had little effect on their VXO properties. In all cases, the crystal and its leads must be thoroughly cleaned with either water or alcohol before re-sealing.

—Ben Vester, W3TLN

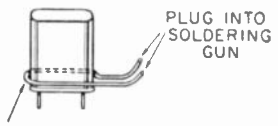


Fig. 11-12—W3TLN's soldering gun crystal can opener. The regular soldering gun tip is removed and the crystal can removing tip is inserted in its place.

CLEANING LITZ WIRE

It is important, when using Litz wire, that none of the individual strands be broken when making a connection and that each strand be cleaned of all enamel. The easiest method I have found to do this is to heat the end of the wire until it is red hot and then plunge the red-hot end into an alcohol bath. This method is superior to using fine sandpaper as there is no risk of breaking the wires and they are all cleaned and ready for the solder.

—R. F. Wright, Jr., W2YZT

PLASTIC TUBE SPAGHETTI

The Hint & Kink concerning ball point spaghetti in July *QST* prompts me to mention the plastic tubing used in hospitals. This tubing is used in large quantities and is usually discarded after being used once. Sometimes fixtures attached to the tubing can be made into feed-through insulators! I am sure that most any hospital would be glad to give the tubing to anyone who asks for it.

—Robert L. Atkinson, M.D.

RESURRECT BROKEN TRANSISTORS

If you have a transistor that is not usable because of a broken lead, take a small needle and force it into the opening around the broken lead and apply some cement to strengthen the connection. If the transistor is going to be soldered into a circuit, it probably would be wise to solder a lead to the needle before it is inserted into the transistor.

—Earl F. Hardwick

SLUG-TUNED COIL KNOB

For small slug-tuned coils that need frequent adjustment, try using the top from an old push-button spray can for a knob. Just put a few drops of cement in the knob hole and press onto the shaft. Some of the spray-can tops have a small arrow that can be used as an indicator.

—Paul Jacobs, K9LXX

SHIELD CAN SOURCE

Flourescent light starters have aluminum cases which make excellent miniature shield cans. The shields measure 13/16 inch in diameter and about 1½ inch in length. Four tabs at the open end of the shield can be run through the chassis and bent for mounting.

—Laverne A. Bamberg, W9KCR

KNOBS FOR APC TYPE CAPACITORS

For years I have been looking for a method of adding knobs to the small APC variable capacitors that normally require screwdriver adjustment. A method was finally found. I cut off a ⅜-inch piece of ¼-inch o.d. copper tubing and slipped it over the screwdriver adjustment shaft. After it was soldered in place, a knob could be added.

—Stanley O. Andrews, W4IIW

REMOVING STATIC ELECTRICITY FROM PLASTIC METER COVERS

A static charge, as noted on plastic meter covers of various test instruments and meters, can in most cases be greatly reduced or eliminated by cleaning the plastic meter face with a liquid detergent. Use the detergent full strength, wipe it on and off the face of the meter with a clean soft cloth.

—Stuart Leland

AIR WOUND COIL MOUNTS

THE sketch in Fig. 11-13 shows how to mount commercial air wound coils, such as the Miniductor and Air-Dux types. The mount uses rubber faucet washers on aluminum brackets. For vertical mounting, any old radio or TV tuning knob slightly larger in o.d. than the inside diameter of the coil is used to support the plastic strips in the coil. These methods of mounting are far superior to the conventional way, which uses the wire coil leads to support the coil.

—Ronald E. Winther, W1CWT

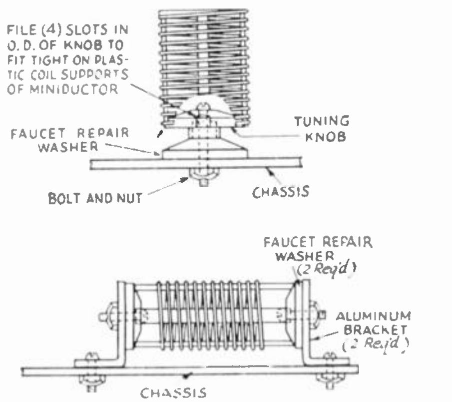


Fig. 11-13—Vertical and horizontal mounting of air wound coils. In the horizontal method, the brackets are bent toward each other to put the plastic strips in compression.

CONVENIENT PANEL MARKER

THE Taperaser blockout typewriting correction tape made by Dixon Co., Jersey City, New Jersey, serves also as a way to put panel markings on a black panel. Just write through the tape on the panel with a ball-point pen and it leaves a white mark that is not easily rubbed off. A bit of clear lacquer spray or varnish over the lettering will make for a neat and permanent job.

—Rev. William P. Hall, Jr., W4NHX

MOUNTING OF SMALL COMPONENTS

WHEN constructing transistorized gear, how often have you looked for a suitable way to support the components and transistors, particularly when the transistors are to be permanently installed in the circuit?

A very simple and effective support can be made using a standard miniature 7- or 9-pin tube socket. Place the component leads in the lugs and after all the wiring is complete, but before lugs are soldered, install the transistors. Hold their leads with a pair of long-nose pliers and then solder all circuit connections. The socket can then be mounted inside the chassis by running a small machine screw through the center hole and fastening it with a nut and lock washer. Here at W2JIO, we've been making some of the newer transistorized gear with this method.

—Bob Gunderson, W2JIO

TRIMMER CAPACITOR SHAFT

TRIMMER capacitors are often used in place of regular variable capacitors by soldering a shaft to the metal slot on the trimmer's rotor. A superior mechanical job, with the extra advantage of electrical insulation when it is desired, can be obtained by joining the rotary part of the trimmer to a phenolic or metal ¼-inch shaft with a glob of epoxy cement, such as that now commonly available at hardware stores.

—Thomas E. Skopal, W3WJN

PROTECTION AGAINST SHORTS AND ARCING

BOLTS or machine screws that extend through chassis or partitions sometimes come dangerously close to high-voltage leads and components. To insure against short circuits and arcing, I use a common household electrical wiring splice-connector threaded over the projecting bolt or screw. These splice-connectors are usually made of insulating plastic and have a tapering internal thread. When they are threaded onto the bolt they make a very tight fit.

—Jerry A. Collum, K8IKM

SEMICONDUCTOR HEAT-SINK CLAMP

WHEN soldering transistors, diodes or other heat sensitive devices, it is a good practice to clamp the leads of the component with a pair of long-nose pliers or other heat-sink clamping device.

I discovered that a common tie clasp works very well as a heat-sink. Every workbench should have more than one of the clamps, since at least two are necessary when soldering diodes in a voltage doubling circuit or when two diodes are connected in series or parallel.

—J. Allen Selvidge, W0OMG

CRYSTAL SOCKETS

MOST amateurs are familiar with the idea of using octal tube sockets as holders for .094 inch crystals, such as the popular FT243 series, but some may be interested to learn that the new .050-inch thin-pin crystals can be mounted in Loktal tube sockets.

—Arnold Reinhold, K2PNK

HOMEMADE TERMINAL BOARD

A CUSTOM terminal board can be fabricated in the home shop simply by driving brass nails into a piece of phenolic or wood. After inserting the nails, you can solder to either the head or the spike end of the nails. Drilling a hole, smaller in diameter than the nail diameter, will facilitate the process.

—Fred W. Asmussen, K0ZAQ

CAR-RADIO DUMMY ANTENNA

When bench-testing a car radio, a suitable dummy antenna to simulate the fender or cowl-mounted antenna can be constructed from a couple of 39-pf. mica capacitors and a small aluminum box. The circuit for the dummy antenna is shown in Fig 11-14, and is placed in series with the signal generator, etc., and the receiver. Motorola-type connectors are mounted on the aluminum box. A variation on the circuit uses adjustable trimmer capacitors which can be adjusted after the unit is assembled, in which case small access holes must be placed over the trimmer adjustment screws.

—Sol Davis, W3WPN

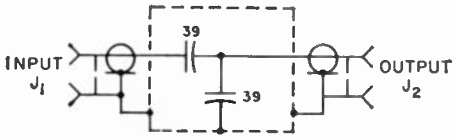


Fig. 11-14—Dummy antenna to simulate a car antenna. J_1, J_2—Automobile antenna connectors (Motorola 1741).

USING RUBBER GROMMETS AS RUBBER FEET

An easily installed substitute for bumper feet is a set of rubber grommets mounted in the usual manner where the feet are desired. This idea works well on metal cabinets, chassis bottom covers, etc. Frequently, the grommets will give more "slip-proofing" than standard rubber feet!

—Meritt F. Malvern, W2ORG

CONTROL ROTATION RIGHT?

I can never seem to remember how to connect up a potentiometer so that when the shaft is rotated clockwise, the gain or what-have-you would increase instead of decrease. I finally solved the problem. When the control is held with the teminals pointing up and the shaft pointing at you, the terminal to be grounded, in normal control applications, is the one on the *right*.

Having accomplished this scientific breakthrough, I went on to memorize: The *right* terminal is the *right* one to ground. Now, all of my controls turn the right way!

—R. F. Van Wickle, W6TKA

COIL-WINDING TIPS

Coil winding is probably as old as amateur radio itself, and many methods of winding have been perfected. Many of the standard methods are not known to the newcomer or beginner, so it is well to repeat them from time to time for the "new generation."

Coil information included in constructional articles is usually approximate and it is sometimes a tedious process to cut and try coil lengths and spacing. One way to simplify coil winding is as follows: Usually the primary or tickler winding of the coil is located at the bottom of the coil and does not require much pruning. Therefore, holes can be drilled above the desired pin connection and the winding wound with the coil ends soldered to the pins. At the spacing desired between the primary and secondary windings, a hole for the cold end of the secondary is made above the pin to be used. A small closed loop is formed at the end of a length of bare tinned No. 20 wire. The wire is pushed through the hole from the outside of the coil and into the proper pin until the wire loop fits snugly against the hole. At a distance above the loop equal to the length of the secondary winding, drill another hole above the appropriate pin. Again, another wire with a closed loop is installed as before. The two loops now afford a readily accessible connection for the beginning and end of the secondary coil. It's an easy matter to modify the secondary coil by unsoldering the coil ends from the fixed loops.

If the coil requires a tap, drill a hole above the proper pin in the space between the primary and secondary coils. Push a length of flexible No. 26 bare wire through the hole and pin. Leave enough wire extending from the hole to reach the spot on the coil to be tapped.

To wind the coils, unwind a length of wire from its spool. Hold the spool in a vise and walk up to the spool while turning the coil under tension. Because of the loops at the beginning and end of the coil, it becomes a simple job to "cut and try" different lengths.

—Cecil W. Guyatt, W4LFO

FAHNESTOCK PHONE JACK

If you need a phone jack for a breadboard experiment, try the scheme shown in the sketch in Fig. 11-15. Mount two large Fahnestock clips parallel to each other, the distance between them being determined by the length of the plug to be used.

—Leonard Prescott, WA9CHG

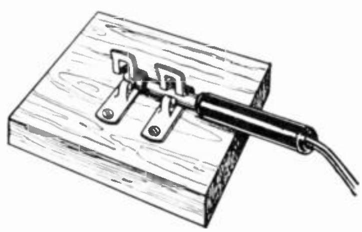


Fig. 11-15—Fahnestock clips used as a phone jack.

COAX TO MIKE CONNECTOR

The standard coax cable connector type 83-1SP can be made to mate with screw-on single contact microphone connectors by simply removing all but ⅛ inch of the center conductor tip of the 83-1SP connector.

—Jerry Malinski, K9LRU
—Carl M. Stern, K9EGH

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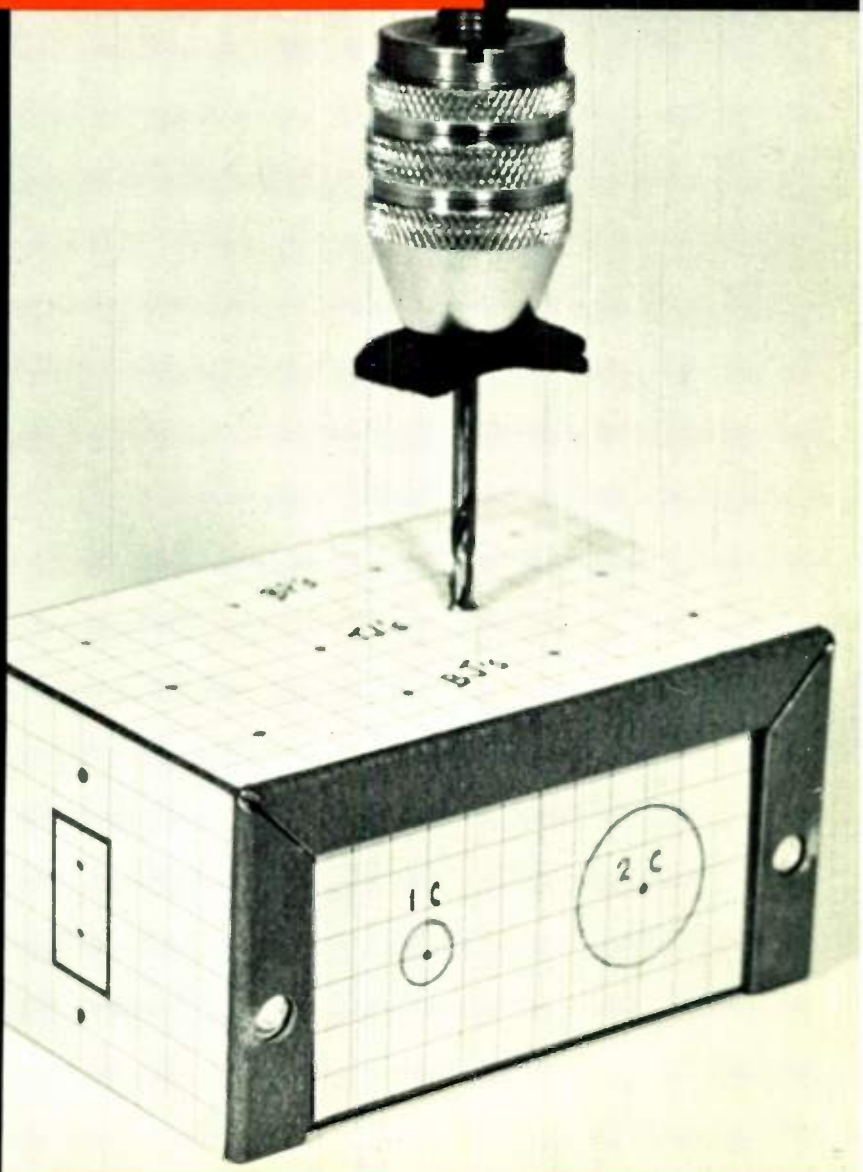

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Foreword

This booklet, the eighth in a series going back to 1933, illustrates two of the outstanding qualities of the radio amateur: his inventiveness in solving the little problems of amateur radio in workshop and station, and his willingness to share his work with his fellow amateurs.

It illustrates in capsule form the American Radio Relay League functioning at its best, for the book has no fewer than 300 authors, each of whom originally contributed his brainchild to *QST*, the League magazine, for publication therein. Gathered here are the best of the ideas presented over a three-year span in the monthly columns, "Hints and Kinks" and "Gimmicks and Gadgets."

At least some of the ideas in this volume will be of interest to every active radio amateur—and many of them will be useful to non-amateurs interested in various phases of electronics.

And should you find your own experiments producing a handy answer to a common problem, send it in to *QST;* you'll be among the authors of Volume 9, for which a need will eventually develop as amateurs continue in their public service hobby.

JOHN HUNTOON, W1LVQ
General Manager

Newington, Connecticut

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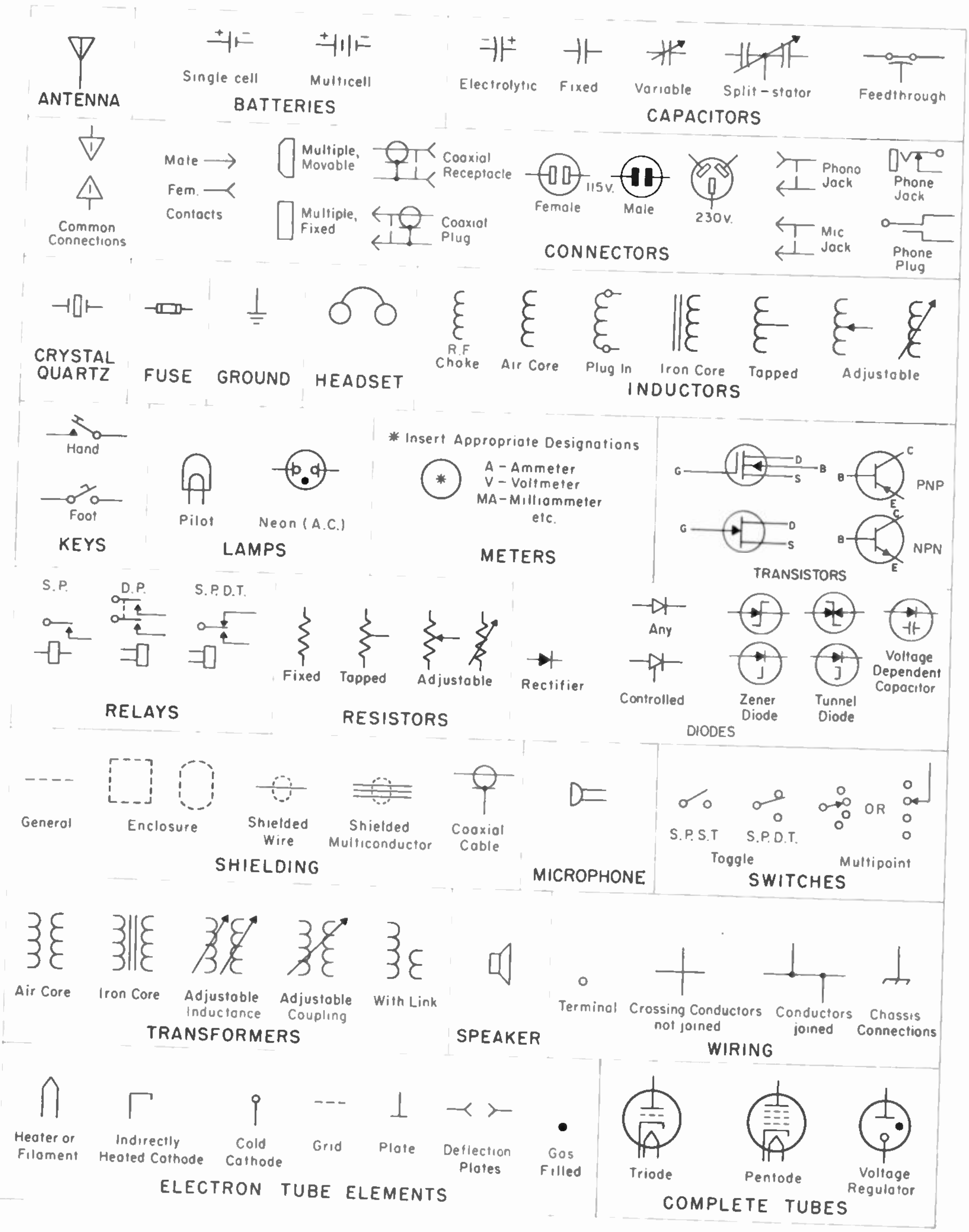
SCHEMATIC SYMBOLS USED IN CIRCUIT DIAGRAMS



Where it is necessary or desirable to identify the electrodes of capacitors, the curved element represents the *outside* electrode (marked "outside foil," "ground," etc.) in fixed paper- and ceramic-dielectric capacitors, and the *negative* electrode in electrolytic capacitors. In the modern symbol, the curved line indicates the moving element (rotor plates) in variable and adjustable air- or mica-dielectric capacitors. In the case of switches, jacks, etc., only the basic combinations are shown. Any combination of these symbols may be assembled as required, following the elementary forms shown.

Hints and Kinks . . .

for the Workshop

REPAIRING SOLDERING PENCIL TIPS

The ceramic around the tip of a soldering pencil will often crack after the iron has had extended use. Eventually the element will become unusable due to the looseness of the tip; however, the tip can be repaired with muffler cement, a substance usually found at auto supply houses. A tube of this cement is very inexpensive, and it can be used for other minor repairs involving heat because it will stand up to temperatures as high as 1200 degrees F.—*Mike Greenway, K4TBN*

CLEANING CRACKLE FINISHES

In an April 1968 Hint & Kink it was suggested that gasoline be used to clean crackle finish panels. I suggest that solvent be used instead. Gasoline is dangerous and particularly so if used from an open can.—*Ralph Gibbons, W7KV*

CLEANING HINT

For the hard-to-clean spots in your rig or bug, try a moistened Q-Tip.—*W1VG*

DENTAL INSTRUMENTS FOR THE AMATEUR

Discarded and broken explorers and scalers are very handy tools for the ham shack. Dentists break the fine points of these instruments, making the tools useless for the purpose for which they were designed. However, such tools are more than adequate for opening up solder-filled holes in sockets and tie-points. Solder won't adhere to the instruments because most modern dental hardware is made of stainless steel. The next time you visit your dentist, ask him for these used or broken items; in most cases, he will be glad to give them to you.—*Dr. Roy R. Campbell, W4DFR*

CLEANING CRACKLE FINISHES

A Hint & Kink in *QST*, August, 1966, suggested that an art-gum eraser be used to clean crackle finishes. However, better results can be obtained by cleaning the finish with xylene and then applying a coat of Krylon clear lacquer. If xylene is hard to get, use gasoline.—*W1ANA*

— • • • —

The August 1966 Hint & Kink on cleaning crackle finishes is too slow. For quicker results, get a bottle of Soil-Off or Mr. Clean. Either one will lift the dirt off and put on a nice sheen.—*Carl E. Braun, W7HRV*

ALUMINUM FINISHES

In reference to W3KOC's article, "Aluminum Finishes," in *QST* for October 1967, there are two other convenient places, which the author neglected to mention, for cleaning, etching and dyeing aluminum: the bathtub and the toilet bowl. The toilet bowl has a flushing feature which, besides its obvious benefits, may be altered to facilitate dyeing with a hot solution. By reaching inside the toilet tank to close the flush valve when the water level in the bowl is low, you can substitute a pot of hot water for the bowl's contents.—*William J. Davenport, WA2OZV*

CLOTHESPIN FIRE ALARM

A fire alarm is a desirable safety device for the ham shack, but usually such a gadget is quite expensive. However, by modifying each leg of a clothespin as shown in Fig. 1-1, a simple fire alarm can be made using materials that cost less than a dollar.

Take an ordinary spring-type clothespin apart and drive a small tack partially into one of the wooden legs about 1⅛ inches from the fat end. Solder a flexible wire below the head of the tack and then drive the tack in the rest of the way. Note, however, it may be necessary to drill a small hole through the clothespin before the tack is driven in so as to keep the wood from splitting. Modify the remaining leg the same way and then reassemble the clothespin.

Tack the clothespin to a wall or bolt it to a piece of equipment. Open the clothespin and place a ball of candle wax or paraffin in its jaws. Wire the clothespin-switch in series with a bell or buzzer and a battery. If there is a fire the paraffin will melt, the switch will close and the alarm will ring. Because the cost of the alarm is so low, there is no reason why every room in the house can't have fire protection.—*Stephen M. Sombar, WAØPRI*

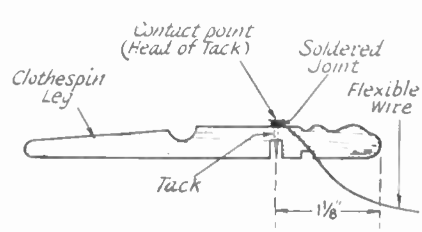


Fig. 1-1—By modifying each leg of a clothespin as shown, a simple fire alarm can be constructed.

JEWELERS' LOUPE HELPS TO RELIEVE EYE STRAIN

An eye loupe affixed to a pair of glasses is very helpful for examining soldered connections in tight, crowded areas. A jeweller's loupe can be purchased for a reasonable sum at any optical center or supply house.—*David Basskin, VE3FPM*

HANDY TOOL

For adjusting hard-to-get-at slotted controls, a useful tool can be fashioned easily from a piece of heavy wire as shown in Fig. 1-2. One end of the wire is bent ninety degrees, and the sides of the bent portion are filed so as to form a flat blade, similar to that of a screwdriver.

The wire is thin enough to get into such tight places as the ventilation holes in a cabinet, yet the flat, angled end provides enough of a blade to easily turn most small trimmers and potentiometers. Of course, care should be taken when using the tool around live circuits.—*Charles G. Newman, WB2NPY*

Fig. 1-2—A right-angle alignment tool made from a piece of heavy wire.

COOLING NUVISTORS

The heat radiating ability of a Nuvistor case can be improved by painting it with dull-black stove paint. The metal guide tabs should be left unpainted, however.—*Richard Mollentine, WAØKKC*

USEFUL PUBLICATIONS

One source of both elementary and advanced electronics literature is the U.S. Government Printing Office. They offer reports of the FCC, radio propagation data, circuit handbooks, military electronics training courses, radio law publications, and many other books and pamphlets of interest to the radio amateur. A catalog of these publications may be obtained by writing for a copy of *Price List 82, Radio and Electricity*, from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. There is no charge for this price list.—*Joseph F. Stephany, K2KSJ*

STRIPPED THREADS

Are you having trouble with stripped threads on aluminum boxes? Try fastening hex nuts over each hole on the inside of the box with epoxy glue. Then use machine screws with lock washers to hold the case together. Vibration and repeated disassembly won't bother the box after this is done.—*Thomas Webb, W4YOK*

STICKING METERS

The magnetic field of a D'Arsonval movement exhibits a persistent tendency to attract small iron and steel particles and to orient them in such a way as to interfere with the free movement of the moving coil. This can cause unreliable readings and a sticking pointer.

It is often possible to remove the foreign particles with adhesive tape. Fold a short length of tape sticky side out and trim it with a pair of scissors to make a narrow paddle. Move the tape in the circular path between the pole pieces until all the foreign particles have been picked up by the tape. Fresh, sticky tape will succeed with the most obstinate slivers. If you are careful, the chances are good that no mechanical damage will result from the process.—*T. D. Koranye, W2SFW*

TIE TABS

The plastic-coated wire tie tabs that are now being used to seal bread wrappers make excellent material for tying up cable assemblies, small rolls of wire and a multitude of other items around the ham shack. Don't throw the tie tabs out. You'll be surprised at the many uses that can be found for them.—*Robert A. Manning, K1YSD*

SOLDERING-IRON TEMPERATURE REDUCER

A one-ampere 200 p.i.v. diode, in series with one side of the a.c. line, will reduce the operating temperature of a small soldering iron for light work or standby service. In addition, the life of the tip will be markedly extended. The diode permits current to pass through to the iron during only one half of the a.c. cycle. As a result, the iron operates at approximately half power. The diode is connected across the contacts of a s.p.s.t. line-cord switch, as shown in Fig. 1-3. By closing the switch, the diode is shorted and the iron is brought to full heat.—*W. P. Gearhiser, W5EPW*

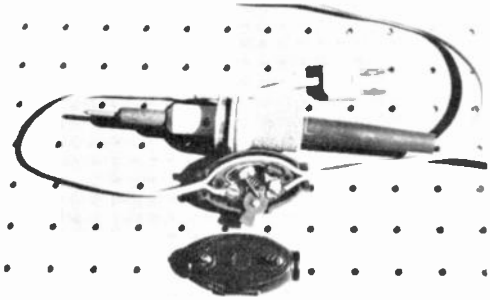


Fig. 1-3—The diode, shown mounted in the line-cord switch, will lengthen the life of the soldering-iron tip.

WIRE SOURCE

A HANDY source for No. 14 through No. 6 solid copper wire is the wire sold for house wiring. Most hardware and Sears stores stock two-conductor plastic covered wire and it can be purchased in any length required.—*W1ICP*

CABLE RACKS

I HAVE found that hose racks, ordinarily used for the storage of garden hose on the side of a house, are ideal for keeping accumulated wire and coaxial cable in order. Aluminum racks, which sell for about 75 cents each, make excellent spools for lightweight wires and cables. Steel models cost approximately a dollar apiece and are useful for storing heavy cable such as RG-8/U. Garden-hose racks are sold by most hardware stores.—*Julian Lovejoy, W1BT*

LIGHTNING CALCULATOR

THE Type A Lightning Calculator can be made more useful by marking the ham bands on the frequency scale with either a ball-point pen or a colored pencil.—*Norm Cucuel, K1LFH*

QUICK CONNECTOR

A SIMPLE, low-resistance, high-strength temporary connection may be had by using a solderless connector or "wire nut," such as the Ideal No. 73B. These connectors are available from most hardware stores and are normally used to fasten wires together in appliances and lamp fixtures. Two or three wires, 14 through 22 gauge, may be connected together by simply holding the wire ends flush and parallel and twisting on the wire nut. The connection can be broken quickly if desired by untwisting the connector.—*Terry Welch, K8ZBI/8*

EMERGENCY ALIGNMENT TOOL

AN emergency tuning wand can be made from a small scrap of thin brass or aluminum and a short length of polystyrene rod. Heat the metal stock with a soldering gun or blowtorch and push it into one end of the plastic shaft with a pair of pliers.—*Jeffrey L. Blake, K3USS*

EMERGENCY SOLDERING-GUN TIP

IT often happens that the tip of a soldering gun breaks at a time when it is inconvenient or impossible to get a replacement. A satisfactory substitute can be made by bending a piece of No. 8 or 10 copper wire into the form of the original tip. The emergency tip should be tinned in the usual manner.—*Erling R. Jacobsen, K4OJY/9*

VIBRATION-PROOF HARDWARE

NUTS and bolts that become loosened due to vibration can be secured by applying a drop of "Loctite" liquid to the threads.—*John C. Nelson, W2FW*

THUMB-GROOVE INDEXING THE HANDBOOK

SECTIONS of the *Handbook* that are frequently used by the reader can be located quickly by filing thumb grooves in the *Handbook* pages as shown in Fig. 1-4 and labeling these grooves as pictured in Fig. 1-5. As illustrated in the second sketch, I filed thumb grooves for only three subjects: the wire-size table, the tube index and the general index. These items seem to fill 99 percent of my general requirements. Other grooves can be added at any time, but usually the sections of the book they indicate are only of short-term use.—*Norm Cucuel, K1LFH*

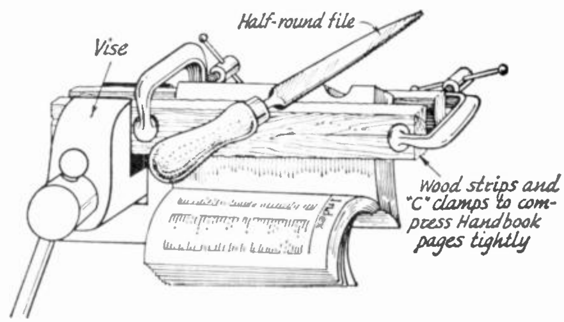


Fig. 1-4—K1LFH's method of thumb-groove indexing the *Handbook*.

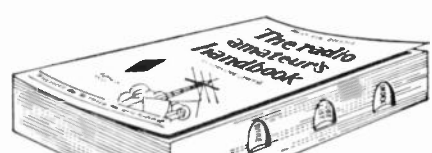


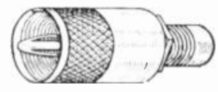
Fig. 1-5—One method of labeling the thumb grooves.

SOLDERING AID

AN excellent "third hand" for soldering purposes or for the support of small assemblies or circuit boards may be purchased in most hardware or dime stores for less than a quarter. The soldering aid consists of a large clip of the type used on clipboards, which is fastened to a one-inch diameter circular magnet. In addition to having a strong spring action and being able to be supported by any heavy ferrous-based tool or object, the clip is an excellent thermal sink for temperature-sensitive components.—*Erling R. Jacobsen, K4OJY/9*

CLEANING CRACKLE FINISHES

WHEN crackle finishes need cleaning, try using an art-gum eraser. The eraser doesn't appear to harm the paint and the refinished surface looks like new.—*Ray Tripp, VE3FOH*



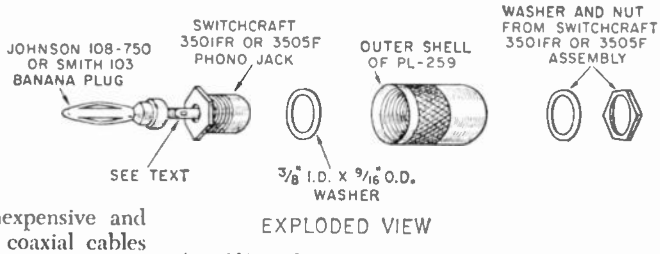


Fig. 1-6—W3LOE's u.h.f. series to phono jack adapter. Before attaching the plug to an SO-239 receptacle, loosen the nut which is part of the phono jack assembly so that the PL-259 outer shell will be free to turn. Once the adapter is installed, tighten the nut. Be sure to loosen this nut before removing the adapter.

ADAPTER PLUG

PHONO plugs and jacks are inexpensive and convenient to use with small coaxial cables such as RG-58/U and RG-59/U in receiving and low-power transmitting applications. R.f. insulated versions of this hardware are available for use at high frequencies. As a result, most modern receivers are equipped with phono jacks as antenna input terminals. Unfortunately, no coaxial antenna relays we know of use phono jacks; most employ u.h.f. receptacles. The usual result is the rather ungainly combination of a phono plug at one end of the receiver cable and a u.h.f. plug with a reducing adapter (UG-175/U or UG-176/U) at the other end. In addition the quick-disconnect feature of the phono-type hardware is lost.

A useful adapter for converting a u.h.f. series receptacle (SO-239 or equivalent) to a phono jack can be made from a Switchcraft type 3501FR or 3505F (r.f. insulated) phono jack, a banana plug (Johnson type 108-750 or Smith type 103), a ⅜-inch i.d. × 9/16-inch o.d. washer and the outer shell of a PL-259 plug as shown in Fig. 1-6. Anyone who has done much experimenting with antennas and high power will have one or two defunct PL-259 plugs around—there is a limit to how high an s.w.r. they will stand without arcing!

The stud of the banana plug is cut so that it can be inserted far enough into the rear end of the phono jack for the shoulder of the plug just to touch the end of the terminal lug, yet leaving enough room inside the jack for a phono plug to be inserted from the front without interference. The stud and lug should be wrapped with several turns of tinned hookup wire for reinforcement and then soldered together. Bolting the combination banana plug and phono jack to the outer shell of the PL-259 completes the assembly—*R. C. Check, W3LOE*

INEXPENSIVE SILVER-PLATING PASTE

I FOUND a way to make silver-plating paste for about $2.65 for five ounces. This amount of paste is capable of plating approximately 2000 square inches of copper or brass stock. The paste is made from one ounce of silver chloride ($AgCl$), two ounces of cream of tartar ($KHC_4H_4O_6$) and two ounces of table salt ($NaCl$). Silver chloride sells for about $2.60 per ounce at any chemical-supply house and the cream of tartar and table salt are found in most kitchens. The materials are mixed dry, and when needed a paste is made from a small quantity of the mixture by dampening it with water. Rub down the metal to be plated with steel wool and make sure the work is clean and free from oils before plating. With a soft, damp, clean cloth, lightly rub the paste onto the metal. After the work is plated, wipe it clean and spray with clear lacquer.—*Jerry L. Russell, K5JIJ*

WORK LIGHT

WHEN examining complex wiring in ham equipment, especially with a magnifying glass, I find the use of an ordinary 60-watt light bulb in the 5-inch reflector of a floodlight holder to be far superior than any flashlight. Floodlight reflectors come in various sizes from 5 to 12 inches in diameter, but all except the smallest are too cumbersome and always in the way. An integral part of the holder is a swivel mounting clamp which permits the floodlight to be easily positioned and frees one hand for other use. Any photography store should be able to supply the needed parts for the work light.—*Wm. K. Thomas, W3RV*

RESTORING ETCHED CRYSTALS

WHILE etching crystals with ammonium bifluoride there are some effects which will in many cases cause loss of oscillation. The etching action usually will eliminate the sharp edges, causing rounded corners. Also the edges will etch faster than the center of the crystal, causing "hills" on each side. This will either curtail activity entirely or reduce the output of the crystal. This condition is especially true when moving the crystal frequency any distance and becomes increasingly more important with higher frequency crystals.

To restore activity, obtain a good grade of plate glass, some No. 600 grinding compound and a little water. Make a thin paste on the plate glass and holding the crystal at a slight angle, proceed to grind a small bevel on all eight edges. A good micrometer is required to find the "hills." Take a reading at the edges first, then the center. Carefully mark the "hills" with a pencil and proceed to grind them down, a few strokes at a time. Check frequently with the micrometer until the crystal surface has been ground flat.

Before mounting the crystal in its holder, be sure to wash it thoroughly in soap and water to remove any grinding dust or other foreign material. Wipe the electrodes carefully with a lintless cloth and make sure you handle the crystal by the edges only. Grease from your fingers can ruin all your efforts to restore the crystal.—*Louis A. Gerbert, W8NOH/6*

QSL CARD MOUNTS

MANY of us pin or tape our QSL cards to a wall, but it leaves the surface in an unsightly condition if the cards are ever removed. By using gummed reinforcements, string and a couple of tacks you only need to make two small holes in the wall for every row of QSL cards. Take some gummed reinforcements and fold them in half with the sticky side up. Glue one to each of the top corners on the back side of your QSL cards as shown in Fig. 1-7. Thread a length of string through the mounted reinforcements and fasten the string to the wall with two tacks.—*Steve Day, WN3EQY*

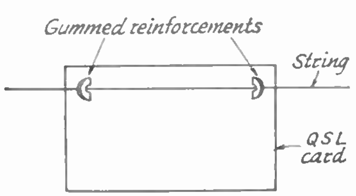


Fig. 1-7—WN3EQY's gummed reinforcement mounts for QSL cards.

CUTTING ALUMINUM

AN easy cut can be made in aluminum tubing or sheet by using a fine-toothed hobby saw sold under the trade names of X-Acto Razor Saw or Zona Saw.—*Stan Hornbaker, WA4TJJ*

CLEANING ALUMINUM

A CORRODED aluminum panel, chassis, or antenna part may be restored to "like new" appearance with Met-All Aluminum Polish, Formula No. 1187, made by Anton Products Corp., 55 Front St., New York.—*Stan Hornbaker, WA4TJJ*

TUNING CAPACITOR HEAT SINK

THE collector lead and case of an r.f. transistor are often internally bonded together. A local ham, Carlot Monser, uses the collector tuning capacitor as a heat sink in a transistor oscillator. The transistor's case and collector lead are clamped to the tuning capacitor.—*Liz Deck, K6MTQ*

PRINTED-CIRCUIT CLEANING TOOL

A SIMPLE tool made from a typewriter eraser can make the job of cleaning printed-circuit terminals easier. A pencil-type typewriter eraser is sharpened to give a tapered point. The eraser in Fig. 1-8A has a hole made in the end with an ice pick so that it fits down over a pin or connector. The other tool shown in B has a locating pin inserted into the eraser to aid in cleaning around a hole in the circuit board.—*NASA Technology Handbook SP-5010*

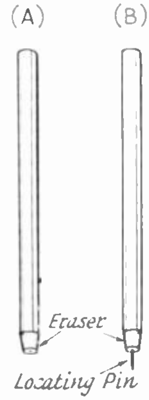


Fig. 1-8—A tool for cleaning pin connections on a printed circuit board (A), and one for cleaning holes in a board after a component has been removed (B).

EQUIPMENT SHELF FROM PIPE FITTINGS

MY operating desk became so crowded with receivers, exciters, converters, and station accessories that I had to construct a shelf-type rack to keep everything within reach. Pipe nipples ½-inch in diameter were used as upright supports and attached to the ¾-inch plywood shelves with floor flanges. The resulting shelves are shown in Fig. 1-9. They provide a convenient way to hold a lot of odd-sized components. —*John B. Johnston, K3BNS*

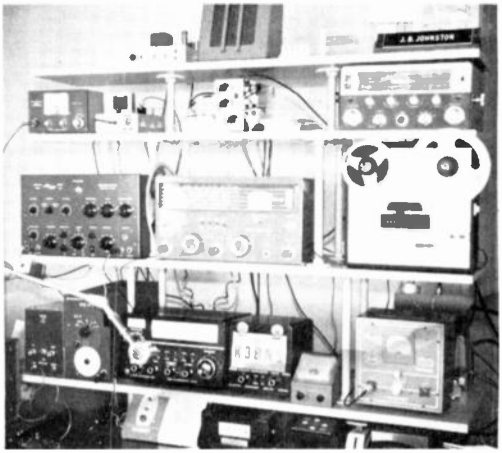


Fig. 1-9—The equipment shelf at K3BNS.

REMOVING SLUGS FROM GREENLEE PUNCHES

PRYING the screw out of a Greenlee punch after it has been used is an exasperating job at best. A compression spring (Fig. 1-10) may be inserted in the die of the punch to facilitate ejection of the slug without the use of a screwdriver or other prying tool.—*NASA Technology Handbook SP-5010*

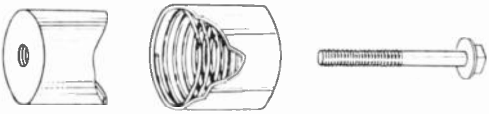


Fig. 1-10—To facilitate the removal of the slug from a Greenlee punch after use, a spring is mounted inside the die.

CABLE LACING CORD

DENTAL floss makes an ideal substitute for lacing cord and is available in most drugstores in several sizes, the most useful being approximately 1/16 inch in width. However, the smaller sizes are useful with miniature cable.—*Kenneth G. Kopp, WA4HAA*

SOLDERING ALUMINUM?

ALUMINUM can be soldered with most of the tin-lead solders ("Hints & Kinks," September, 1964) as well as with some special solders. When first made, these joints appear satisfactory, but unfortunately, they are seldom permanent. Aluminum readily sets up a galvanic cell with the other metals and corrosion soon starts. In order to be even fairly permanent, the joint must be kept absolutely dry.

Atmospheres near the seacoast, with high humidity, or industrial smog, are poison for the joint. If the joints can not be kept dry they must be protected with lacquer, paint, or other organic substance. This may give fair life to the joint but it is better practice to make joints of aluminum by welding, brazing, or riveting. In some cases, plain fluxes (of a special nature) have been used without any solder and good life obtained.

In the past, the writers have tested hundreds of solders submitted to one of the government bureaus. Joints which had strength (tensile or sheer) equal or better than the basis aluminum would invariably fail when placed in a pan of water for a few days. Some would even fall apart upon one night's soaking in ordinary tap water. So unless you can keep the joint absolutely dry, don't solder.—*R. W. Woodward, W1VW, and William Nighman, W4ZSH*

SILVER POLISH IN THE HAMSHACK

ONE item that I have found to be quite useful in the hamsack is my wife's sliver polish. I have used this polish to clean switch contacts, key contacts, silver-plated tank circuits, the TV set's channel turret contacts, and even the automobile distributor points.—*Arthur S. Gillespie, Jr., W4VON*

SOLDERING-IRON HOLDER

AN inexpensive soldering-iron holder (Fig. 1-11) can be easily constructed with a few parts from the junk box. I used a 12 × 1¾-inch piece of Masonite to which I attached an aluminum bracket to support the tip of the iron. The bracket was filed in a V shape at the top so the iron would always seek the bracket's center. Two Fahnestock clips were then fastened back-to-back at the opposite end of the Masonite, the exact position depending on the iron to be used. Placing the clips back-to-back allows the iron to be positioned so it rests on top of the clips when in use and, by applying a little pressure to the iron's handle, it can be locked in place to prevent accidents during other bench operations or for storage.—*Robert Anderson, K1TVF*

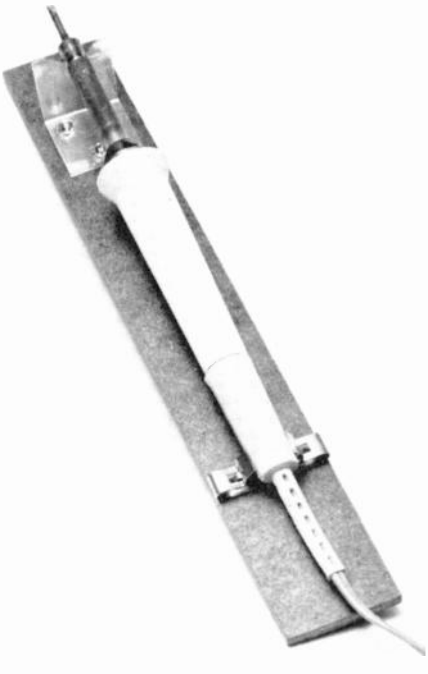


Fig. 1-11—K1TVF's soldering-iron holder.

A NEW RUBBER CEMENT

GENERAL ELECTRIC is marketing a new silicone rubber cement, called Clear Seal, that will find many applications in the ham shack. It is sold in 3-ounce tubes and will seal anything but vinyl and polyethylene. I have sealed the ends of coax and beam connections with it. Also, when I wound a transformer, I coated each layer of wire before wrapping the insulating paper, making a completely sealed unit. The wire ends were practically impossible to pull out, and the cement will stand 500 degrees F.

For r.f. applications, I tried the cement on the plate tank coil (Fig. 1-12) for an amplifier with a pair of 813s. This coil shows no sign of deterioration after six months of use.—*Ross F. Fox, W8PZX*

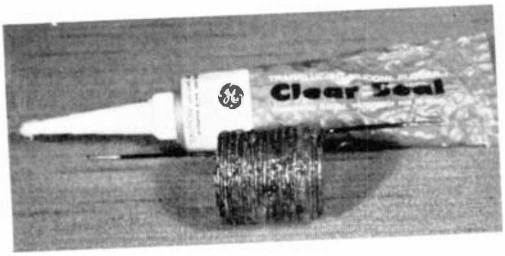


Fig. 1-12—W8PZX's tank coil. The turns are cemented in place so the coil will hold its shape.

SCR NOISE

In Hints and Kinks in the December 1967 issue, K1MET describes a motor speed control using a silicon controlled rectifier (SCR). It's a very handy gadget for the uses described in the article, but one thing must be pointed out: No responsible amateur should use the device without proper filtering of the a.c. leads. The amateur using the speed control without filtering has no right whatsoever to complain about noise on the a.c. power lines from domestic appliances or other apparatus, since he's then generating lots of noise himself.

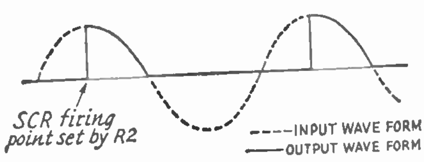


Fig. 1-13—Typical SCR waveform.

The output from the motor-speed control is shown in Fig. 1-13. Due to the steep rise when the SCR fires, the device generates a wide spectrum of noise, which of course propagates along the power lines.

A filter like that in Fig. 1-14 has proved to be sufficient to keep the noise out of the power

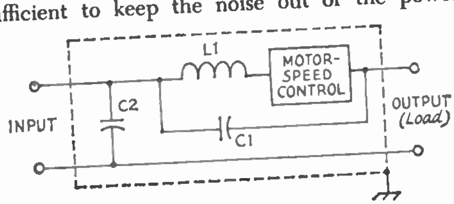


Fig. 1-14—Filter circuit for SCR control.
L_1—300-500 µh., ferrite or iron slug
C_1, C_2—0.1 µf. (see text)

line. The entire device with filter must of course be completely screened, to confine the noise where it should be—in a grounded box.

When using the speed control with motors or tools with a power consumption of less than 50 watts, C_1 and C_2 should not be larger than 0.05 µf. in order not to disturb the wave form too much.—*Kjell Strom, SM6CPI*

HELPER FOR THE WORKBENCH

Almost every experimenter finds from time to time that he needs to have a means of varying the a.c. supply voltage to equipment under test. This need, together with a few associated requirements, led to the design of the "Black Box" shown in Fig. 1-15. While similar units are available commercially, they are usually costly: the unit described here was built of surplus parts at a cost of under $20.

By the time construction was started, it was decided that the device should:

1) Furnish continuously-variable a.c. from 0 to 140 volts,

2) provide isolation from the power line; the output should be ungrounded,

3) be completely self-protected against overload or short circuit,

4) provide an indication of the output voltage, and

5) not produce excessive heat.

The unit was assembled using the circuit shown in Fig. 1-16. T_1 is a 1:1 transformer that provides isolation from the a.c.-line ground. T_2 is a variable-voltage autotransformer (e.g., Variac, Powerstat). CB_1 is a double-pole magnetic circuit breaker with one pole in the load circuit and the other in the primary circuit of T_1. Variable voltage is taken from J_1, while fixed line voltage may be taken from J_2. The variable voltage is monitored by the a.c. voltmeter M_1.

At considerable saving in cost, I used major components found by careful search of the surplus and used-equipment market. Suitable standard catalog items are listed under Fig. 1-16, depending on the power level desired.

You will find that the lowest-priced components are usually those that are included in apparatus offered for sale as manufacturers' surplus. Be sure, however, that the units selected are for 60-Hertz supply. The 400/500-Hertz units found in surplus are not suitable.

For economy in space, T_1 and T_2 should have approximately equal ratings in watts or volt-amperes. If the ratings differ, power drawn from the unit should be limited to the rating of the lowest-rated unit, and the circuit breaker should be selected accordingly. Very little protection will be sacrificed by using a lower-cost single-pole breaker. I happened to find one with two poles at a bargain. The variable-voltage transformer I picked up has a brush rating of 3 amperes. Each pole of the breaker has a rating of 2.5 amperes. While a 3-ampere breaker might have been selected to match the brush rating

Fig. 1-15—The protected variable-voltage test unit. The double-pole circuit breaker is opposite the a.c. voltmeter. The control of the variable-voltage transformer is at the center, and the outlets for fixed and variable voltages at the bottom. This steel cabinet (Bud CU-1124) measures 12 by 7 by 6 inches, but a size should be selected to accommodate the particular components used.

exactly, a more conservative approach was taken for two reasons: In the first place, all of the components were to be operated in a completely-closed metal case. This might result in operating temperatures higher than those anticipated in the manufacturer's "free-air" rating. In the second place, circuit breakers of the type used generally have a current-time relationship in their operation. They will carry the rated current continuously and carry small overloads for a minute or more: large overloads cause immediate tripping. When experimenting, the breaker may operate and be reset several times in a minute. Damage to the brush could result in this kind of service if higher circuit-breaker ratings were used.

There are so many uses for the arrangement that it is hard to select a few that will best illustrate its versatility. The device is always used when work is done on faulty appliances; its value lies in its ability to open a faulty circuit quickly. If an a.c.-d.c. radio set is under test, it protects the person working from receiving a shock from a "hot" chassis. A few difficult intermittent troubles have been made to show themselves when the equipment involved was subjected to under-voltage and over-voltage testing. It is helpful in determining transformer ratios and characteristics of other equipment components. It can also be used to control soldering-tool temperatures, battery-charging rates and Christmas-tree light voltages (bulbs rarely fail when they are operated at 90 volts).
--George P. Schleicher, W9NLT

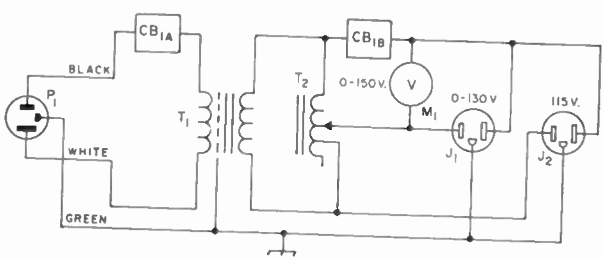


Fig. 1-16—Wiring diagram of the protected testing unit.

CB_1—Double-pole magnetic circuit breaker, 115 volts, a.c., current rating to match ratings of T_1 or T_2; see text (Heinemann, Wood Electric Type 190, or similar).

J_1, J_2—A.c. outlet with grounding terminal (Amphenol 160-2, or similar).

M_1—0-150 a.c. voltmeter; see text.

P_1—A.c. power plug with ground terminal.

T_1—115/115-volt isolation transformer. Typical:
250 watts—UTC R-74.
350 watts—Stancor P-6415.
600 watts—UTC R-75.

T_2—Variable-voltage transformer, 115-volt 60-Hertz input, 0-130—140-volt output.
Typical:
3-amp.—GE 9H30LA10X.
4-amp.—GE 9H40AA10X, Superior 21, Standard 375BU.
7.5-amp.—GE 9H60AA10X, Superior 116U, Standard 500BU.

Chapter 2

Hints and Kinks . . .
for the Receiver

SB-100 IMPROVEMENTS

The Heath SB-100 transceiver can be modified to obtain greater gain, slightly increased sensitivity and considerably more audio output. The first seven changes listed below convert the SB-100 to an SB-101, except that no filter switch is added. They are official Heath modifications that were found by directly comparing the SB-100 and SB-101 schematic diagrams and parts lists. The other changes are our own.

1) Change R_{221} from 470 ohms to 100 ohms.
2) Change R_{927} from 220 ohms to 100 ohms.
3) Change R_{928} from 150 ohms to 56 ohms.
4) Change R_{104} from 47 ohms to 56 ohms.
5) Change R_{105} from 47 ohms to 56 ohms.
6) Insert a 4700-ohm, 1-watt resistor between ground and the ground end of the 10,000-ohm BIAS ADJUST potentiometer.
7) Connect a 0.005-µf. disk ceramic capacitor from the B+ connection of the LMO to ground.

Considerably more output from the transceiver is obtained by removing C_{928}, a 0.05-μf. negative feedback capacitor between pin 7 of V_{14B} and T_{301}, and adding a 100-μf., 25-volt electrolytic, C_1, from pin 7 of V_{14B} to ground (see Fig. 2-1). The increase in distortion appears to be negligible, and the audio output is greatly increased.

Overall gain of the receiver is quite dependent upon the low-voltage supply used with the transceiver. Rather than the nominal +300 volts specified, the authors recommend a slightly higher voltage (up to 10 percent).

Prior to these changes, the authors were somewhat disappointed with the performance of the receiver section of the SB-100. The audio output was quite low, especially on 10 meters, and the S meter indicated a low signal level. The changes given here corrected both of these conditions and also improved the transmitter audio and driver levels.—*Charles B. Andes, WB2VXR and Emil E. Hrivnak, W2CCL*

ELIMINATING BACKGROUND NOISE

If the XYL or kids create too high a background noise while you are working c.w., use a pair of "hearing protectors" such as those used by jet airport workers. These protectors are manufactured by the American Optical Company and are sometimes distributed by local gun dealers. The model 1200 has a headband for over-the-head mounting. Drill a small hole through the superior part of the "domes." Feed the leads from a small earphone, such as those that come with transistor BC sets, through the hole. If this doesn't cut out all the interference, use a tiny earphone of the type that plugs directly into the auditory canal, and put the protector over the whole works.—*C. A. Weed, M.D., WA1BDJ*

ANOTHER SIMPLE CB CONVERSION

There is no need to purchase transmitting crystals when converting the Lafayette HE-20C and HE-90 CB transceivers to 10 meters. In each case, the transceiver's receiver oscillator operates 1650 kHz. above the channel frequency. For 10-meter operation, just replace the receiver crystals with the transmitter crystals and vice versa and adjust the appropriate stages. —*Donald E. Huber, WB2UKA*

STABILIZING A RECEIVER R.F. AMPLIFIER

A short while ago I had difficulty stabilizing a 6EH7 r.f. stage in a HQ-129X remodeling project. I finally came to the conclusion that the trouble was a v.h.f. parasitic. Taking a tip from transmitter-circuit practice, I put a parasitic suppressor in the plate lead to the 6EH7. The suppressor, consisting of 5 turns of No. 18 wire on a 50-ohm ½-watt resistor, was installed right at the tube socket. Once this was done, the amplifier settled down and worked like a charm!—*Bill Lamb, WA8QYK*

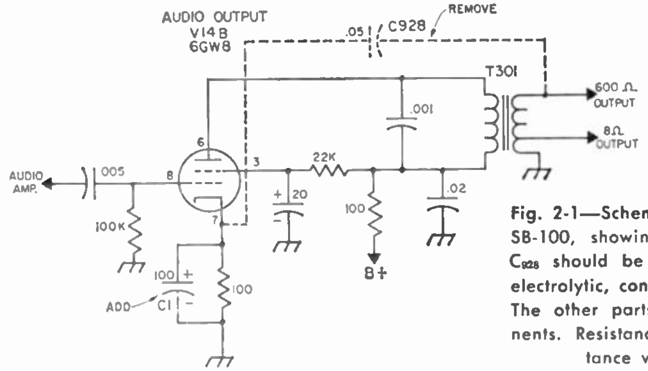


Fig. 2-1—Schematic of the audio output stage in the SB-100, showing modifications for increased gain. C_{928} should be removed and C_1, a 100-µf., 25-volt electrolytic, connected from pin 7 of V_{14B} to ground. The other parts shown are original SB-100 components. Resistances are in ohms; K = 1000. Capacitance values are in microfarads (µf.).

SB-100 MODIFICATIONS

When operating c.w. with the SB-100 transceiver, the slow-decay a.g.c. characteristic of the receiver is rather annoying. By making the changes shown in Fig. 2-2, fast- and slow-release times can both be made available. Begin the modification by replacing the audio gain control with a 500,000-ohm potentiometer that has a push-pull switch attached. Then disconnect R_{117} from circuit-board ground, and wire the resistor to S_1 so that the switch can be used to complete the broken connection. As a result, the receiver will have fast-decay a.g.c. when the switch is pushed in (opened), and slow-decay a.g.c. when the switch is pulled out (closed).

For the brave experimenter installing incremental tuning in the SB-100, the unit can be recalibrated by adjusting the small variable capacitor whose shaft extends through the rear panel of the l.m.o. In this way the same amount of capacitance can be removed from the tuned circuit of the l.m.o. as is added by the incremental-tuning modification. Since the total capacitance will remain unchanged, the calibration of the tuning dial will be no worse after the modification than before. However, if the dial is "slipped" to recalibrate the receiver, as described by WA1BDJ in the "Hints & Kinks" column of *QST* for May 1967, the calibration will not hold from end to end. Also in reference to WA1BDJ's article, it was found that it is easier and much more convenient to move the microphone connector to the rear panel than to move the earphone jack.—*Robert Clark, K9HVW/WA4VYL*

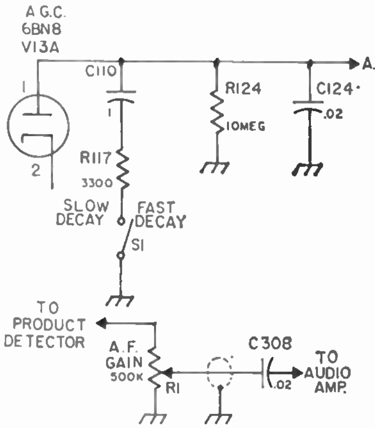


Fig. 2-2—A.g.c. modification for the SB-100. Resistances are in ohms (K = 1000) and resistors are ½ watt. Capacitances are in µf. C_{110}, C_{124}, C_{308}, R_{117}, R_{124} and V_{13A} are original components.

R_1—500,000-ohm audio taper control with push-pull switch. (Mallory PP55A, Burstein-Applebee No. 14B845).

S_1—Part of R_1.

INCREASING THE BANDSPREAD OF THE SP-400

A simple method of increasing the bandspread of the Hammarlund "Super-Pro" and most other older receivers is shown in Fig. 2-3. The bandspread-tuning knob was removed and a small planetary drive installed between the control shaft and the knob. As a result, it now takes five turns of the knob to cover ten dial divisions, whereas before it took one revolution of the knob to tune ten divisions. This increase in bandspread is a big help on crowded bands.

The planetary drive used in the modification is a Jackson Brothers type 4511/DA which sells for only $1.50. Threaded bushings are used to space the drive from the panel. If you don't care to take the receiver out of its cabinet, you can drill two small holes in the panel and tap the holes for threaded rods that will fit both the panel and the bushings. Otherwise, the panel can be drilled and the bushing attached to the panel with appropriate screws inserted from the inside of the receiver.—*John F. Gallagher, W2VAQ*

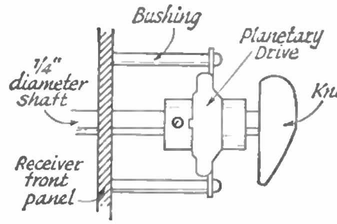


Fig. 2-3—W2VAQ's method of improving the bandspread of older receivers.

IS YOUR RECEIVER FUSED?

Several manufacturers of otherwise electrically sound communication receivers, possibly in order to cut manufacturing costs, have left out one basic and important component: a fuse in the a.c. line. A young local amateur with a very popular medium-priced receiver had the following experience which illustrates the grief that the lack of a simple fuse can cause.

The electrolytic capacitor in his receiver power supply shorted when the clock timer turned on the receiver in the early morning. Before the 15-ampere breaker in the house circuit kicked out, the capacitor took with it the choke, rectifier and power transformer. The latter caught fire and burned all the surrounding wiring before the fire smothered itself out. Repair of the damage required the purchase of $10.00 worth of components and eight hours of labor.

The solution to the problem is simple. Look at your receiver's schematic or check its wiring. If there is no fuse, remove the power plug from the line cord and replace it with the type of plug that holds two type 3AG fuses. A pair of two-ampere fuses should be sufficient for most commercial receivers.—*John D. Birle, W8ELE*

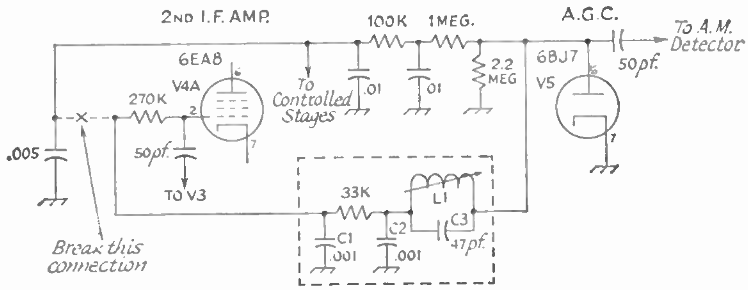


Fig. 2-4—Diagram of the HR-20 modification. Unless otherwise indicated, capacitances are in µf., resistances are in ohms (K = 1000), resistors are ½ watt. Added components are shown inside the dotted lines. C_1 and C_2 are disk ceramic and C_3 is silver mica. L_1 is a 60-µh., ¼-inch diameter, slug-tuned coil.

S.S.B. NOISE LIMITER FOR THE HR-20

The noise limiter in the Heathkit HR-20 receiver is only useful for a.m. reception. When using the HR-20 to receive s.s.b. signals in my car or home, I could hear ignition noise from automobiles that were two or three blocks away. Sometimes the ignition noise from older cars and trucks completely blanketed the signals. By adding three disk-ceramic capacitors, one slug-tuned coil and a resistor, I was able to reduce most ignition interference to a very low level. A diagram of what was done is shown in Fig. 2-4.

The circuit is similar to one used in the Drake 2-B. Except for L_1-C_3, a 3-MHz. i.f. trap, the purpose of the added components is to reduce the attack time of the a.g.c. voltage going to the control grid of the second i.f. amplifier. This very fast attact helps to effectively suppress sudden noise peaks and pops.

The parts required for the modification were installed near V_5. A small hole was drilled in the chassis to accommodate the slug-tuned coil. Once the parts were connected, the only adjustment necessary was to tune the i.f. trap to 3.0 MHz.—*Ross F. Fox, W8PZX*

NOTES ON THE KNIGHT-KIT C-560

The February 1967 *QST* article on converting CB transceivers to 10 meters included data on the Knight-Kit C-560. I have converted one of these units and have additional information that may help other C-560 owners.

Fig. 2-5 shows the receiver tunable oscillator before modification. By replacing C_{48} with a 47-pf. NPO capacitor, the entire 10-meter phone band can be covered with the main tuning capacitor, C_{47}. Since C_{47} has a built-in vernier drive mechanism, the tuning rate is entirely satisfactory. The band is set by adjusting L_7 and the frequency span is determined by setting C_{45}.

If desired, the fixed-channel facilities of the C-560 can be used by swapping the unit's CB receiver crystals with the unit's CB transmitter crystals. Regardless of whether the CB transmitter crystals are used, the CB receiver crystals can be employed in the transmitter as they lie in the 28.615- to 28.905-MHz. range for CB channels 1 through 23.—*Harold S. Eisley, KØTOS*

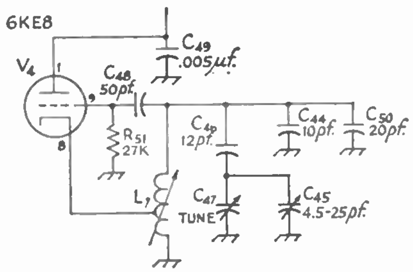


Fig. 2-5—Schematic diagram of the Knight-Kit C-560 tunable receiver oscillator before modification. By replacing C_{48} with a 47-pf. capacitor and retuning L_7 and C_{45}, the converted CB receiver will cover the entire 10-meter phone band.

HQ-180C CLOCK

For meteor-scatter schedules, timing is of the utmost importance. Did you ever try to set the clock on the HQ-180C without shutting off the receiver and therefore the time signals needed to set the clock? It's a rough job. I solved the problem by installing a toggle-type microswitch in series with one side of the a.c. line and the clock. So that no holes would have to be drilled in the receiver, I mounted the switch on an L bracket and fastened the assembly to the inside of the receiver with one of the screws used to bolt the clock to the front panel.—*From K2DNR's OVS report*

INCREMENTAL TUNING FOR THE SB-100

Incremental tuning for the SB-100[1] is an easy task and requires only a handful of parts, including a capacitor diode.[2] Fig. 2-6 shows the hook-up. The value of C_1 can be varied to give a wider or narrower range of tuning. Increasing

[1] "Recent Equipment," *QST*, Sept. 1966.
[2] See Swanson, "Offset Tuning and F.S.K. for the Drake TR-3," *QST*, June 1966.

the capacitance of C_1 will give a greater tuning range. A push-pull switch is recommended for S_1 since, for calibration, the potentiometer R_2 is adjusted with S_1 closed (on) for zero beat with the crystal calibrator in the SB-100. Switch S_1 is then turned off and the l.m.o. restored to zero beat again by adjusting R_2. During this last step, it may be necessary to "slip" the main tuning dial slightly, as outlined in the SB-100 manual under "Calibration." This action may result in the loss of a few kHz. at the lower end of each band. However, by experimenting with the value of C_1, it may be possible to include the entire band with this modification.

Finding a place to mount the new components may be somewhat difficult because space is at a minimum in the SB-100 chassis. The phone jack on the front panel may be transferred to the rear apron and R_1 mounted in its place in the front-panel PHONES hole. With a little ingenuity, the rest of the components can be mounted just behind R_1. One other possibility is to build the unit completely outboard from the SB-100.

The connection to pin 2 of the 6BZ6 l.m.o. is a problem since it would require breaking the seal on the l.m.o. box. The easiest way to make the connection, therefore, is to simply wrap a piece of small copper wire around pin 2 of the 6BZ6 tube and then carefully plug the tube into the socket. Connection can then be made to the small copper wire. Be careful that the wire doesn't short to other components or to ground.—*C. A. Weed, M.D., WA1BDJ*

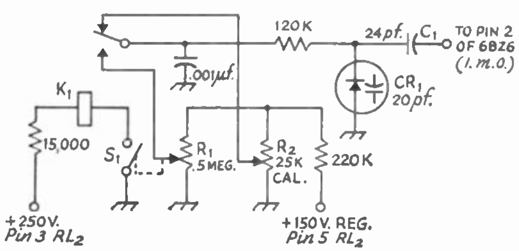


Fig. 2-6—Circuit for incremental tuning for the Heath SB-100 transceiver. Resistors are ½-watt composition unless otherwise specified; all resistances are in ohms (K = 1000).

C_1—24-pf. silver mica.

CR_1—20-pf. Varicap (TRW V20E, available from Allied Electronics, Chicago, Ill.

K_1—5,000-ohm s.p.d.t. relay (Guardian series 200).

R_1—0.5-megohm log-taper potentiometer with push-pull switch (Mallory PP55A).

R_2—25,000-ohm potentiometer (Mallory U-29).

SIMPLE CB CONVERSION

THE Town & Country MC-27 CB transceiver, manufactured by Utica Communications Corporation of Chicago, can be converted to 10 meters without any additional components or crystals. Since the transceiver's receiver oscillator operates 1680 kHz. above channel frequency, the receiver crystal is in the phone portion of the 10-meter band. To convert the unit to 10 meters, just swap crystals; that is, put the transmitter crystal in the receiver-crystal socket, the receiver crystal in the transmitter-crystal socket, and repeak the necessary coils. —*Joseph F. Moomaw, Jr., W4FZG*

HX-20 AND HR-20 DIAL POINTERS

BOTH the Heathkit HX-20 and HR-20 have very wide slide-rule dial pointers, making it difficult to read the dial scale with any degree of accuracy. Using a printed-circuit soldering aid, slide the pointer along the cord to the edge of the panel and bend it 90 degrees, so that the edge of the pointer will be facing forward instead of the wide part. The "new" pointer will be about a third as wide as before and readily visible, as both the edge and wide part are painted white. In case the edge hasn't been coated, a small bottle of white refrigerator touch-up paint will do nicely. After making the modification, run the pointer across the dial to see that it doesn't rub, and check the calibration.—*Ross F. Fox, W8PZX*

"UNPOTTING" PERMAKAY FILTERS

IN the "Hints and Kinks" column of *QST* for May, 1963, G. L. Roberts and J. D. Gooch tell how to modify the Motorola Permakay 455-kHz. filters for ham use. The authors state that the potting compound must be removed carefully and that it, "may take an hour or two." It took me six hours using a steam drill. After the job was completed, all I had was a very battered filter and the desire to find a solvent for epoxy potting compound. Epoxy compares with glass for hardness, and it is unaffected by water and most common solvents. However, I found that acetone will slowly dissolve epoxy. Acetone has little effect on the components in the filter, although it will soften the coating on the ceramic capacitors. This is no problem, as you are going to replace the capacitors in the filter anyway.

The "unpotting" job will take two or three days. Take a paint can with a tight-fitting lid and lay the filter flat on the bottom of the can. Pour in some acetone, but not so much as to cover the bakelite base of the filter. Put the lid on the can and wait 12 to 24 hours. Then clean off all the epoxy that is loose and soak the filter once more. Repeat this procedure as many times as necessary.—*Donald S. Krehbiel, W7PLF*

IMPROVING THE HE 45-B RECEIVER

IMPROVED receiver performance can be realized in the Lafayette HE 45-B six-meter transceiver by removing the 12BA6 r.f. amplifier stage and installing in its place a pair of 6CW4 Nuvistors in cascode. The modification takes about two hours to accomplish and should put "new life" into the receiver front end, both in

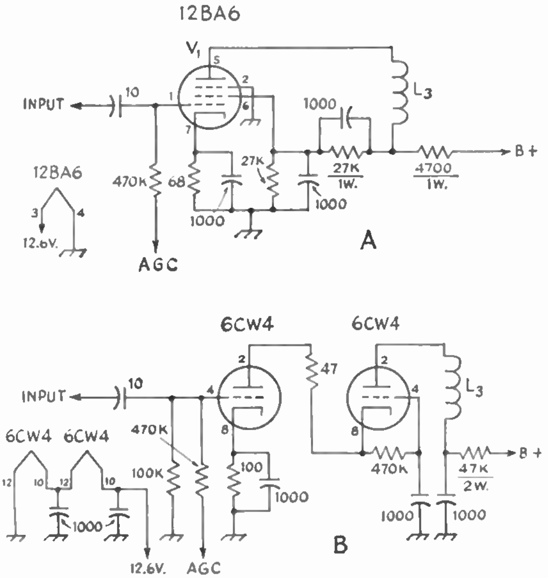


Fig. 2-7—Diagram of the receiver r.f. amplifier circuit of the Lafayette HE 45-B transceiver before modification (A) and after (B). All capacitances are in picofarads (pf. or μμf.); resistors are ½-watt composition unless otherwise specified; resistances are in ohms (K = 1000).

noise figure and sensitivity. Fig. 2-7A shows the original r.f. amplifier circuit, and Fig. 2-0B shows the conversion.

Begin the modification by disconnecting the 10-pf capacitor and 470,000-ohm resistor from Pin 1 of V_1. Do not remove these components, but just put them back out of the way as they will be used later. Unsolder from Pin 5 of V_1 the wire coming from the top of L_3. Remove both resistors connected to the cold end of L_3. Replace the 4700-ohm resistor with a 47,000-ohm unit. Unsolder the two heater leads from Pin 3 of V_1 and push these wires aside to be reconnected later. Clip the remaining leads going to V_1 and file down the rivets holding the socket until they are flush with the top of the chassis. Remove the socket, along with the components which are left on it. Save the parts for possible use in the new amplifier. Enlarge the socket hole with a one-inch chassis punch and make a small plate of 1/16-inch aluminum to cover the opening. Mount two Nuvistor sockets as close together and as near the center of the plate as possible. After attaching the plate to the chassis, solder the two filament wires previously connected to Pin 3 of V_1 to Pin 10 of the second Nuvistor stage. Connect the loose ends of the 10-pf. capacitor and 470,000-ohm resistor formerly attached to Pin 1 of V_1 to Pin 4 of the first Nuvistor stage. The remaining wiring should be obvious from the diagram.

In my case, no adjustments to the receiver were necessary upon completion of the wiring, except to the "S" meter: it had to be zeroed again. However, depending upon the components used and their placement, it may be necessary to repeak both the input circuit and L_3.—*Shirley H. Davis, W2GOR*

HIGH-GAIN VOLTAGE-CONTROLLED TRANSISTOR AMPLIFIER

HIGH-GAIN transistor amplifier designs are often relatively unstable. In addition, most of these circuits require excessive power. It is possible to build an amplifier combining high gain with stability and low power consumption, using the circuit in Fig. 2-8. This amplifier's gain is controlled by an external reference voltage. Closed-loop gain is about 15,000.

The gain of the amplifier stage, Q_1, is stabilized by using a difference amplifier circuit, Q_2 and Q_3, to sense and correct changes in Q_1's operating point. The a.c. gain of Q_1 is controlled by its d.c. operating point. This d.c. operating point is controlled by the difference amplifier, Q_2 and Q_3, through the feedback loop from the collector of Q_3 to the base of Q_1. Varying the reference voltage to the base of Q_3, therefore, varies the a.c. gain of the amplifier.

The overall stability of this circuit depends on the use of quality components and transistors with betas greater than 100.—*NASA Tech Brief 65-10138*

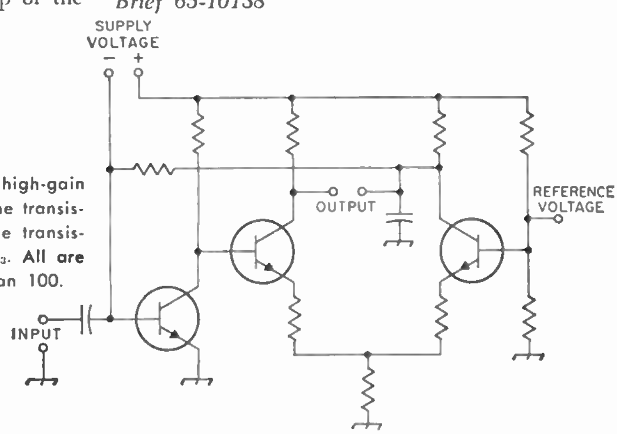


Fig. 2-8—Simplified circuit diagram of the high-gain amplifier. Resistors values will depend on the transistors used and available supply voltage. The transistors are, from left to right, Q_1, Q_2 and Q_3. All are silicon n.p.n. types with betas greater than 100.

INSTANT B.F.O. FOR CONVERTERS

Recently I required a b.f.o. for my home receiver, which consists of a Gonset 3–30-MHz. converter feeding a BC receiver at 1500 kHz. To save the effort of wiring an oscillator, I simply put a transistor radio near the BC receiver antenna terminals, and set the "transistor" to 1500 minus 455 or 1045 kHz., so that the local oscillator would be tuned to my first i.f. The transistor radio on-off switch became the b.f.o. switch, the tuning knob acted as a pitch control and the position of the "transistor" determined the amount of oscillator injection. I did have to get out the soldering iron, though, to wire in an a.g.c. defeat switch to ground out the a.g.c. line in the BC receiver. Of course, a transistor radio with a 455 kHz. i.f. may be used in this way for any converter with an output from 955 to 2055 kHz.—*Alan Budreau*

AUDIO LIMITER FOR C.W.

A simple audio limiter making use of the threshold voltage of silicon diodes can easily be contained in an extension jack such as the Switchcraft type 830. Fig. 2-9 shows such an assembly, which is also provided with a short length of 2-conductor cable (single conductor with shield in this case) and a phone plug. The whole business serves as a phone-cord extension that can quickly be taken out of the circuit when desired.

Fig. 2-9—C.w. limiter built in an extension jack, using the circuit of Fig. 2-10. The two diodes and R_1 are clustered at the right-hand end. R_2 is soldered to the jack-spring contact at the left.

The limiter circuit used is shown in Fig. 2-10. P_1 goes into the phone jack on the receiver, which usually is connected to a tap on the audio output transformer. As this is a relatively low-impedance audio source, R_1 is used to raise the impedance and thereby give the diodes something they can short-circuit effectively when the threshold level is reached. The value shown, 3300 ohms, represents a reasonable balance between good clipping and reduction in headphone signal strength. R_2 is not actually essential, but 1000 ohms resulted in a signal level satisfactory to the writer when using headphones having a nominal impedance of 500 ohms. It can be omitted if a higher level is wanted. Any physically-small silicon diodes having a p.i.v. rating of 50 volts or so can be used.

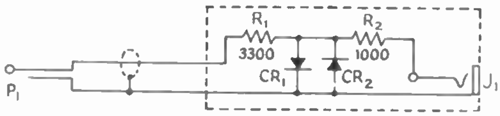


Fig. 2-10—Circuit of the diode limiter. J_1 is an extension jack (Switchcraft type 830) and P_1 is any suitable type of headphone plug. Other components are discussed in the text.

A disadvantage of this type of circuit is that the maximum level is fixed by the characteristics of the diodes, which clip at about 1 volt peak-to-peak. This is good, but not ear-shattering, headphone volume in phones of 500 ohms impedance or higher. The fixed level is far outweighed by the advantage of battery-less operation.—*W1DF*

C.W. AUDIO SELECTIVITY

Many of the selective audio circuits for the C.W. man require special choke coils and additional tubes. Yet, a simple but effective audio filter may be constructed from a TV-flyback transformer and a 0.01- or 0.02-μf. capacitor, and the modification won't require much digging around in your receiver.

Secure a flyback transformer and place the capacitor in parallel with the transformer. This resonant circuit is connected between the grid of the first audio amplifier stage in your receiver and ground. Then, while listening to incoming signals, try different taps on the transformer with one capacitor lead until the filter is resonant at about your favorite beat-note for c.w. reception.

The Q of the flyback transformer is high enough to give a good peak in audio response at the beat-note you wish, while noise and other audio-frequency notes are attenuated.—*Bill Medler, W1FRT*

PANADAPTOR ADAPTOR

Most commercial and surplus Panadaptors have 455-kHz. input frequencies, but each amateur receiver seems to have a different intermediate frequency, anything from 50 kHz. to 8 MHz. A 455-kHz. Panadaptor may be "mated" with any receiver by using the frequency converter shown in Fig. 2-11. This converter may use either a crystal oscillator or signal generator to provide the local oscillator signal. The advantage of using a signal generator is that it extends the usefulness of the Panadaptor converter combination—it becomes a hamshack spectrum analyzer. Oscillator injection is applied to J_2. R_2 is a load for the

for the Receiver

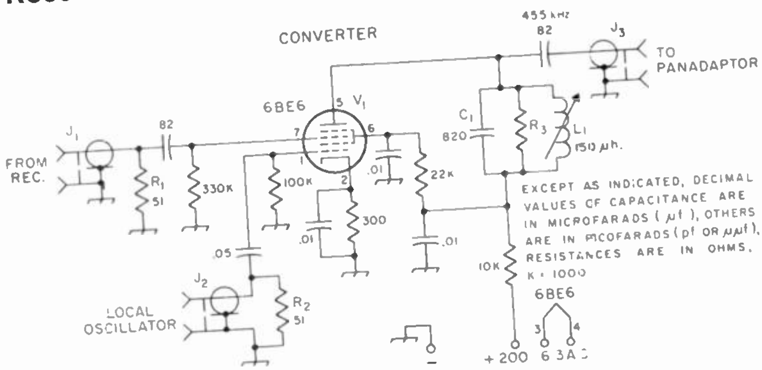


Fig. 2-11—The mixer for converting any receiver's i.f. to 455 kHz. Resistors are ½-watt composition, and capacitors are ceramic.

C_1—820-pf. ceramic.
L_1—Slug-tuned inductor, 110-200 µh. (Miller 4512).
J_1, J_2, J_3—Phono-type connector, chassis mount.
R_1, R_2—5-percent composition.
R_3—See text.

signal generator; if a crystal oscillator is used, R_2 may be omitted. The local oscillator frequency should be 455 kHz. above the i.f. frequency of the receiver. It may be necessary to broaden the response of the 455-kHz. tuned circuit by loading it with resistor R_3. Depending on the compensation available in the Panadaptor, R_3 may be between 500 and 10,000 ohms.

A pick-up loop around the mixer tube is the most convenient method of obtaining i.f. signal for the converter as re-alignment of the receiver i.f. is not required. R_1 is placed across the converter input circuit when a step-type attenuator is used between the receiver and the converter for level measurements; otherwise it may be omitted.—*Ture Heline, K1MFQ*

CHEAP AND EASY SQUELCH

OFTENTIMES it is desirable to incorporate a squelch circuit in a communications receiver. Generally this requires the addition of a vacuum-tube circuit. A quick and easy way to add this feature to receivers that have a conventional diode-type second detector is shown in Fig. 2-12. A 1-megohm control is added between the receiver's B supply and the return of the last i.f. transformer's secondary winding.

Depending upon the amount of positive bias that reaches the secondary of the i.f. transformer, the detector diode will reach different degrees of cutoff. This is preset by the squelch control. The incoming i.f. signal, depending on its strength, will override the positive bias on the detector, and permit it to conduct. The sensitivity of this circuit is only slightly inferior to a conventional squelch circuit. Various squelch levels can be secured by appropriate settings of the control.—*W1CER*

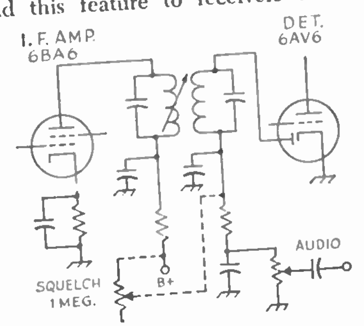


Fig. 2-12—Circuit for the addition of a squelch to a communications receiver. The tubes and unmarked components are those found in a typical circuit. The addition of the squelch control is shown with dotted lines. The control is 1 megohm, linear taper.

WWV ON THE DRAKE 2B

OWNERS of the Drake 2B may receive WWV on 15 MHz. by placing the band switch to 40, the preselector to 10, and tuning to 7 MHz. WWV on 5 MHz. may be copied by placing the band switch on 80, preselector on 10, and tuning to 4090 kHz. on the dial. In both cases you are receiving images, by detuning the preselector to degrade the receiver's image rejection.—*Craig A. Will, WB6GFZ*

USING THE DRAKE NOISE BLANKER

AFTER trying several noise-blanker circuits, I tried the one used by Drake in the R4 receiver—this one really works. The circuit shown in Fig. 2-13 was built into my home-constructed receiver.

The blanking pulse was first connected to the first i.f. stage, but the circuit did not work well. Connecting the blanking pulse to the last i.f. stage made the unit perform as it should.

The noise is amplified in the 6BA6 amplifier, and rectified by the 1N625 pulse detector. A noise pulse causes a negative pulse to appear on the grid of the first half of the 12AX7

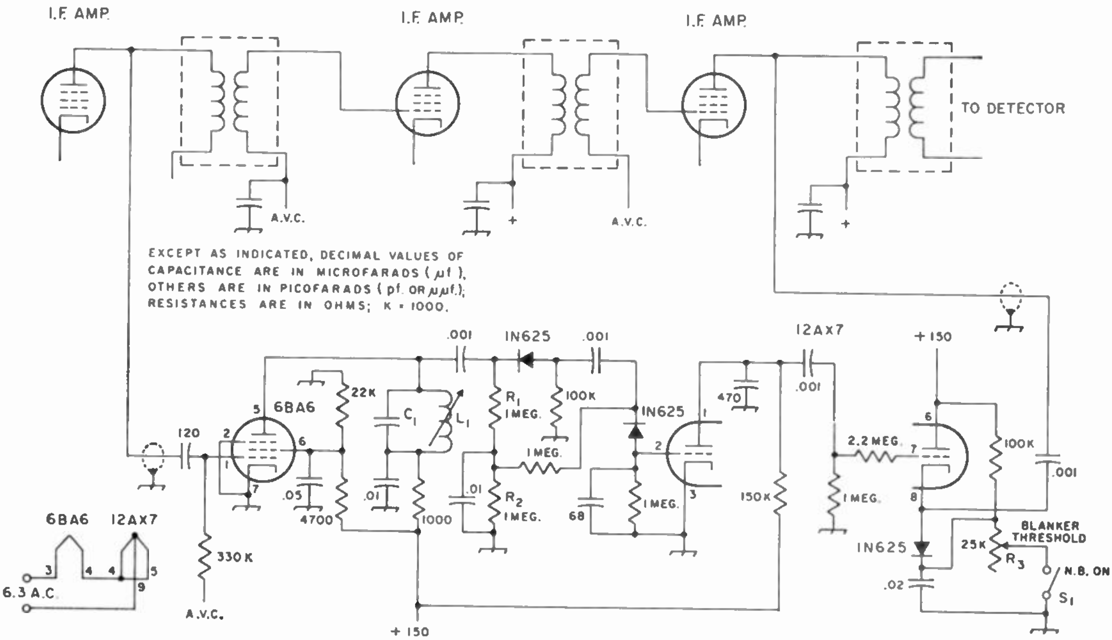


Fig. 2-13—Schematic diagram of the Drake noise blanker. Capacitors are disk ceramics, and resistors are ½-watt.

C_1—Capacitor contained in the i.f. transformer used for L_1.

L_1—One section of a 455-kHz i.f. transformer (detune the other section).

R_1, R_2—1-megohm, ½-watt resistor.

R_3—25,000-ohm linear taper control.

S_1—S.p.s.t. toggle switch.

which cuts this stage off, while the resulting positive pulse in the plate circuit causes the second section to conduct. The plate of the last i.f. stage is grounded for r.f. during the time the second half of the 12AX7 is conducting, through the diode in the 12AX7's cathode circuit. The 25,000-ohm control applies positive bias voltage to the cathode of the second half of the 12AX7 for threshold control.

The blanker is connected to the receiver by short lengths of RG-58/U cable. The i.f. stages must be realigned to compensate for the capacitance of the cables. Then a v.t.v.m. is connected to the junction of R_1 and R_2 and L_1 is adjusted for maximum. The threshold control is set for best blanking action without distortion of the audio.—*Jim Brannin, K6JC.*

REDUCING BROADCAST STATION INTERFERENCE

Some receivers, particularly those that are lacking in front-end selectivity, are subject to cross-talk and overload from adjacent-frequency ham or commercial stations. This condition is particularly common with simple receivers that use bipolar transistors in the r.f. and mixer stages. With the latter, the range of linear operation is small compared to that of vacuum tubes. Large signals send the transistors into the nonlinear operating region, causing severe crosstalk.

The most common cross-talk problem in ham radio is that which is caused by the presence of nearby broacast stations in the 550- to 1600-kHz. range. In some regions, the ham bands—when tuned in on even the best receivers—are a mass of distorted "pop" music, garbled voices, and splatter. It should be pointed out that the broadcast stations themselves seldom are at fault, although in isolated instances they are capable of generating spurious output if operating in a faulty manner.

The most direct approach to the problem of broadcast-station interference is to install a rejection filter between the antenna feed line and the input terminals of the receiver. Such a filter, if capable of providing sufficient attenuation, prevents the broadcast-station signals from reaching the ham receiver's front end, thus solving the cross-talk problem.

An effective band-rejection filter, containing two *m*-derived pi sections in cascade, is shown in Fig. 2-14. It offers sharp rejection to signals in the 500- to 1600-kHz. range but does not impair reception above or below the broadcast band. It is designed for use in low-impedance lines, particularly those that are 50 or 75 ohms.

The band-rejection filter is housed in a 3⅛ × 2⅛ × 1⅝-inch Minibox. Phono connectors are used for J_1 and J_2—an aid to cost reduction. Different-style fittings can be used if the builder wishes. Standard-value components are used

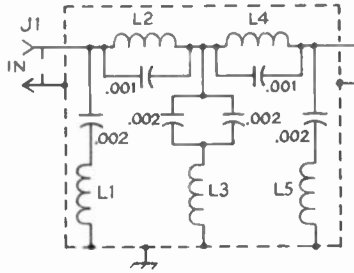


Fig. 2-14—Capacitance is in µf. Capacitors are disk or tubular ceramic.

J_1, J_2—Phono jack.
L_1, L_5—10-µh. inductor (Miller 70F105A1 suitable).
L_2, L_4—33-µh. inductor (Miller 70F335A1 suitable).
L_3—4.7-µh. inductor (Miller 70F476A1 suitable).

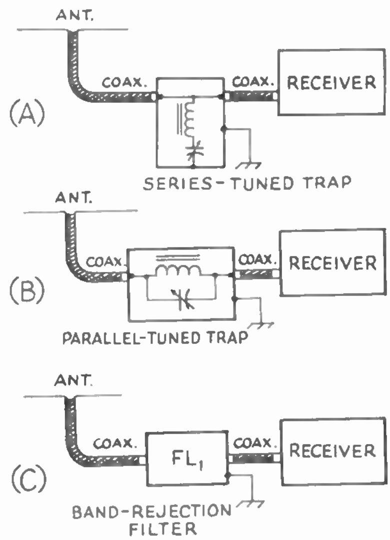


Fig. 2-15—Examples of series- and parallel-tuned single-frequency traps (installed) are shown at A and B. At C, FL_1 represents the band-rejection filter described in the text. If possible, the filter used should be bolted to the chassis or case of the receiver. The receiver should have a good earth ground connected to it.

throughout the filter and the values specified must be used if good results are to be had.

In situations where a *single* broadcast station is involved in the cross-talk problem, a simple series- or parallel-tuned wave trap, tuned to the frequency of the interfering station, may prove adequate in solving the problem. Such a trap can be installed as shown in Fig. 2-15. The trap inductors can be made from ferrite-bar broadcast radio loop antennas and tuned to resonance by means of a 365-pf. variable capacitor. Traps of this type should be enclosed in a metal box, as is true of the band-rejection filter.—*WICER*

OUTBOARD B.F.O.

PROPER b.f.o. performance is essential for c.w. and s.s.b. reception. Some receivers have b.f.o. circuits that are unstable, both electrically and mechanically. Another b.f.o. fault that is sometimes encountered is that of insufficient output. A third bugaboo, and one that is annoying to beginners, to say the least, is the matter of proper b.f.o. adjustment with respect to the i.f. passband of the receiver. Some receivers do not have any markings on the front-panel b.f.o. control to tell where to set it for upper- or lower-sideband reception. That is to say, the operator has to experiment with the settings of the control in order to find the right relationship to "zero" for satisfactory reception . . . often time consuming and frustrating.

By using a crystal-controlled beat oscillator, it is possible to correct the ills mentioned in the foregoing paragraph. A working example of such a circuit is given in Fig. 2-16. The unit is built to operate "outboard" and can be powered from the receiver's accessory socket. If the receiver does not have one, it should be a simple matter to add an outlet.

Two crystals are used, Y_1 and Y_2, permitting upper- or lower-sideband reception by merely switching one of two crystals into the circuit by means of S_1. A level control, R_1, enables the operator to vary the b.f.o. injection to the second detector of the receiver so that the desired ratio between i.f. and b.f.o. signals can be obtained. A s.p.s.t. switch, S_2, is part of the R_1 assembly and is used to place the b.f.o. in standby when it is not being used.

This circuit was designed for use at 455 kHz. It could be used at higher i.f.s, but C_1 would have to be made smaller in capacitance to provide the proper feedback for the oscillator. Oscillator V_{1A} is a standard Pierce type, is easy to get operating, and should work well at higher crystal frequencies, too.

There is nothing stringent to observe as far as layout and wiring rules are concerned. Any small Minibox or similar container can be used to house the circuit. If desired, it can be built into the receiver—space permitting—to become a permanent part of the equipment.

The LEVEL and LOWER-UPPER SIDEBAND controls are mounted on the front of the b.f.o. chassis for easy accessibility. J_1, the output jack, is located on the rear wall of the box. A 3/8-inch diameter rubber grommet is also on the rear of the case and is used as an outlet for the power cable which connects the b.f.o. to the receiver's accessory outlet.

The proper crystals for the b.f.o. will have to be chosen according to the actual i.f. of the receiver. Some receivers use a 455 kHz. center frequency, while others call for 456 kHz. Actually, there isn't much difference when it comes to selecting Y_1 and Y_2. The receiver can always be realigned to match up with the b.f.o.

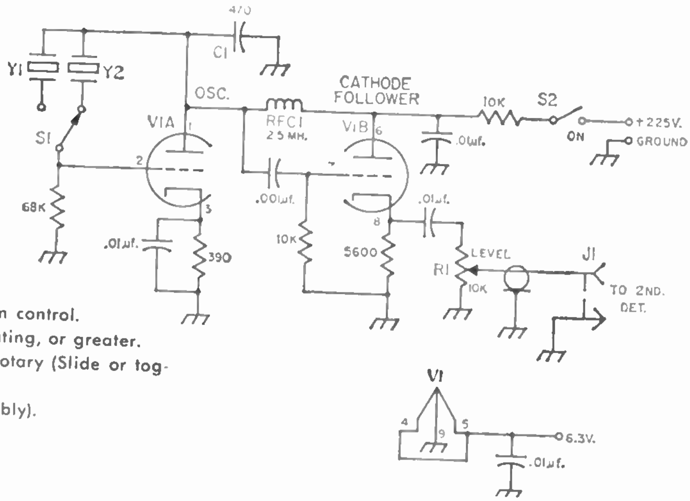


Fig. 2-16—Schematic of the b.f.o. Capacitances are in pf. unless otherwise indicated. Resistance is in ohms. K = 1000. Capacitors are disk ceramic. Fixed-value resistors are ½-watt composition.

C_1—See text.
J_1—Phono jack.
R_1—10,000 ohm linear-taper carbon control.
RFC_1—2.5-mh. r.f. choke, 50-ma. rating, or greater.
S_1—S.p.d.t. single-water phenolic rotary (Slide or toggle switch suitable also.)
S_2—S.p.s.t. switch (part of R_1 assembly).
V_1—12AU7.
Y_1, Y_2—See text.

crystals, provided they're not too far removed in frequency. War-surplus type FT-241A crystals were used in this model. If the receiver calls for a 455-kHz. i.f., order a crystal for 456 kHz., and another for 454 kHz. In other words, pick a crystal that is one kilohertz higher than the i.f., and another that is one kilohertz lower than the i.f. This will be satisfactory for most applications. If a 455-kHz. i.f. is being used (center frequency), it is helpful to have a 455-kHz. crystal on hand for aligning the i.f. The crystal can be plugged into the b.f.o. and the i.f. transformers then aligned for peak response. Crystals in this range are available (±5 Hertz tolerance) for $1.75 each, ground to your specifications.[1]

To feed the b.f.o. signal into the station receiver, mount a phono connector on the rear apron of the receiver's chassis. Use a short piece of shielded audio cable, or miniature coax line, and route the b.f.o. signal to the secondary side of the last i.f. transformer. Using "gimmick" coupling, wrap two or three turns of the center conductor of the b.f.o. cable around the connecting lead which joins the i.f. transformer secondary to the detector tube's grid, or to the r.f. side of the detector diode. Make sure that the two wires are insulated from one another so that a short-circuit will not occur. Ground the shield braid of the b.f.o. cable where it enters the receiver and again at the end which is near the detector circuit. If more b.f.o. injection is needed, increase the number of wraps of the gimmick coupler until the desired performance is obtained. R_1 should be set somewhere near midrange during this adjustment.

This b.f.o. can also be used in s.s.b. exciters to serve as a carrier generator for upper and lower sideband operation. Crystals Y_1 and Y_2, however, would have to be chosen to match the passband characteristics of the crystal-lattice or mechanical filter being used. R_1 could be used as a carrier-insertion control if this were done, routing some of the b.f.o. signal around the filter and into the mixer for c.w. and a.m. operation, or for tuneup purposes when desired. —*WICER*

[1] JAN Crystals, 2400 Crystal Drive, Fort Myers, Florida. Catalog available on request.

10-METER FET PREAMPLIFIER

Because many of the older ham receivers suffer from front-end insensitivity in the 28- to 30-MHz. range, an outboard preamplifier can often be used to breathe new life into tired old receiving equipment. Also, it is not an uncommon experience to own one of the newer receivers that has a weak front end as far as the upper frequency range is concerned.

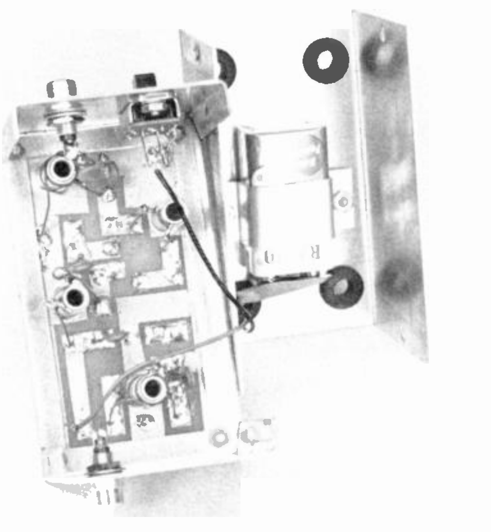


Fig. 2-17—The input jack and the on-off switch are mounted on one end of the box—upper left of photo—and the output connector is on the opposite end of the box, lower left.

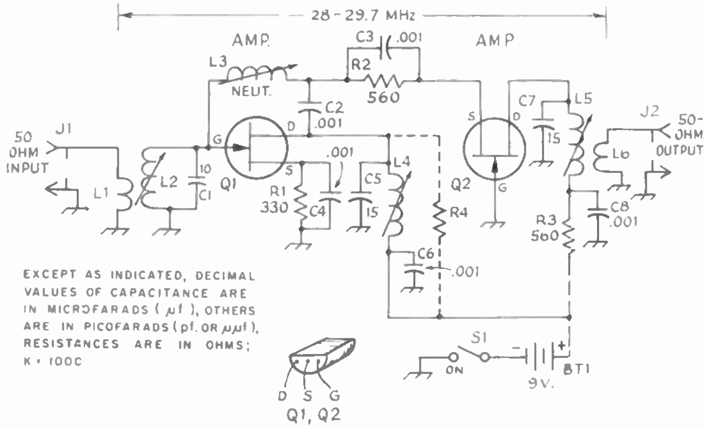


Fig. 2-18—Schematic of the 10-meter preamp. All capacitors are disk ceramic. Resistors are ½-watt composition.

BT_1—9-volt transistor radio battery.
C_1-C_8, inc.—For text reference.
J_1, J_2—Phono connector.
L_1—5 turns insulated wire over ground end of L_2.
L_2, L_4, L_5—17 turns No. 30 enam. wire, close-wound on ¼-inch dia. slug-tuned form (J. W. Miller 4500-2 form or 4503 1-3 μh. prewound inductor.*)
L_3—33 turns No. 30 enam., close-wound on ¼-inch dia. slug-tuned form (J. W. Miller 4500-2 form) or J. W. Miller 5-9 μh. prewound inductor, 4505.
L_6—5 turns insulated wire over C_8 end of L_5.
Q_1, Q_2—Motorola MPF102 JFET or similar.
R_1-R_5, inc.—For text reference.
S_1—S.p.s.t. slide switch.

A preamplifier can be used effectively with these receivers too.

Although coil data was not compiled for some of the other ham bands where preamplifiers are useful—21, 50, 144 and 220 MHz, for instance—this circuit-board pattern and the general circuit hookup itself should be adaptable to use on other frequencies. The cascode arrangement used is standard and should present no problems to the experienced builder should he wish to tailor it to some other frequency range.

A schematic of the preamp is given in Fig. 2-18. Motorola MPF102 FETs are used at Q_1 and Q_2, but any JFET (N-channel) whose upper frequency limit is 60 MHz. or greater can be used with equal success in this circuit. The classic Wallman configuration is used in this solid-state adaptation of the early circuit. Q_1 operates as a neutralized triode amplifier and is followed a common-gate stage, Q_2. L_3 is the neutralizing inductor. R_1 and R_2 are used as source-bias resistors and their values were chosen to provide a compromise between good noise figure, overall gain, and overload immunity.

Slug-tuned inductors are used throughout. The preamplifier is stagger-tuned to provide near-uniform response across the entire 10-meter band. The approximate gain of this unit is 35 decibels. Stability is good when the preamp is connected in a non-reactive low-impedance line of 50 or 75 ohms. If for some reason L_3 will not completely stabilize the circuit, the swamping resistor shown in dashed lines, R_4, can be added. Its value should be somewhere between 1800 and 10,000 ohms. Use only the highest value of resistance that will insure stability. The lower the resistance, the lower the gain and the worse will be the selectivity.

A 2¼ × 2¼ × 4-inch Minibox is used as a case for the unit (Fig. 2-17). The cascode preamp is built on an etched-circuit board which is 2¼ inches wide and 4 inches long. It is

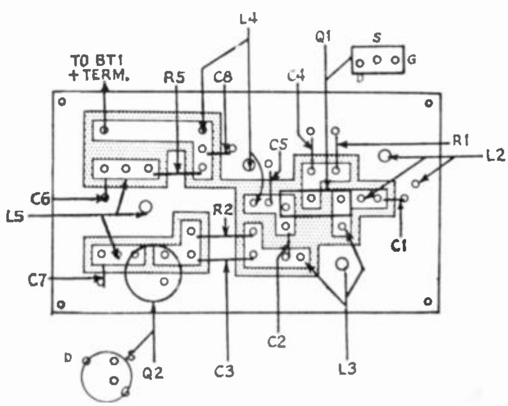


Fig. 2-19—A-half-scale drawing of the etched-circuit board showing placements of the parts. All coils are mounted under the board (copper side and inside the Minibox) as are C_1, C_5, C_6, and C_7. See text for location of S_1, J_1, J_2, and BT_1. All other components mount on phenolic side of the circuit board.

* J. W. Miller Co., 5917 S. Main Street, Los Angeles, California 90003.

mounted over a cutout on the Minibox cover, and is held in place by four 4-40 screws. A scale drawing of the circuit board is given in Fig. 2-19.

S_1, J_1, and J_2 are mounted on the same half of the Minibox that contains the circuit board. BT_1, a small 9-volt transistor radio battery, is attached to the inside surface of the other half of the box. A home-made aluminum U clamp secures BT_1 to the cover. Rubber feet are attached to the bottom of the box to prevent damage to table tops.

Ordinary masking tape was used to preserve those parts of the circuit board that are retained. The tape was cut into strips of the desired size, then pressed firmly in place with a dull instrument to assure that a good seal existed.[1] The masked-off board was then immersed in etching solution for approximately 30 minutes. Kepro ferric-chloride solution was used for this project. Vector etchant kits are also excellent for this purpose.

Connect the preamp in the coax line between the antenna and the receiver input terminals. Turn S_1 to ON and tune in a signal from a grid-dip meter or a signal generator. If the preamplifier is oscillating—as evidenced by "birdies," blank carriers, or popping noises as the coil slugs are adjusted, set the slug of L_3 (toward maximum inductance) for a position where the oscillation ceases. The next step is to tune in a signal at 28 MHz. and adjust L_2 for maximum gain. After this is done, tune L_1 for a peak at 29.7 MHz. L_3 should be peaked in a like manner at approximately 28.7 MHz. It may be necessary to readjust L_3 for best stability and noise figure after the foregoing procedure is completed.

The preamplifier should now be ready for use. It is important that the usual precautions be observed to prevent r.f. burnout of the input transistor. A good coaxial antenna relay is a *must* if proper isolation is to be had during the transmit cycle. The life span of BT_1 should be good because the entire circuit draws only four milliamperes during operation.—*W1CER*

[1] The masking tape can be cut to the desired shapes much more easily if a strip of tape is first laid on a piece of kitchen-variety waxed paper as a backing. Strip off the waxed paper just before putting the tape on the copper.

SIMPLE AUDIO FILTER

MANY receivers incorporate only one degree of selectivity, suitable for s.s.b. reception. Code reception can often be improved by the addition of an audio-filter to the output of the receiver. The audio-filter circuit shown in Fig. 2-20 includes a power supply and an audio amplifier, and its use requires no change to the receiver itself. The tuned circuits, L_1C_2 and L_2C_3, use toroid transformers made for teletype units. These transformers have two windings which must be connected in series in order to get the required 88-mh. inductance. Fig. 2-21 shows how this is done. These inexpensive inductors are available through several sources that advertise in *QST* Ham-Ads every month. If loudspeaker reception is not contemplated, T_1 can be omitted

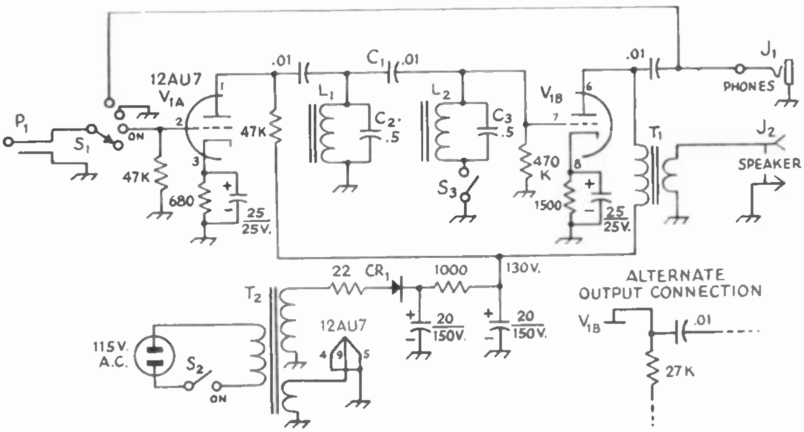


Fig. 2-20—Circuit diagram of the audio filter. All capacitances are in µf. Capacitors marked with polarity are electrolytic. Resistances are in ohms; all resistors are ½-watt.

C_1—0.01 µf., disk ceramic.
C_2, C_3—0.5 µf., paper (see text).
CR_1—Silicon rectifier, 400 volts p.i.v. or more.
J_1—Headphone jack, open-circuit type.
J_2—Phone jack.
L_1, L_2—88-mh. toroid (see text).
P_1—Headphone plug.
S_1—Single-pole, four-position wafer switch, with a.c. switch mounted on back (Centralab 1465 or similar).
S_2—See S_1.
S_3—Single-pole, single-throw toggle.
T_1—Output transformer, 10,000-ohm primary, 3.5-ohm secondary (Knight 54 A 1448 or equivalent).
T_2—Power transformer, 125 volts, 15 ma.; 6.3 volts, 0.06 amp. (Knight 54 A 1410 or equivalent).

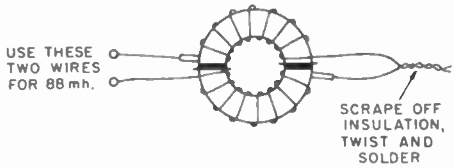


Fig. 2-21—This drawing shows the method of connecting the windings of the 88-mh. toroid to obtain the required inductance.

and the alternative output connection can be used.

Two degrees of selectivity are available. When S_3 is closed, two tuned circuits are active, and the bandwidth at 20 db. down is just a little over 100 Hertz. With S_3 open, the bandwidth increases to about 1100 Hertz. The peak frequency is about 750 Hertz.

A 2 × 5 × 7-inch chassis is sufficient to house the filter, or it might be built in a suitable Minibox. There is nothing very critical about the parts arrangement other than keeping the input and output circuits well isolated from each other. Machine screws 1½ inches long, rubber grommets and washers can be used to hold the toroids.

With both tuned circuits working, the selectivity is extremely sharp, and some "ringing" will be apparent. This is perfectly normal, the inescapable result of confining the response to a narrow band of frequencies. If the ringing is considered excessive, try changing the value of C_3 slightly.—*W1ICP*

3.5-MHZ. AUTO-RADIO CONVERSION

The problem of finding an inexpensive mobile converter was solved by modifying an auto receiver to tune 3.5–4 MHz. If your car is equipped with a good broadcast receiver (with an r.f. stage), it can be made to work on 75 meters by switching in additional coils in parallel with the r.f. and mixer-oscillator stages as shown in Fig. 2-22.

Mount the slug-tuned coils (L_1, L_2, L_3) near the permeability-tuned coils of the auto receiver. Because only one end of each coil must be switched, a 3-pole, single-throw rotary or lever-action switch is required. The additional padding trimmers, C_1, C_2 and C_3, are adjusted with the slug-tuned coils for proper tracking. A grid-dip meter is a help in making initial adjustments.

An oscillating i.f. stage is used for a b.f.o. The addition of the b.f.o. requires disabling the a.g.c. when the b.f.o. is on, so a switch was fastened at the rear of the b.f.o. control. Most of this series of auto receivers have two large-diameter studs that project through the chrome mounting plate. These were drilled to take the switch and b.f.o. control shafts, thus no holes are required in the mounting plate.

Because of the cramped quarters in most receivers, some space has to be gained somewhere. The rectifier tube was replaced by silicon diodes, and the audio output transformer mounted on the side of the case, giving enough space for the modifications.—*Hamilton Amateur Radio Club Bulletin*

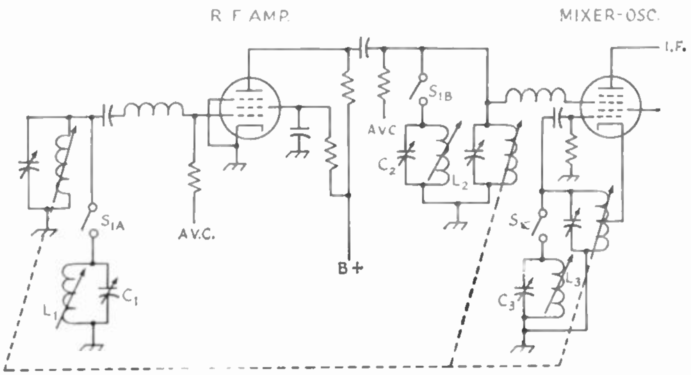


Fig. 2-22—Diagram of the converted auto receiver. Unmarked components are parts of the original circuitry.

C_1, C_2, C_3—7–150-pf. trimmers.
L_1—18 turns No. 26 enam., close-wound on ¼-inch diam., slug-tuned form.
L_2—30 turns No. 28 enam., close-wound on ¼-inch diam., slug-tuned form.
L_3—10 turns No. 26 enam., close-wound on ¼-inch diam., slug-tuned form.
S_1—3-pole, single-throw rotary or lever-action switch.

Hints and Kinks . . .

for the Transmitter

SIMPLIFIED METER SWITCHING

The writer recently built a simple 6146 c.w. power amplifier to follow a small transistor transmitter. A 6AQ5 clamper tube was used to protect the amplifier, and a 0-1 milliammeter and suitable shunt and multiplier resistors were employed to indicate either grid or cathode current. However, as shown in Fig. 3-1, a s.p.s.t. toggle switch, S_1, was used to do the meter switching, rather than the usual multiple pole switch. When S_1 is closed, M_1 and R_1 serve as a voltmeter to indicate the potential drop across the cathode resistors, R_2 and R_3. When S_1 is opened, the voltmeter indicates the potential drop across the 240-ohm grid resistor, R_4. The full scale cathode and grid current readings are approximately 200 ma. and 5 ma., respectively.—*Wes Hayward, W7ZOI*

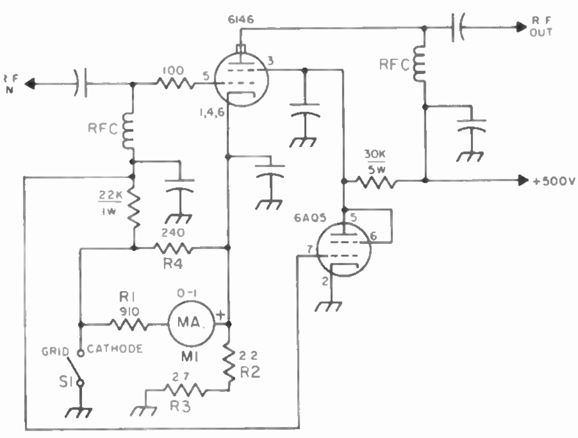


Fig. 3-1—Only a s.p.s.t. toggle switch is necessary to do the meter switching in this amplifier. Resistances are in ohms; K = 1000; resistors are ½ watt unless indicated otherwise.

M_1—0-1 milliammeter.

R_1, R_2, R_3, R_4—For text reference.

S_1—S.p.s.t. toggle switch.

T4X HINT

If you have an early model of the Drake T4X transmitter and operate both s.s.b. and c.w., the following information should prove helpful. It came directly to me from the Drake Company in answer to an inquiry.

"Early models of the Drake T4X transmitter have an operational shortcoming which makes for inconvenience if you want to change from c.w. to s.s.b. or vice versa. To go from s.s.b. to c.w. you have to reach around and plug in the key, and the reverse when going from c.w. to s.s.b. There is a very simple remedy for this inconvenience, which allows the entire operation to be controlled by the function switch just as it is done in the later models of the T4X. With the T4X bottom turned up and the front panel facing you, observe the rearmost switch wafer of the function switch. There is a terminal on the rear switch wafer close to the chassis that is unused. Connect a wire to this unused terminal, run it straight back to the injection jack at the chassis rear and route the wire through the notch in the corner of the injection shield to the terminal on the key jack to which the white wire is attached. Lead dress is important and the added wire should be installed just as described. This modification allows the function switch itself to control the changeover and will not alter the operation of the T4X in any other way."—*W1ETU*

ON SWAN 350 MODIFICATION

In response to a question from a Swan 350 owner concerning the Hint & Kink on page 42 of January 1968 *QST*, W6QKI, general manager of Swan Electronics, had a number of comments which we reproduce below:

"The problem of short tube life with 6HF5s has affected only a relatively small percentage of Swan owners, and the main reason for running full power during tuning is because there is no better way to adjust the final for proper loading. As soon as you reduce power, whether by reducing drive, or screen and plate voltage, you can no longer find the correct setting for the P.A. LOAD controls. When loading adjustment is not properly set you lose efficiency, resulting in less output. Also, the final will 'flat-top' sooner, and distortion products are much greater. This is why we have been reluctant to provide for reduced-power tuning, and instead encourage the operator to become accustomed to rapid tuning procedures. Many owners tell us they have run their original tubes for as long as two to three years of regular operating without replacement. Their secret is mainly that they don't tune up often, and when they do it is done quickly.

"One of the problems we find is that some operators will dip the plate tuning and adjust the plate loading rather slowly, trying to tune to exactly a certain number of milliamperes. They find 30 seconds rather short, and the tubes find it rather long. The best way for tuning up is to use a field-strength meter or bridge, and simply adjust P.A. TUNE and P.A. LOAD for maximum output, disregarding the p.a. cathode current. Tuning up with a plate or cathode current meter is mostly a carryover from the days when it was the only tuning indicator in the transmitter, and r.f. ammeters came rather high. But with so many s.w.r. bridges or field-strength meters around today, tuning for maximum output is simple, fast, and by far the better way.

"Referring to Step (3) of the Swan 350 modification article in January *QST*, we had actually removed this wire in later 350s and in all of the 500s manufactured through December of '67. This requires then that you have to insert carrier with the CAR. BAL. control every time you tune up, and then rebalance the carrier to operate. This is not nearly as convenient, and our reason for doing it was not to control power during tune-up, but to reduce a possible spurious problem when operating 15-meter c.w. Steps (4) and (5) in the article really don't do anything, because once you have done Step (3) you can control the power level during tune-up with the CAR. BAL. control, if this is the way you wish to tune up. However, as stated before, we don't recommend tuning up at reduced power. Incidentally, by doing Step (5) you no longer have offset transmit frequency when operating c.w. This won't bother the phone man, but will make a c.w. man unhappy.

"One other note regarding p.a. tube life: the tubes must be fairly well matched for idling current. We supply them in matched pairs on request. Usually a replacement pair picked from a dealer's shelf will not be matched very closely, and when idling current is set for 50 ma., one tube is drawing most of this. Tube life will then be quite limited. If the original tubes fail, and this can sometimes happen through no fault of the owner, they should be replaced by a matched set from the dealer, or from the factory."—*Herbert G. Johnson, W6QKI*

SWAN 350 MODIFICATIONS

Ever since I obtained my Swan 350 transceiver, I have been deeply concerned that the transmitter runs wide open in the TUNE-CW position, except when the final amplifier has been dipped and unloaded. The final tubes (6HF5 color television sweep tubes) are subject to damage or burn out unless fast action is taken during tune-up. According to the manufacturer's instruction manual, the transmitter shouldn't be in the TUNE-CW position under key-down conditions for more than thirty seconds at a time. It's not too difficult to satisfy this requirement when operating the rig as part of a fixed station, but it is rather trying to load a mobile antenna in such short order; it can be done, but why gamble on losing a pair of final tubes or burning out an antenna loading coil? The following is my solution:

1) Remove the bottom cover of the transceiver.

2) Locate the REC-TUNE-CW switch, S_2.

3) Remove the white wire with violet tracer from S_2. Note that this wire comes from pin 9 of the balanced modulator, V_{13} (7360).

4) Wire a 1-megohm potentiometer (connected as a rheostat) in series with the white lead with violet tracer and the terminal on S_2 from which this wire was disconnected. Locate the plate which is used to cover the accessory-socket hole on the rear of the transceiver. Remove the plate and make a duplicate. Then mount the potentiometer on the new plate and attach the plate to the chassis. Finally connect two wires to the control and route them along the side of the chassis to S_2.

5) Locate the end of the 50-pf. capacitor, C_{1001}, connected to S_2, and ground it to the chassis with a short jumper wire.

With the modification described above and with S_2 in the TUNE-CW position, you can vary the cathode current of the final amplifier tubes from approximately 100 ma. to 600 ma. by adjusting the added potentiometer. Note also that it will no longer be necessary to touch the CAR BAL control in order to adjust the power amplifier stage.

Besides the changes discussed, there are two alternative ways to control the output of the final. The first is to use a fixed resistor in lieu of the 1-megohm potentiometer. The power amplifier meter will read about 200 ma. with a 500,000-ohm resistor and about 100 ma. with a 1-megohm resistor, provided the CAR BAL control has been adjusted according to the instruction manual. Note that this control must be varied in order to obtain full output (580 ma.). The second way is to disconnect the white wire with violet tracer from S_2 and to ground the end of C_{1001} as described in step 5 above. Then the CAR BAL control can be used to vary the cathode current of the final from 50 to approximately 600 ma., provided the transceiver is in the TUNE-CW position. This last modification may be the easiest of the three; however, frequent turning of the CAR BAL control may result in erratic operation of this potentiometer (evidenced by difficulty in balancing out the carrier for s.s.b. operation).—*Wayne D. Carpenter, W4JMU*

IMPROVING THE VU2JN TRANSMITTER

In case some experimenting amateur has difficulty trying to build "A Transistor Transmitter From India" as described by VU2JN on page 16 of *QST* for November 1967, here is a possible remedy. The oscillator in my unit would not oscillate with any of my seventeen 40-meter crystals. As shown in Fig. 3-2, the problem was solved by adding a 330-pf. silver mica capacitor, C_1, between the base and the emitter of the OC171. Now the oscillator starts readily with any 40-meter crystal.—*Bob Richardson, W6WHM*

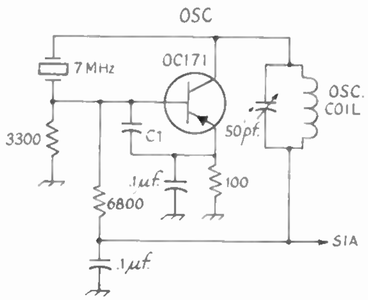


Fig. 3-2—Diagram showing W6WHM's modification to the VU2JN transmitter. The only added component is C_1, a 330-pf. silver mica. Resistances are in ohms.

AMPLIFIED A.L.C. FOR THE HT-32B

THE amplified a.l.c. circuit shown in Fig. 3-3 can be used to prevent flattening in the final amplifier stage of the Hallicrafters HT-32B transmitter. This circuit is essentially the same as that used in the HT-46 and described on pages 45 and 46 of *QST* for August 1966.

In my unmodified HT-32B, flat-topping would occur at an audio level control setting of 2 or higher. After installation of the amplified a.l.c. circuit, the level control could be turned up to 6 before the final amplifier started acting up. Although it would be nice if the level control could be used over its full range, I find that with my microphone I never turn the control beyond a setting of 6, since background-noise pickup becomes objectionable above this point.

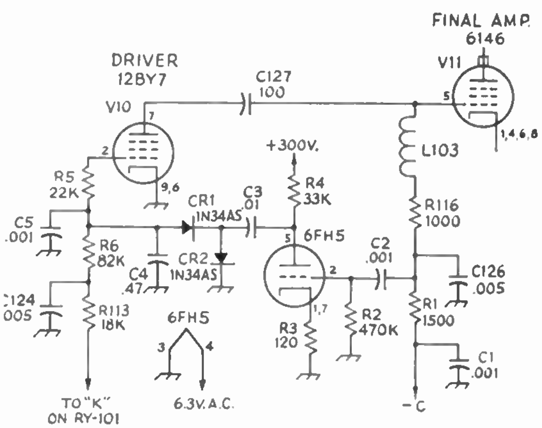


Fig. 3-3—Diagram of the amplified a.l.c. circuit WA3HLW added to his HT-32B. C_{121}, C_{124}, C_{127}, L_{103}, R_{113}, R_{116}, V_{10} and V_{11} are original parts. Resistances are in ohms (K = 1000) and resistors are ½ watt. Decimal-value capacitances are in μf. and others are in pf. Capacitors are ceramic except for C_1 which is paper tubular.

The entire assembly including tube and socket are mounted under the chassis on spare lugs of the terminal strip immediately forward of choke L_{127}. R_5 and R_6 replace the original 100,000-ohm driver grid resistor, R_{111}. The rest of the wiring is straightforward and should be obvious from the schematic.—*M. E. Lundfelt, WA3HLW*

TVI TIP

WHEN using a transceiver with an external speaker, possible TVI can be prevented by inserting at the set an r.f. choke in series with each of the speaker leads. Otherwise the speaker leads might become radiating antennas.—*Richard Mollentine, WAØKKC*

NCX-3 OUTPUT STAGE

NATIONAL NCX-3 users should check the output stage of their transceivers, especially if the transceivers are used in mobile service. A recent failure showed that the soldered connection had broken between the braided-metal plate lead and the plate cap of one of the 6GJ5 tubes. The connection to the other 6GJ5 was being made by only one strand of the braid. As manufactured, this connection between the braid and the plate cap depends entirely upon the soldered joint for strength. To reduce the possibility of a plate lead becoming undone, wrap the connector and the braid with three turns of No. 18 or smaller tinned copper wire. Cover the entire connection with a full flow of solder.—*A. A. Wicks, WB6KFI*

COOLING THE RANGER II

CONSIDERABLE heat is generated in the r.f.-tight cabinet of the Johnson Viking Ranger II, most of it coming from the 5R4GYB high-voltage rectifier. This heat can be greatly reduced by using a plug-in silicon replacement for the vacuum-tube rectifier. Several types are available from many of the mail-order electronic supply houses, some rectifier units costing less than a comparable home-assembled version. Replacing the 5R4GYB in the Ranger with one of these plug-in units caused the high voltage to increase to 560 volts under full load and to rise to 580 volts with no load. The 700-volt electrolytic filter capacitor remained well within its rating and the only change necessary was to reduce the static current of the modulator to about 60 ma., by moving the slider of the high-voltage bleeder resistor about ⅛ inch toward the panel.

The use of a silicon rectifier in the Ranger's low-voltage supply is not recommended. The increase in voltage that comes from using a silicon rectifier is undesirable in the low-level stages, requiring that a series resistor be used: unfortunately, this resistor generates more heat than the low-voltage rectifier tube.—*G. L. Countryman, W4LA*

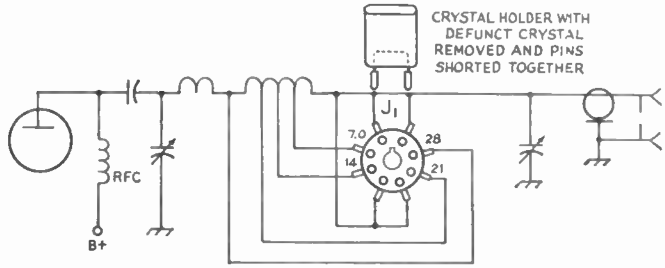


Fig. 3-4—K1DBA's inexpensive r.f. switch. J_1 is an octal socket and P_1 is made from an FA-9 or FT-243 crystal holder or an equivalent plug.

JUMPER PLUG SWITCH

Low-level r.f. switching may be accomplished by using a standard octal socket and a jumper made from an old FA-9 type crystal holder or an equivalent plug. After wiring the socket as shown in Fig. 3-4 and marking the contacts as to coil tap, the undesired section of the coil can be shorted by inserting the shorted crystal holder in the desired contact and either of the two other possible alternatives. Leaving the jumper out altogether will allow the entire coil to remain in the circuit. The coil should be mounted close to the socket so that short leads may be used to keep losses down.—*Clement Paskus, K1DBA*

SB-200 TIP

My Heathkit SB-200 linear amplifier worked fine except for one thing: the meter illumination lamp generated enough heat to melt the meter's case. I remedied this situation by removing the lamp and taping it to the filter capacitors directly behind the meter. Of course, the hole had to be plugged to keep dust out.—*Kenneth Ray Fleming, WAØNLN*

IMPROVED LOADING FOR THE SB-34

On 3.5 MHz. the loading capacitor in my SB-34 transceiver had to be turned completely counterclockwise in order to fully load the transmitter. Changing C_{75} from 1100 pf. to 1300 pf. cured the problem. C_{75} is found mounted on the bandswitch, S_{7A}, inside the bottom of the final amplifier cage.—*Robert W. Lewis, K8KNI*

COAXIAL NEUTRALIZING CAPACITOR

During the construction of my linear amplifier I came up against the familiar problem of obtaining a neutralizing capacitor. I needed a capacitor of 10 to 15 pf. with a voltage rating of 2000 volts. Now RG-58/U has a capacitance of 28.5 pf. per foot and a voltage rating of 1900 volts (r.m.s.), so I figured that six inches of it would do the job.

My procedure for making a coaxial neutralizing capacitor is as follows. First determine the length of coax required to provide sufficient capacitance and add 4 inches. Call this length A. Measure the distance between the plate and grid circuit of the amplifier, taking the route the coax will take. Call this length B. Cut the coax to length A or B, whichever is the greater. Remove ½ inch of vinyl insulation and braid from both ends. Strip the dielectric from one end and pull the inner conductor through the dielectric so that the dielectric protrudes beyond the other end of the inner conductor by about ½ inch. Now slide both center conductor and dielectric through the braid for about 2 inches. Then slide the outer insulation over the braid to expose ½ inch of braid at the other end. Fig. 3-5 shows the relative positions of the various parts of the coax when the capacitor is ready for installation. Connect the braid to the grid circuit and the center conductor to the plate. The capacitance can be varied by sliding the inner conductor together with the dielectric back and forth inside the braid. In the case where the routing of the coax requires a longer length than calculated, the braid and outer insulation should be trimmed to a length 3 inches greater than that required to provide sufficient capacitance. After the amplifier has been neutralized the inner conductor can be trimmed to suit the lead dress, providing the length inside the braid is not disturbed. Depending on lead placement, stray capacitance between the outside of the coax and the plate circuit may reduce the calculated length of coax by an inch or two.—*Mike P. Hughes, VE3EIH/W5*

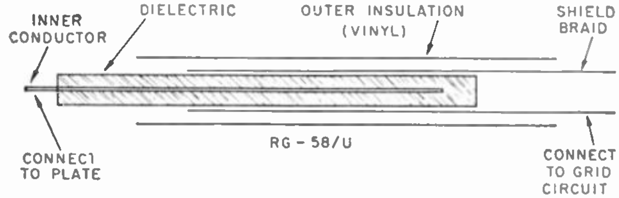


Fig. 3-5—Cross-sectional view of RG-58/U coaxial neutralizing capacitor.

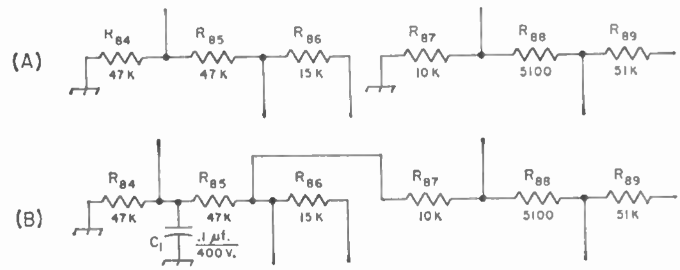


Fig. 3-6—(A) Circuit of the HX-20 before modification. (B) Modification of the bias networks as described in the text. C_1 is a 0.1- or 0.25-µf, 400-volt, paper capacitor. R_{84} through R_{89} are original parts of the HX-20.

IMPROVED C.W. OPERATION OF THE HEATH HX-20

Two simple modifications to the Heathkit HX-20 exciter will improve its performance on c.w. without affecting its operation on s.s.b. The first is to disconnect the bottom of the 6146 grid-bias bleeder chain from ground (R_{87}, R_{88}, R_{89}) and to connect it to the junction of R_{85} and R_{86}. This will apply cutoff bias to the final when the function switch is in the OPERATE position and the key is up. Closing the key reduces the bias to normal Class AB_1 level. The final runs much cooler with no static key-up current, and any possible diode noise is eliminated in cases where a t.r. switch is used.

The second modification is to connect a capacitor to ground at the junction of R_{84} and R_{85} (see Fig. 3-6B). The keying of the HX-20 is a little "hard," and a suitable capacitor, C_1 at this point softens it sufficiently to eliminate local key clicks, both on make and break. A value of 0.1 µf. is sufficient if the HX-20 is used "barefoot" or to drive a linear, but if it is used to drive a Class C amplifier, the value should be 0.25 µf.—*D.W.R. McKinley, VE3AU*

VXO WITH THE 20A

Ed Tilton's VXO (*QST* for July 1963) works well with the Central Electronics 10A, 10B and 20A. Crystals around 12.5 MHz. are used on 80 meters, 16 MHz. on 40, 23 MHz. on 20 meters, and 17 MHz. on 10. Connection is made to either the transmitter crystal socket or v.f.o. input, using the coupling method described in the VXO article.—*Lee V. Mincemoyer, W3PQK*

CRYSTAL OSCILLATOR FOR THE 32V

The crystal oscillator shown in Fig. 3-7 was designed for use on MARS and traffic frequencies when using the Collins 32V series transmitters, which are normally v.f.o. control only. Novices may also make use of this adapter if the transmitter power input is held to 75 watts. The unit is constructed on a small chassis which is placed inside the 32V. When crystal operation is desired, the 6SJ7GT in the p.t.o. is removed and placed in the crystal-oscillator circuit. P_1 is then placed in the p.t.o. tube socket. To change back to v.f.o. operation, P_1 is removed and the 6SJ7GT moved back to the p.t.o.—*Peter Kimball, K1YER.*

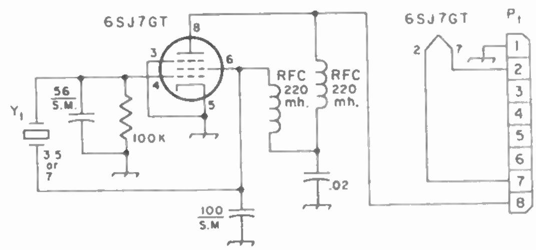


Fig. 3-7—Circuit of the crystal-oscillator adapter. Resistances are in ohms (K = 1000); decimal values of capacitance are in microfarads (µf.), others are in picofarads (pf.). SM indicates silver mica capacitors. P_1 is an octal plug. Each r.f.c. is 220 µh.

TRANSISTOR OSCILLATOR

A simple transistor oscillator for use with FT-243 and HC6/U surplus crystals is shown in Fig. 3-8A. The advantage of this circuit is that no tuned circuits are required. It may be used as an oscillator for a transmitter, local oscillator for a converter, or a low-level signal source. The improved circuit in Fig. 3-8B uses an additional transistor and diode to provide bias stabilization for the oscillator stage for applications where very stable operation is required.—*A. Rohrbacher, DJ2NN,* in DL-QTC. (RCA SK3006 and SK3004 transistors are shown in Fig. 3-8 in place of the AF127 and OC71 used by DJ2NN. The European transistors are not available here.—*Ed.*)

PARASITIC SUPPRESSORS FOR FINAL AMPLIFIERS

For several years I have been using the non-inductive resistors intended for use in the heater supply of series-string TV sets as the *R* component in parasitic suppressors. The bundles of 2-watt carbon resistors often used are hard to assemble and look messy; by the time they are assembled their outside diameter is rather

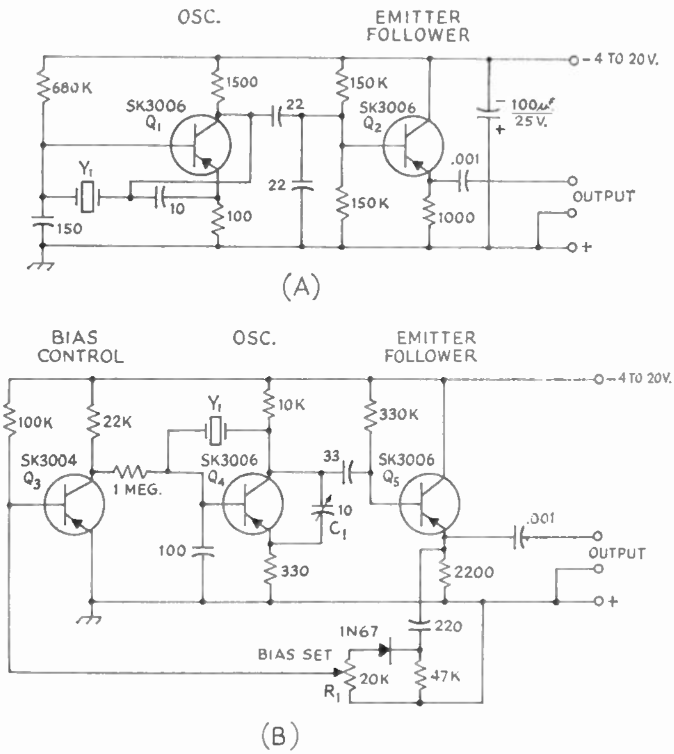


Fig. 3-8—(A) Diagram of the transistor oscillator for surplus crystals. (B) Another configuration providing high stability by regulating the oscillator's bias. Resistors are ½-watt composition; fixed capacitors are ceramic except those with marked polarities, which are electrolytic.

C_1—10-pf. ceramic trimmer.
R_1—20,000-ohm linear-type control.
Y_1—FT-243 or similar crystal requiring 26-pf. load capacitance.

large, and it takes something resembling a tank coil to get over the top of them.

On the other hand, noninductive resistors are available from TV suppliers and are a convenient size. Globar model FRTI is rated at 100 ohms cold to 20 ohms hot, is about 2 inches long, ⅛-inch diameter, and has pigtail leads. The fact that these resistors change value as they heat in no way appears to detract from their effectiveness in parasitic suppressors.—*Fred L. Mason, KH6OR*

(Alert readers will note this system was used by W1LLF in amplifiers for the '68 *Handbook*. Two General Cement type 25-918 resistors were used in series for a larger total resistance.—*Editor.*)

V.F.O. DRIFT MEASUREMENT

Wanting to check the drift of a v.f.o., I lacked an audio signal generator for making determinations of the beat frequencies between the v.f.o. and a 100-kHz. standard. I recalled Lissajous figures and decided to utilize the Philadelphia Electric 60-Hertz power as a standard of comparison. In these times, power companies hold frequency to relatively close limits and the 60 Hertz is usually good to better than 0.5 percent.

The block diagram, Fig. 3-9, shows the layout for the test. The 36th harmonic of the 100-kHz. oscillator and the 3600-kHz. signal from the v.f.o. are fed into the receiver. The resultant audio signal is taken from a resistor across the 500-ohm output taps, and applied to the verticle plates of a scope. About 50 volts is fed to the horizontal plates, using a step-down transformer connected to the power line.

The 100-kHz. standard was warmed up for an hour and checked against WWV. At time "zero," the v.f.o. was fired up and the beat was adjusted as quickly as possible to 60 Hertz, as indicated by a circle on the scope. From here one checks the times at which the 120-, 180-, 240-Hertz, etc., patterns occur on the scope. It is relatively easy to identify these harmonic patterns as, momentarily, the rows of loops become stationary. It is possible to check up to the 15th harmonic or 900 Hertz, even though one cannot count the actual number of loops after there are more than a half dozen visible.

The scheme worked beautifully, and deflated my opinion of the v.f.o. which I have been using.—*E. E. Pearson, W3QY*

(Receivers with 3.2-ohm output may not have enough voltage from the receiver for direct connection to the vertical plates of the oscilloscope. The scope's vertical amplifier, or an audio output transformer with its high-impedance side connected directly to the vertical plates, may be used.—*Editor.*)

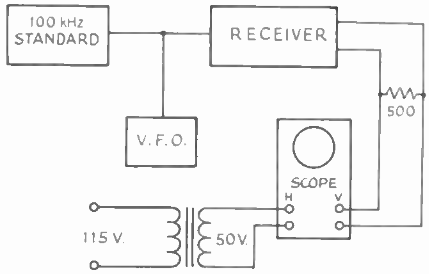


Fig. 3-9—Test setup for v.f.o. drift measurement by comparison with 60-Hertz power line.

TUNED INPUT CIRCUIT FOR GROUNDED-GRID AMPLIFIERS

In many designs of cathode-driven amplifiers a tuned input circuit was eliminated because the designer probably felt that a 100-watt-output exciter would provide more than adequate drive, and that the addition of a tuned input circuit unnecessarily complicated the circuit. However, as Orr and Sayer[1] pointed out recently in *QST*, a tuned input circuit is required in order to reduce intermodulation distortion. Also, as many amplifier builders have found out after building an amplifier and attaching the exciter, their driving power may be on the scant side. A tuned circuit to match the input of the amplifier to the exciter will help take care of both problems.

Fig. 3-10 shows the circuit of a band-switched impedance-matching unit that covers the 80- through 10-meter bands and can be used without making any changes in the amplifier. It connects between the amplifier (at the regular exciter connection point) and the output terminal of the exciter.

The circuit consists of a pi network with a high *C* to *L* ratio to match the low input impedance of the grounded-grid configuration in the amplifier. A double-pole, five-position wafer switch is used to switch the appropriate circuit into use. If the amplifier construction lends itself to it, the switch could be ganged to the amplifier band switch. If not, the input circuit must be switched separately whenever the amplifier plate circuit is switched.

The unit was built into a 3 × 4 × 6-inch aluminum chassis, the coils L_1 through L_5 being mounted in a straight line across the chassis. J_2 can be a standard coax chassis fitting, with the connection made to the amplifier via a short coax cable. Alternatively, a short length of RG-58/U with a PL259 plug on the free end can be connected directly to the output of the tuned circuit. We used about four inches of cable, including the plug.

[1] Orr and Sayer, "Semi- and Super-Cathode-Driven Amplifiers," *QST*, July, 1967.

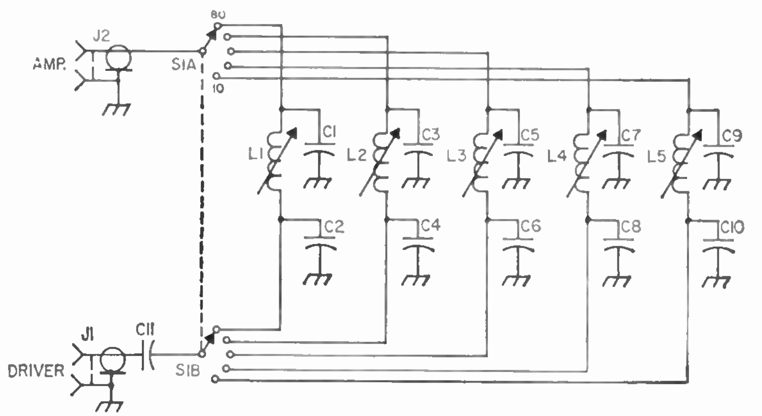


Fig. 3-10—Circuit diagram of the tuned-input circuit for grounded-grid linear amplifiers.

C_1, C_2—1800-pf. 500-volt mica, for 80 meters.
C_3, C_4—1000-pf. 500-volt mica, for 40 meters.
C_5, C_6—470 pf. 500-volt mica, for 20 meters.
C_7, C_8—330 pf. 500-volt mica, for 15 meters.
C_9, C_{10}—220 pf. 500-volt mica, for 10 meters.
C_{11}—0.01-μf. disk ceramic.
J_1, J_2—Coax chassis receptacle, SO-239.
L_1—80 meters, 15 turns,
L_2—40 meters, 8 turns, close-spaced.
L_3—20 meters, 6 turns, close-wound.
L_4—15 meters, 4 turns, close-wound.
L_5—10 meters, 4 turns, spaced over 1 inch.
All coils wound on Millen 69046 ½-inch diameter slug-tuned forms.
S_1—Two-pole, five-position steatite wafer switch.

Coil information is given in Fig. 3-10. All coils are wound with No. 18 enameled wire. In building the unit, we found that it was easier to mount one coil and its associated capacitors before installing the next coil.

For adjustment, merely attach the unit to the amplifier and feed the driver output into J_1. Switch S_1 to the appropriate band and then apply drive to the amplifier. Peak the slug in the unit's coil while looking for maximum drive. You may have to reduce the output from the exciter and also retune the exciter as you make the adjustment. In any event, tune the coil slug for maximum and that particular band will be adjusted. Proceed to the next band and make the same adjustments, doing the same with the remaining bands.

The circuit will transform amplifier input impedances ranging from 50 to 100 ohms into 50 ohms for the exciter, in the 75-meter phone band (3800–4000 kHz.), and will cover a somewhat greater impedance range on the higher bands. The unit has been tested with 100 watts running through it continuously; the coils will get slightly warm at this power level but operation is stable. The limitation on matching range is set by the inductance variation it is possible to get in the slug-tuned coils.—*W1ICP*

THE KWM-2 AND RANGER ON FIELD DAY

Here is information from the top Class 1A group in last year's competition on modifying two popular transmitters for 30-watt operation. For the KWM-2, replace the 6146s with 2E26s, lower the final plate voltage to 400 volts (this can be accomplished by removing the 5R4 in the KWM-2 power supply and connecting a 400-volt unfiltered supply to Pin 8 of the 5R4 socket), and lowering the screen voltage. Break the connection between R_{115} (2200 ohms) and the junction of L_{13}-L_{14}, and connect as shown in Fig. 3-11. R_1 provides a screen-voltage adjustment, and should be set for 10-ma. static plate current.

The Ranger is modified by replacing the 6146 with a 2E26, and inserting a 10K-ohm resistor in series with the screen supply for the final tube. It may be placed at the 6146 socket.—*Lost Pines Radio Club, W5KPI*

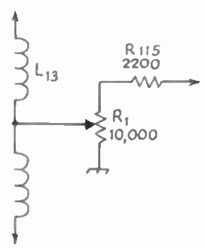


Fig. 3-11—KWM-2 modification. R_1 is a 10,000-ohm, 2-watt, linear-taper control. Lower coil is L_{14}.

TRANSISTORIZED 15-METER TRANSMITTER

The low-power rig shown schematically in Fig. 3-12 was designed for the 15-meter band and uses two inexpensive (64 cents) epoxy-cased silicon transistors. The rig's simplicity is realized by operating the oscillator, Q_1, in its third-overtone mode. Garden-variety 7-MHz. crystals are used. The amplifier, Q_2, operates in the common-emitter configuration and has a power input of almost one watt. With a 12-volt power supply, the measured power output was one-half watt into a 50-ohm resistive load. With the transistor shown. the supply potential should not exceed 12 volts and modulation should not be applied to the Q_2 collector. Diode CR_1 and its associated circuitry provides a convenient means for tuning the transmitter and may be used with a v.o.m. or v.t.v.m. A method for measuring power output is included in Fig. 3-14.

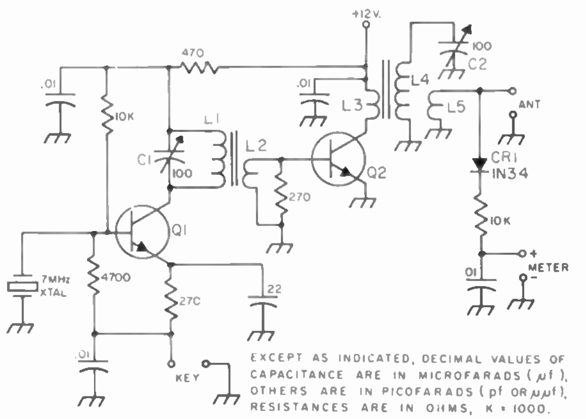


Fig. 3-12—Circuit diagram of the 21-MHz. rig. Fixed resistors are composition, ½ watt or smaller. Fixed capacitors are ceramic.

C_1, C_2—7-100 pf. midget compression mica trimmer (Elmenco 423).

L_1—App. 2.5 μh.; 30 turns No. 28 on ferrite toroid form (Arnold type FE 0437-0501, 0.437 inch. o.d.; see also footnote 1).

L_2—5 turns No. 28 on same form as L_1.

L_3—5 turns No. 22 on same type form as L_1.

L_4—App. 0.8 μh.; 17 turns No. 28 on same form as L_3.

L_5—4 turns No. 22 on same form as L_3.

Q_1, Q_2—2N3641 (Fairchild) or equivalent.

The transmitter is built on the 2 × 3-inch printed-circuit board shown in Fig. 3-13, and the finished circuit card is mounted inside a small aluminum box of suitable size. The crystal socket and p.c. board should be mounted so that the interconnecting lead length is small. The author included a ceramic wafer switch in his unit which serves as an antenna changeover switch. Extra terminals also remove the power supply from the transmitter during receive periods.

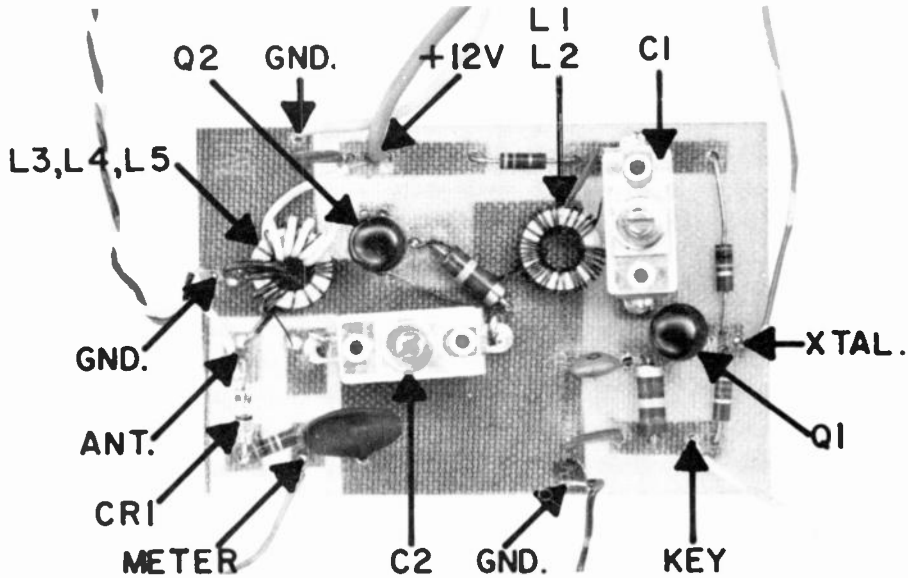


Fig. 3-13—Plan-view photograph, full size, of the transmitter. Principal components are identified in this view as an aid to assembly; ones not labeled can easily be recognized by referring to Fig. 3-12. The dark areas are copper backing on the opposite side of the translucent circuit board.

Toroid coil forms[1] are used for both of the tuned circuits for reasons of compactness, shielding and economy. After the transmitter has been built, a 51-ohm resistor should be temporarily connected to the antenna terminals to serve as a dummy load. Adjust capacitor C_1 for good keying as monitored in a communications receiver, and tune the output tank capacitor, C_2, for maximum power output as indicated by a voltmeter connected to the meter terminals or the peak-reading r.f. voltmeter connected to the dummy load (Fig. 3-14). The transmitter should be used only with a well-matched 50- or 70-ohm antenna. If the s.w.r. is excessive the builder should consider an antenna tuner such as the T network described by Johnson.[2] Capacitor C_2 should be repeaked when the antenna system is connected.

[1] A kit of 2 small suitable toroid coil forms is available for $1.00 postpaid from Alcom Electronics, 2025 Middlefield Road, Mountain View, California, 94040. Fairchild transistors are available through any Fairchild distributor.

[2] Johnson, "Band-Switching Transmatches," *QST*, October, 1967.

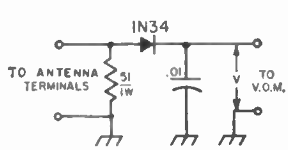


Fig. 3-14—Dummy load and peak rectifier for measuring power output. The fixed capacitor is ceramic.

Since the total current drawn by the transmitter is about 100 ma., power may be economically supplied by a 12-volt lantern battery. If a line-operated power supply is desired, the circuit used in the author's receiver[3] would be ideal.—*Wes Hayward, W7ZOI*

ONE-WATT RIG FOR 40 METERS

Having built a number of transistorized transmitters whose circuits were taken from various radio publications, I concluded that many of them were either too expensive, unnecessarily complicated, or too critical to adjust. This rig is not complicated and is quite inexpensive. The transmitter has a clean c.w. note and the tuning is not critical.

The power output is approximately one watt where a 45-volt battery is used. Although this may seem like a small amount of signal to work with, plenty of DX is possible if a good antenna system is used. Because it operates from a dry battery, it is an ideal transmitter for portable operation. The circuit can easily be assembled in a 1½ × 2 × 4-inch Minibox, offering even more appeal to the portable operator.

The oscillator, Q_1 (Fig. 3-15), is similar to a vacuum-tube Pierce oscillator. Output from the oscillator is fed to the emitter of Q_2 through coupling link L_2. Drive to the p.a. stage is regulated by adjusting R_1, which increases or decreases the collector current of Q_1.

[3] Daughters, Hayward, and Alexander, "Solid State Receiver Design using the MOS Transistor," Part II, *QST*, May, 1967, p. 25.

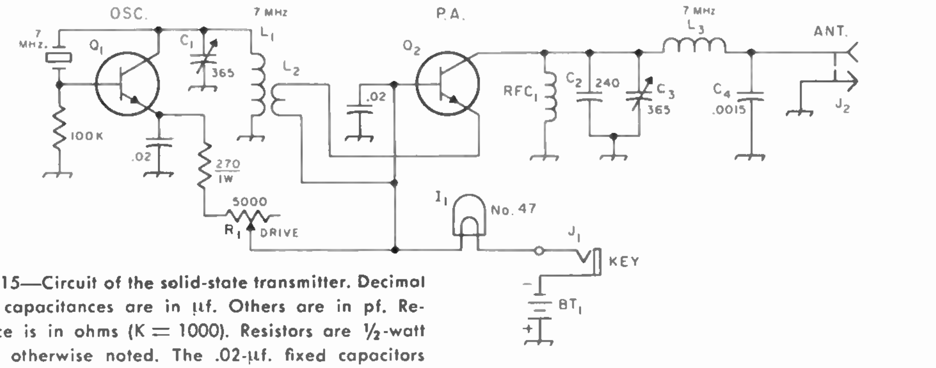


Fig. 3-15—Circuit of the solid-state transmitter. Decimal value capacitances are in µf. Others are in pf. Resistance is in ohms (K = 1000). Resistors are ½-watt unless otherwise noted. The .02-µf. fixed capacitors are disk ceramic.

BT_1—45-volt battery (Eveready 482 or Burgess M30 suitable).
C_1, C_3—365-pf. miniature variable.
C_2—240-pf. mica.
C_4—1500-pf. mica (see text).
I_1—No. 47 lamp or equal.
J_1—Open-circuit key jack.
J_2—Antenna jack (RCA phono connector suitable).
L_1—17 turns No. 24 enam. wire, ½-inch dia., space-wound one wire diameter (or 17 turns of B&W 3004 Miniductor stock).
L_2—3 turns No. 24 insulated wire over cold end of L_1.
L_3—11 turns No. 22 enam. wire, ½-inch dia., space-wound one wire diameter (or 11 turns of B&W 3004 Miniductor stock.)
Q_1, Q_2—2N697 or similar.
R_1—5000-ohm, 2-watt linear-taper control.
RFC_1—1-mh. 100-ma. choke.

A pi network is used in the collector circuit of Q_2. The circuit is tuned to resonance by C_3. A fixed capacitor, C_4, is used at the output of the tank circuit. This value gave a good match to a 50- or 75-ohm load in the author's station. If desired, C_4 can be replaced by a 3-section broadcast variable (365 pf. per section) whose total capacitance with all three sections in parallel would be about 1100 pf. Then a 680-pf. mica capacitor can be wired in parallel with the broadcast variable, providing ample total capacitance for matching into low-impedance loads. The variable capacitor would provide some adjustment for those who prefer a loading control.

The total collector current of the rig is monitored by I_1, a No. 47 pilot lamp. The bulb glows faintly at a current of 50 ma. A 100-ma. meter can be used in place of the pilot lamp if the builder wishes.

Because so few parts are used in this circuit, layout is uncomplicated and is pretty much up to the builder. It is important that all connections be well soldered. Make all leads short and direct. Keep L_1 and L_3 as far apart as possible. Try to mount them at right angles to one another so as to discourage mutual coupling between stages.

The transistors have TO-5 cases. Standard TO-5 heat sinks are available at low cost and should be used to prevent the transistors from overheating. The cases of the transistors are common to their collectors, so care should be taken to prevent the heat sinks from touching other parts of the circuit.

Place a 100-ma. meter in series with the battery lead to the transmitter. With a No. 47 lamp connected to J_2, for use as a dummy load, close the key and adjust R_1 for a meter reading of 50 milliamperes. Next, adjust C_1 and C_3 for maximum brilliance of the dummy-load bulb. At this power level the dummy should light to normal brilliance, indicating roughly one watt of output.

While monitoring the c.w. signal from the transmitter, adjust C_1 for the best-sounding note. Depending upon the crystal used, the best point may be at resonance, or perhaps slightly to one side of resonance. The drive control, R_1, can be used to vary the power input. Lowering the power level will give longer battery life.

With an antenna connected to the transmitter, C_1 and C_3 should be tuned for maximum output as observed on an s.w.r. bridge, field-strength meter, or receiver S meter. R_1 should be adjusted for a maximum total current of 50 milliamperes. The key should not be held down for periods in excess of 30 seconds so that the transistors will not become overheated.

About a dozen hams in the Los Angeles area have built this rig, and experienced no difficulty. One of the fellows has already worked 20 states with his transmitter.—*F. L. Dwight, K6JBV*

EFFECTIVE LOW-PASS FILTER

THE low-pass filter to be described is simple, inexpensive, and was designed for use with transmitters operating below 30 MHz. The filter is specifically designed to provide high attenuation in the v.h.f. television bands and at 40 MHz., a common television intermediate frequency. When properly constructed and tuned the unwanted signal attenuation through the filter is in excess of 50 decibels—a power reduction greater than 100,000.

After examining several existing low-pass filter designs intended for amateur use, a decision was made to build a filter using the insertion-

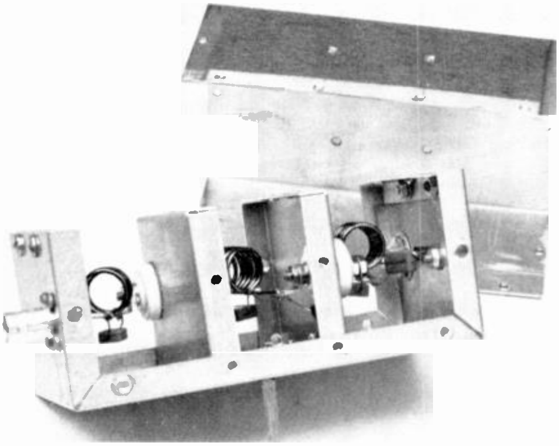


Fig. 3-16—Side view of the low-pass filter. The filter contains standard components and will handle power levels of 50 watts at 28 MHz., about 150 watts at 21 MHz., and 300 watts at 14 MHz. and lower frequencies, when used with antenna systems having a low s.w.r.

loss design concept. This design offers the following advantages over the image-parameter designs previously described:

1) Two less coils are required for the same stopband attenuation.
2) Relative freedom in the selection of frequencies of maximum attenuation.
3) Easier to tune.

The schematic and component values are given in Fig. 3-17. The frequencies of maximum attenuation are 40.5 MHz., 47.5 MHz., and 78.1 MHz. The filter sections are formed by the parallel combinations of C_2 and L_1, C_4 and L_2, C_6 and L_3, respectively. The theoretical maximum v.s.w.r. is 1.1:1 in the passband. (The design cutoff frequency is 30 MHz.)

The filter is designed for 50-ohm unbalanced systems. The component values for any other impedance may be rapidly determined by a simple calculation. To accomplish this, multiply the capacitor values by $50/Z_0$ and the inductor values by $Z_0/50$. For example, if a 70-ohm line is used the values of C_2 and L_1 would be:

$$C_2 = 12\ 50/Z_0 = 12\ 50/70 = 8.6 \text{ pf.}$$

$$L_1 = 0.0334\ Z_0/50 = 0.334\ 70/50 = 0.468\ \mu\text{h.}$$

The frequencies remain unchanged for different impedances.

The coils are made from No. 14 enameled copper wire, and are formed on a ½-inch dia. mandrel. L_1 has 8 turns while L_2 and L_3 each have 6 turns. After the coils are formed, the capacitors are soldered across them and the parallel branches are initially tuned to resonance by adjusting the turns spacing until a grid-dip meter indicates resonance at the frequencies shown in Fig. 3-17. The coil/capacitor assemblies are then mounted in the chassis (individually) and the resonant frequency is checked again. Finally, the shunt capacitors are mounted and soldered in.

The filter is housed in a 5 × 3 × 2-inch aluminum Minibox (Fig. 3-16). Aluminum shields are used to provide isolation between filter sections. Each shield is secured to the Minibox at eight places to assure isolation and prevent "hot spots." Also, the two angle brackets shown in the photograph are included to prevent leakage from the enclosure. The paint is removed from along the edges of the cover to insure good metallic contact between the overlapping flanges, when the unit is assembled.

These constructional details may appear frivolous. But, it must be emphasized that the harmonic currents must not be allowed to reach the outside surface of the housing. If the harmonics do reach the outside, and the connecting coaxial cables, they will flow over the filter to the antenna and the filter will be relatively useless.

The filter has been found effective in eliminating TVI in a relatively weak signal area. The maximum v.s.w.r. introduced by the unit is 1.3:1, measured at the high end of the 10-meter band (29.7 MHz.).

In conclusion, it is well to emphasize that this low-pass filter is *not* a proposed cure for all types of television interference. The filter acts only to reduce the radiation of harmonic energy from the antenna system. Other possible sources of interference, such as direct radiation from the transmitter, fundamental TV receiver overloading, and many others, are described in the *ARRL Handbook*. The author strongly recommends the latter as a valuable source of information for identification of TVI and the subsequent cure for each variety of interference.
—*Glenn R. Welsh, WB6HRM*

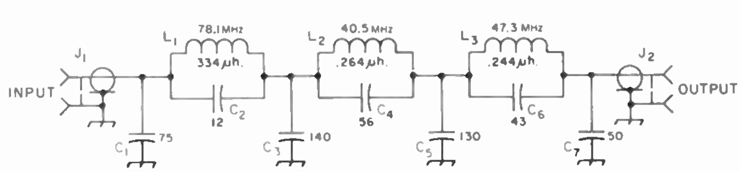
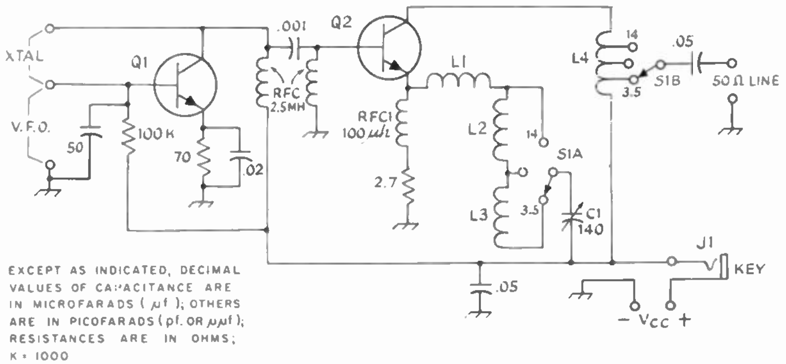


Fig. 3-17—A schematic diagram of the low-pass filter. All capacitors are in pf. and are silver-mica units rated at 500 v.d.c.

J_1, J_2—Type BNC coaxial chassis connector (U.h.f. or type N connectors may be used if desired).

L_1–L_3, inc.—See text.



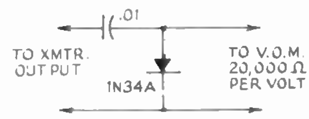


Fig. 3-18—The transmitter circuit. Capacitors are disk ceramic; resistors are ½-watt composition.

C_1—140-pf. midget variable.
J_1—Open-circuit jack (insulated if on metal chassis).
L_1, L_2, L_3—See text.
L_4—20 turns No. 26 enam. close-wound on ¼-inch diam. powdered-iron core 1⅛ inches long (core removed from V6 Superex choke); tapped 10, 13 and 16 turns from supply end (3.5, 7 and 14 MHz. respectively).
Q_1, Q_2—2N3053 or equivalent.
RFC_1—App. 100 µh.; 100 turns No. 26 enam. scramble-wound on same type core as L_4.
S_1—Rotary, 2 poles, 3 positions. Separate switches may be used (see text).

UNUSUAL R.F. AMPLIFIER CIRCUIT

EVER wished for an r.f. power amplifier in which the d.c. input would *drop* when the tank circuit was tuned off resonance? Fig. 3-18 is such a circuit.

The unconventional thing is the *series*-tuned tank circuit connected between the emitter of Q_2 and common ground. The collector output is taken through a tapped coil for matching into a 50-ohm line. When the tank is tuned to resonance (by C_1) at the driving frequency the impedance between emitter and ground is very low and Q_2 resembles a grounded-emitter amplifier. However, when C_1 is tuned away from resonance the impedance between emitter and ground rises rapidly, and a feedback voltage is developed which reduces the drive and consequently the d.c. input to the collector. The r.f. output changes similarly.

The driver in Fig. 3-18 can be used either as a Pierce-type crystal oscillator or as a v.f.o. amplifier. Its output is choke coupled to the base of the amplifier.

The amplifier tank coils, L_1, L_2, and L_3, should have reasonably good Q and the inductances should be such that, with C_1, L_1 will tune to 14 MHz., L_1 and L_2 in series will tune to 7 MHz., and all three in series will tune to 3.5 MHz. The coils were small toroids in a breadboard transmitter that W3MOO sent us to try out, but since the cores were homemade from powdered-iron slugs of unknown characteristics, they are probably not reproducible. The transmitter at W3BV uses a single tank coil, tapped for the two higher bands. It has 40 close-wound turns of No. 26 enameled wire on a National XR-50 form, tapped at the 30th turn for 7 MHz. and the 20th turn for 14 MHz. The entire coil is used for 3.5 MHz. In general, circuit values are not critical, as shown by the fact that they have been varied in several different models that have been assembled using the basic circuit. A heat radiator such as the Wakefield type NF207 (fits TO-5 case) should be used on Q_2.

Concerning setting up the transmitter, W3MOO writes:

"Before placing in service, the following checks should be made. They may save transistor damage. Place the transistors in their sockets and connect an ohmmeter to the positive and negative supply terminals and close the key. Read the resistance on the 100X scale. With one ohmmeter polarity, the resistance should be around 1000 ohms; with reverse polarity, the resistance should be about 9000 ohms. If these readings are not met, check the wiring, especially the transistor connections.

"If the readings are OK, connect a 50- to 60-ohm 2-watt carbon resistor to the r.f. output terminals. Plug in an 80-meter crystal (or 80-meter v.f.o.) at the appropriate points. Connect the probe (Fig. 3-18) to the output terminals. Connect 9 to 12 volts to the supply terminals and close the key. Adjust C_1 for maximum reading on the probe meter. The r.f. probe reading should be 7 to 10 volts with a supply current of about 150 ma.

"Finally, connect an antenna through a matched 50-ohm line, using an antenna tuner if necessary, and start operating.

"A word about L_1: This functions as an auto-transformer to match the load to the transistor. Maximum r.f. voltage across the dummy load is the objective. It would probably be better to use a separate switch so the turns ratio could be varied independently of the band switch."

Some experimenting with the size of L_1 and the positions of the taps is in order, although the coil specified in Fig. 3-18 works satisfactorily.

At 12 volts, the total supply current was 140 ma. on the model we tested. Of this, 115 ma. went to the collector of Q_2, the remainder being the driver current. Both currents increase with increasing supply voltage; at 18 volts the Q_2 collector current was 200 ma. and the total current 240 ma. Power output (on 80 meters, using an 80-meter crystal) was close to 1 watt at 12 volts and approaching 2 watts at 18 volts, measured with an r.f. ammeter into a 52-ohm load. (The usual r.f. voltmeter measurements are not too reliable with transistor amplifiers as the harmonic output is high, distorting the waveform so that "turnover" effects in a peak-reading voltmeter give misleading readings.)

Higher voltages can be used without damaging the 2N3053s, but if the key is held down any length of time the collector current rises and the output drops off. With c.w. keying the collector current is stable at 18 volts, and at 12 volts the key can be closed for long periods with no change in collector current.—*W1DF*

Hints and Kinks . . .

for the Phone Rig

CHEST MICROPHONE

After operating mobile for a time, I found that VOX should be used. As a result I whipped up the chest microphone arrangement shown in Fig. 4-1. A length of No. 10 hard-drawn copper wire was covered with transparent plastic tubing and bent to the configuration pictured. Then a very inexpensive crystal mike was attached. The resulting arrangement is extremely light weight and has been most satisfactory.—*Russ Alexander, W6IEL*

Fig. 4-1—A length of plastic-covered wire makes an inexpensive support for a mobile microphone.

ANOTHER ADAPTER FOR MIKES WITHOUT P.T.T. SWITCH

An adapter for microphones without push-to-talk control, described by W1DJV in the "Hints & Kinks" column of *QST* for October 1966, employed two toggle switches. As shown in Fig. 4-2, a single lever switch can be used instead. The desired mode of operation is achieved simply by switching S_1 to either VOX or P.T.T.

A small Minibox makes a suitable container for housing the adapter. The numbered terminals should go to a shielded cable that terminates in a microphone plug that mates with the microphone fitting on the equipment used. J_1 ought to match the existing plug on the user's mike. S_1 is a 2-pole, 3-position lever switch.—*J. A. Loy, VE2MH*

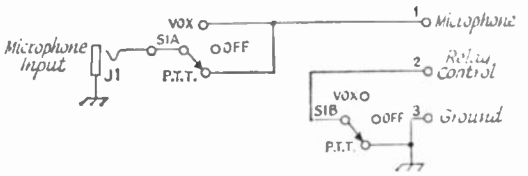


Fig. 4-2—VE2MH's microphone adapter.

ADAPTER FOR MIKES WITHOUT P.T.T. SWITCH

Having recently purchased a Heath HW-12, and not owning a microphone with push-to-talk control, I had to build an adapter for use between my mike and the mike jack on the HW-12. The circuit shown in Fig. 4-3 enables the operator to use S_2 to control the transceiver in the same fashion as would result from a p.t.t. switch on the microphone. By placing S_2 in the "off" position and activating the circuit with S_1, normal VOX operation results.

The adapter is built in a 1⅝ × 2¼ × 3¼-inch Minibox. Terminals 1, 2 and 3 are connected to a 12-inch length of 2-conductor shielded mike cable which is terminated with a microphone plug that mates with the mike jack on the equipment used. An Amphenol 80MC2M plug is used with the author's HW-12. J_1 can be selected to match the existing plug on the operator's mike. S_1 is a s.p.s.t. toggle switch; S_2 is a d.p.s.t. toggle.—*Norm Bradshaw, W1DJV/W8EEF*

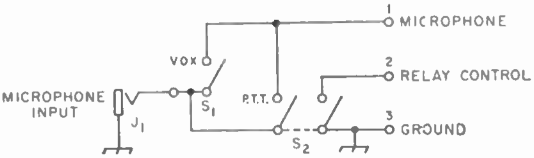


Fig. 4-3—W8EEF's microphone adapter.

MICROPHONE COVER

An excellent microphone cover, which can be tightened around the base of a mike, can be had by saving the sacks that come with many liqueurs. These are usually velvet and are very efficient at keeping dust and dirt out of a microphone when it is not in use.—*Paul W. Kohanski, WA8PJK*

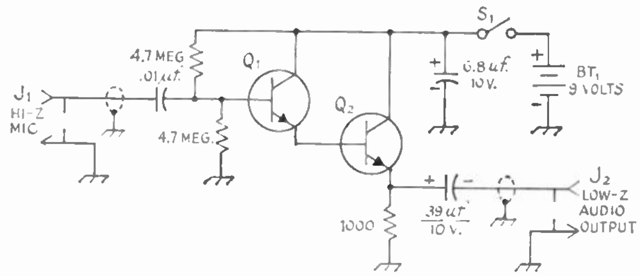


Fig. 4-4—Circuit diagram of microphone impedance step-down transformer. All resistors are ½ watt. The parts shown were used because they were on hand; component values in this circuit are not critical.

J_1, J_2—Phono jacks.
Q_1, Q_2—2N930 or 2N2484.
S_1—S.p.s.t. switch.

TRANSISTORIZED IMPEDANCE TRANSFORMER

The circuit shown in Fig. 4-4 is a solid-state impedance-matching transformer which will allow a high-impedance microphone to be used with a transceiver having low-impedance audio input, such as the Sideband Engineers' SB-34. Basically the "transformer" is a Darlington configuration emitter-follower using high-gain transistors. Input impedance is greater than one megohm and the circuit has a voltage gain of one. The unit can be built in any shielded enclosure such as a small Minibox. Current drain is only 3 ma., making it practical to use a self-contained battery. The connectors shown in the diagram are for illustrative purposes only; in actuality, they should be chosen to match existing cable fittings.—*Mel Ladisky, WB6FDR/WA2AED*

TRANSISTOR SPEECH AMPLIFIER

The speech amplifier shown in Fig. 4-5 is intended for use with crystal microphones. The input impedance is about 1 megohm, and the maximum output is 6.3 volts r.m.s. For 0.002 volts in—an average value for crystal microphones—the output is 2 volts. The frequency response is 150 to 5000 Hertz.—*Hank Cross, W1OOP*

MICROPHONE PREAMP USING THE FET

High-quality microphones almost invariably have low output, often 10 to 15 db. below the inexpensive crystal types. Many ham rigs, the author's Conset Communicator II included, do not have enough audio gain to be usable with a "good" mike, unless you yell at the thing. A preamplifier is the obvious answer.

The field-effect transistor is a natural for a preamp circuit because of its high input impedance, low internal noise, and low distortion. The Motorola MPF103 ($1 each) was used in our unit. Higher gains may be obtained, if required, by using the MPF104 or 105. The current drain of the FET circuit is so low that the battery will last almost its shelf life.

The circuit, shown in Fig. 4-6, has been designed to minimize hum problems. The use of a transistor, of course, eliminates heater-supply hum. The coupling and bypass capacitors have been chosen for a roll-off below 300 Hz. to get rid of power-line harmonics induced in the microphone itself and its connecting cable.

The bias value for maximum gain was found to be quite critical. Some experimentation with the value of R_1 may be necessary to get the most gain from individual FETs, because of the wide differences in forward transfer admittance (transconductance, to tube-thinkers). MPF103s

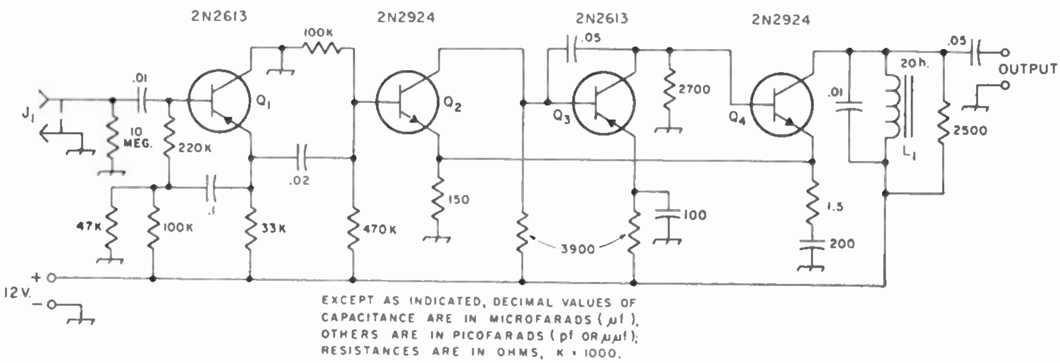


Fig. 4-5—Diagram of W1OOP's speech amplifier. Resistors are ½-watt composition. Fixed capacitors of decimal values are paper or Mylar, others are ceramic.

J_1—Microphone connector.
L_1—20-hy. audio choke, or primary of a driver transformer
Q_1, Q_3—2N2613 or 2N508.
Q_2, Q_4—2N2924 or 2N2712.

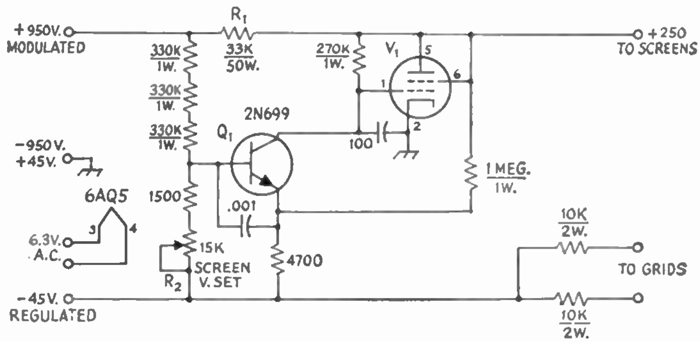


Fig. 4-7—Circuit diagram of the screen regulator/modulator. Resistances are in ohms and fixed resistors are ½-watt composition unless otherwise noted. Capacitors are disk ceramics; decimal values of capacitance are in microfarads (μf.); others are in picofarads (pf.). K = 1000.

Q_1—N.p.n. transistor, 2N699 or 2N2108.
R_1—33,000-ohm 50-watt wire-wound resistor (see text).
R_2—15,000-ohm 2-watt linear taper control.
V_1—6AQ5, 6BQ5, or 6CL6.

vary between 1000 and 5000 μmhos, with typical transistors around 3000.

The FET preamplifier is built in a 2¾ × 2⅛ × 1⅝-inch Minibox; the small components are mounted on a 2¼ × 1-inch piece of Vectorbord. No suitable battery clip for vertical mounting was available, but it worked out (happily) that the battery made a good press fit behind the on-off switch. The output trimmer-type control, R_2, used was salvaged from a computer board obtained at a surplus store. A Mallory MCT-1 miniature control would be a suitable, and much less expensive, substitute.

The r.f. choke, RFC_1, was necessary to eliminate r.f. feedback in the audio system when the preamp was used on v.h.f. No trouble was encountered on h.f. using 1 kw., but 2 meters was another problem. If feedback is encountered, the origin should be pinpointed, and a bypass capacitor, r.f. choke, or both, should be used. If the trouble is the preamp itself, filtering should be done in the gate lead.—*Douglas A. Blakeslee, W1KLK*

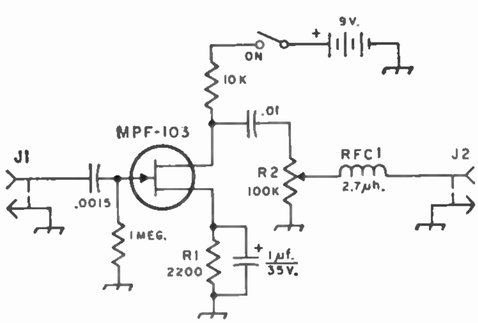


Fig. 4-6—The FET preamplifier. Resistances are in ohms; all resistors are ½-watt composition. Capacitors are paper, except the one marked with polarity, which is electrolytic; values are in microfarads. RFC_1 is a Millen 34300-2.7, a 2.7 microhenry choke. See the text for a discussion of this choke, R_1 and R_2. J_1 and J_2 are phono jacks.

4X150 SCREEN MODULATOR/REGULATOR

The circuit shown in Fig. 4-7 is what I use for the screen supply of an amplifier using a pair of 4X150As on a.m., s.s.b., and c.w. The plus B for the screen is taken from the modulated plate supply, and on a.m. this circuit provides modulated screen voltage. On s.s.b. and c.w. the circuit is a regulator which will absorb reverse screen current so the tubes do not "run away."

In other amplifier configurations, R_1 could be made lower, and two 6AQ5s used, or a separate regulator used on each screen. A 6CL6 or 6BQ5 may be substituted for the 6AQ5.—*H. H. Cross, W1OOP*

SOLID-STATE AMPLIFIER/MODULATOR

The little audio assembly shown in Fig. 4-10 offers two output impedances, 3.2 and 24 ohms, permitting the circuit to be used either as a modulator or an audio amplifier. The circuit operates from 12 volts, d.c., and draws approximately 500 milliamperes. Up to three watts of output are available before significant distortion occurs. Inexpensive transistors are used in the circuit.[1]

A schematic diagram of the unit is given in Fig. 4-8. The input circuit is designed to match a low-impedance microphone. The author uses an HA1 dynamic earphone from a surplus telephone handset. A good impedance match results and the microphone's output is ample for developing the required audio power. If a high-impedance microphone is to be used, the circuits of Figs. 4-9A and 4-9B offer a means by which to match the microphone to the input transistor, Q_1.

The connection between the base of Q_1 and the emitter of Q_3 provides negative d.c. feedback which assures bias stability over a wide

[1] This series of RCA transistors is listed in the industrial version of the Allied Radio catalog and can be ordered by the RCA numbers. The 40231 costs 47 cents, the 40309 70 cents, and the 40310 sells for $1.21.

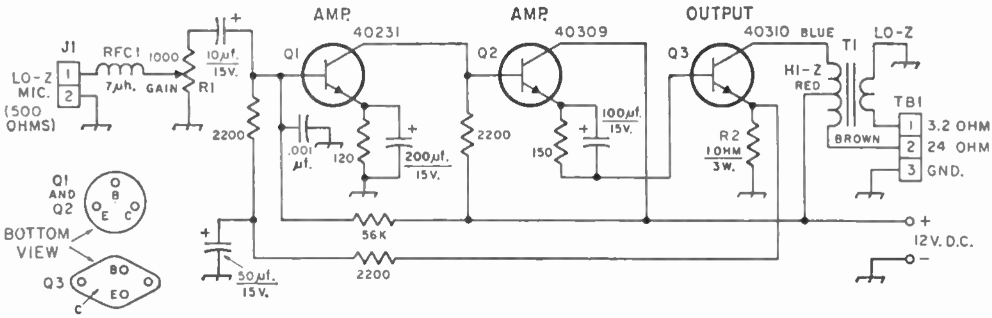


Fig. 4-8—Schematic of the amplifier/modulator. Polarized capacitors are electrolytic, others are disk ceramic. Resistance is in ohms, K = 1000. Resistors are ½-watt composition unless otherwise noted.

J_1—To mate with microphone.
R_1—1000-ohm audio-taper control.
R_2—See text.
RFC_1—7-µh. choke (Ohmite Z-50 suitable).
T_1—6-watt transistor output transformer; primary, 48 ohms, c.t., secondary, 3.2 ohms (Lafayette Radio 33R8578).
TB_1—Insulated terminal strip (Millen E-302).

range of operating temperatures. Emitter resistor R_2 is somewhat rare as far as junk-box availability is concerned. The easiest way to obtain one is to make it yourself, by winding 73 inches of No. 32 enameled copper wire on a 1-watt, high-value (1000 ohms or greater) resistor as a form. Nichrome wire is available in various per-inch resistances, and could be used instead; also, Allied Radio Corp, sells a 1-ohm, 3-watt resistor which will work satisfactorily. If a hand-wound unit is used, the wire can be scramble-wound on the resistor body and the pigtails of the resistor used as tie points for the ends of the wire.

Output from the microphone is amplified by Q_1 and is then fed to the output stage, Q_3, through emitter-follower Q_2. Q_3 operates Class A, hence the high value of current drawn by the modulator. T_1 has a 48-ohm, center-tapped primary, lending itself to practical use as a modulation transformer with a one-to-one impedance ratio. When used as a modulator, the unit should look into a secondary load of approximately 24 ohms. This means that the transistor (or transistors) being supplied with modulated d.c. should take a combined current of 500 ma. d.c. A mismatch as great as two to one is tolerable, however, giving some latitude in the design of the final stages of the transmitter.

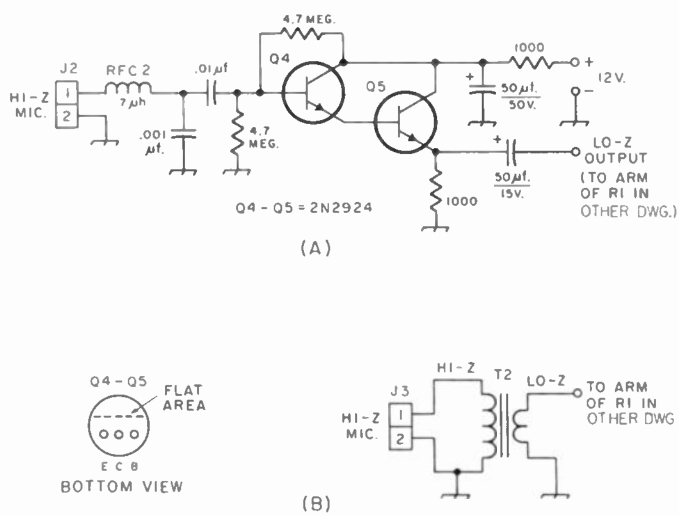


Fig. 4-9—Alternative input circuits for high-Z microphones. Capacitors with polarity marking are electrolytic; others are disk ceramic. Resistances are in ohms, K = 1000; resistors are ½-watt composition. A—Darlington hookup, a modified version of the WB6FDR/WA2AED Hint and Kink in November 1966 *QST*. This circuit, if used, should be built on the same chassis as the circuit of Fig. 4-8. J_2 is same type as J_1 of Fig. 4-8. RFC_2 is same as RFC_1 of Fig. 4-8. B—Transformer coupling. T_2 can be any transistor input transformer with a primary impedance of 20,000 ohms or more and a secondary impedance of 500 or 1000 ohms. An Argonne AR-100 would be satisfactory. T_2 should be mounted near Q_1 of Fig. 4-8, and on the same chassis.

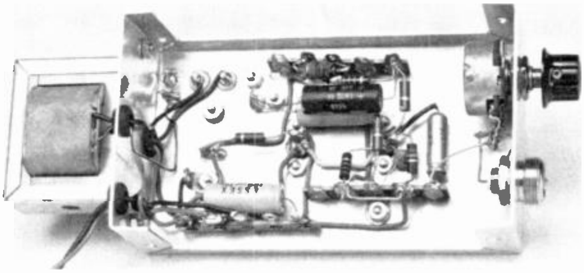


Fig. 4-10.—Underside of the amplifier/modulator. The layout is not critical. D.C. supply is brought in by means of the twisted hookup wires at the lower left of the chassis.

A homemade modulation transformer having separate primary and secondary windings and a tapped secondary, offering a host of impedance-matching possibilities, was built and tried by the author. An old 8-watt, tube-type output transformer was used as the foundation. The windings were stripped from the cardboard bobbin and a new primary having 150 turns of No. 24 Formvar-insulated wire was wound. A layer of Kraft paper was added, then a secondary winding consisting of 225 turns of No. 24 Formvar wire was scramble-wound on the bobbin. The secondary was tapped every 25 turns, up to the last 50 turns, to provide the multimatch feature. Although a voice-coil winding for 4-ohm speakers was not added, a third layer consisting of 62 turns of No. 24 enameled wire could have been included for that purpose.

Although the circuit is designed for use with a 12-volt d.c. supply, it can be operated safely with as much as 14 volts applied. It will perform nicely with as little as 6 volts, but at reduced output.

The amplifier/modulator is built on a 2¼ × 3 × 5¼-inch Minibox. Rubber feet were added to the bottom cover to prevent damage to table tops or other surfaces upon which it is placed. Transistor sockets are used for Q_1 and Q_2. Q_3 is attached to the chassis for heat-sinking purposes, but is insulated from it by the mica washer that comes with the 40310. A thin layer of silicone grease is used between the chassis and the mica spacer, and between the spacer and Q_3. This results in better heat transfer between Q_3 and the chassis. Although it is desirable to use the grease, it isn't a requisite.

As a modulator, this unit can be used with any solid-state transmitter whose power input is 6 watts or less. Since it is capable of as much as 3 watts output, 100-percent modulation should be possible. If the transmitter does not present a load that is within the 2-to-1 mismatch ratio mentioned earlier, Q_3 may be damaged by high audio peak voltages. If the transmitter runs less than a couple of watts of input, chances are that its modulating impedance will be somewhat higher than 24 ohms, and in such case less audio will be required for 100-percent modulation. A 24-ohm, 2-watt resistor can be connected between the 12-volt bus and terminal 2 of TB_1, to provide the modulator with a suitable load. This will help to prevent damage to Q_3. Keeping R_1 adjusted for only the amount of audio needed will also help protect Q_3 when a mismatch exists.

As an audio amplifier, this unit can be connected to a 4-ohm speaker and used as an audio channel for a receiver, as a mobile p.a. system, or as a low-power amplifier for musical instruments. Because of its high current drain, it is not recommended for use with a dry-battery pack.—*W1CER*

TURN-TO-TALK MICROPHONE

Most economical microphones available do not have any provision for push-to-talk switching—you either purchase a more expensive microphone with appropriate switching or devise some method of adding a switch. In the author's case, a satisfactory solution was to change the single-conductor microphone output cable to a three-conductor shielded line and mount a miniature mercury switch inside the microphone case. The mercury switch is mounted so that when the microphone is picked up and tilted, the switch closes. Epoxy glue can be used to secure the mercury switch in place or, as in Fig. 4-11, a new microphone element and switch were mounted in an old case, using sponge rubber to hold everything in place. The author used a 1.5-amp. 30-volt mercury switch that is ¾ inch long by 3/16 inch diameter (Burstein-Applebee No. 17A994).—*Leo J. Mallas, W7NLU*

Fig. 4-11—The mercury switch is mounted at the bottom of the case, as indicated by the arrow.

Hints and Kinks . . .

for the Power Supply

VOLTAGE REGULATION FOR LARGE VARIATIONS IN LOAD CURRENT

Have you ever been in need of a few more milliamperes of regulated current than the maximum obtainable from a single VR tube? There are, of course, several answers to this problem. One is an electronically-regulated supply with its attendant complexity and high-current vacuum tubes or transistors. Another answer is a supply stabilized by expensive Zener diodes. A third solution, shown in Fig. 5-1, is relatively simple and economical. With this circuit, it is possible to handle large current variations by using parallel or series-parallel strings of VR tubes of the same current and voltage ratings.

Since no two VR tubes have exactly the same starting- and operating-voltage characteristics, they should never be connected *directly* in parallel with each other. If they are so wired, the one with the lowest starting voltage will ionize and prevent the others from operating; the tube that started to function will be forced to handle all the regulator current and possibly be destroyed. However, as shown in Fig. 5-1, the use of diodes, in conjunction with individual current-limiting resistors, will not let each VR tube handle more than its share of the current, since the tubes will be isolated from each other by the back-to-back connection of the diodes.

The current-limiting resistors should be chosen so that the maximum rated regulator current, usually 40 ma., is drawn by each VR tube under minimum-load conditions. The maximum net current that each VR tube can regulate will be about 35 ma., since each regulator tube has a 5-ma. minimum current requirement that must be satisfied to sustain each tube in its conducting state. If two tubes are used, the circuit will have a regulation capability of 70 ma. As many VR tube and current-limiting resistor combinations as necessary may be paralled to obtain the desired current regulation, as long as a separate diode is used in each branch. It may be noted that when maximum load current is being delivered from a supply containing several VR branches, one or more VR tubes may be extinguished, depending upon each regulator's keep-alive voltage. This does not apparently degrade the voltage regulating characteristics of the circuit as long as one or more VR tube remains in the conducting state.—*J. S. King, Jr., WA3BOE*

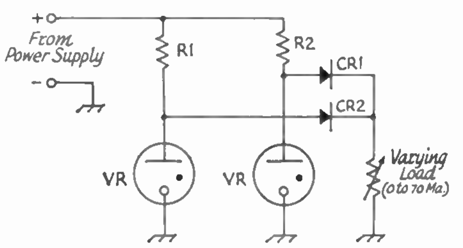


Fig. 5-1—Regulator circuit for loads that may vary as much as 70 ma. The VR tubes are identical. R_1 and R_2 are chosen so that 40 ma. is drawn by each VR tube under minimum-load conditions. CR_1 and CR_2 are 50 p.i.v. silicon rectifiers with a minimum current rating equal to the maximum load current divided by the number of diodes used. The supply voltage should be at least 30 to 40 percent higher than the voltage rating of the VR tubes.

TRANSISTOR POWER SUPPLY

The circuit shown in Fig. 5-2 is an 8.7-volt 500-ma. electronically filtered transistor power supply based on a design submitted by Ralph W. Parlette, WB6JOY. Easily constructed, the supply is inexpensive, has good regulation and very low ripple. CR_1 through CR_4 form a bridge rectifier and C_1, a capacitor-input filter. Zener diode CR_5 provides the reference voltage for emitter-follower Q_1. C_2 smooths out the small amount of ripple that appears across CR_5. The effective capacitance across the load is equal to the current gain of Q_1 multiplied by the capacitance of C_2. R_1 limits the amount of current through CR_5; it is adjusted for a Zener current of approximately 15 ma. (no load). C_3 is an r.f. bypass capacitor and R_2 provides a small (10 ma.) bleeder load for the supply.

The output voltage of the unit is equal to the Zener voltage minus the emitter-to-base bias voltage of Q_1. Other voltages can be obtained by using different Zeners and changing R_1. R_1 should be chosen so that the Zener will operate as a more or less constant voltage reference for the transistor regulator at output loads of 0 to 500 ma. yet stay within its maximum current rating when no external load is attached. Q_1 is not special; any similar power transistor should work. Of course, the higher the current gain of the transistor, the better will be the electronic filtering. Q_1 should be mounted on a heat sink.

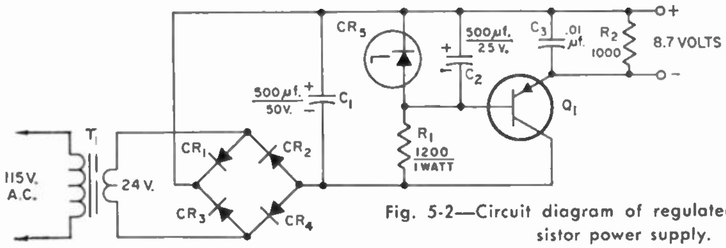


Fig. 5-2—Circuit diagram of regulated 8.7-volt transistor power supply.

C_1, C_2—Electrolytic.
C_3—Disk ceramic.
CR_1, CR_2, CR_3, CR_4—50 p.i.v. 2-ampere silicon.
CR_5—9.1-volt 1-watt Zener (General Electric 24XL9.1).
Q_1—Delco or Motorola 2N1970.
R_1—Composition.
R_2—½ watt composition.
T_1—24- or 25.2-volt 1-ampere filament transformer.

Power-supply ripple at full load was measured with an oscilloscope at 4 millivolts r.m.s. Increasing both C_1 and C_2 to 1000 µf. lowered the ripple to approximately 1 millivolt r.m.s. If less filtering can be tolerated, removing C_2 from across the Zener will raise the ripple to 15 millivolts r.m.s. The output changed only 0.1 volt as the line voltage was varied over a 30-volt range. Increasing the external load current from 0 to 500 ma. dropped the output voltage 0.2 volt.—*W1YDS*

DUAL-VOLTAGE D.C. SUPPLY

Recently I built a linear amplifier requiring a small bias voltage on four 811A's, along with a d.c. supply to operate an antenna relay which evidenced the customary hum in its normal a.c. operation, but which operated quietly on d.c. A back-to-back arrangement of two 6.3-volt filament transformers would not work in the usual configuration. Since the filament transformer supplying the 811A's had its center tap grounded, only 3.15 volts would be available for a half-wave diode rectifier.

My solution is shown in Fig. 5-3. The secondary of filament transformer T_2 acts as an autotransformer to give 6.3 volts for the bias rectifier. One end of T_2's 6.3-volt winding is connected to the grounded center tap of the 811A transformer, T_1, and the center tap of T_2 is tied to one end of the secondary of T_1.—*George H. Goldstone, W8MGQ*

USING AN OVERLOAD RELAY WITH AN ELECTRONICALLY REGULATED SUPPLY

I wanted to protect my final by using a screen-grid overload relay in series with a regulated screen supply (1965 *Handbook*, page 333, Fig. 12-24). However, inserting the relay destroyed the regulation by introducing resistance into the screen circuit. After considerable cut and try, I found that the overload relay could be placed between the output of the filter and Pins 3 and 4 of the 6L6 as shown in Fig. 5-4. When using the relay in this position, C_3 *must be omitted* or the relay will kick out every time C_3 charges. Also, the capacitance of C_2 should be made as large as practical. These modifications result in excellent regulation plus overload protection.—*Loren G. Windom, W8GZ*

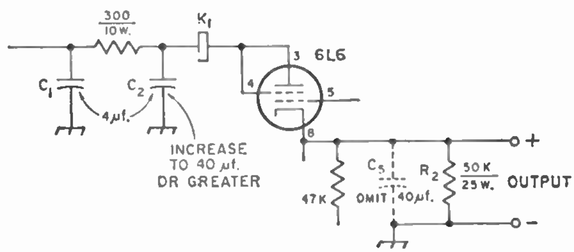


Fig. 5-4—Diagram showing modifications to *Handbook* screen supply. K_1 is screen-grid overload relay. C_3 is removed from original circuit and C_2 is increased in value.

CR_1—50 p.i.v. 500-ma. silicon.
CR_2—400 p.i.v. 500-ma. silicon.
K_1—Antenna relay.
R_1—Value dependent upon relay requirements.
T_1—6.3 v. at 20 amp.
T_2—6.3 v. at 1 amp.

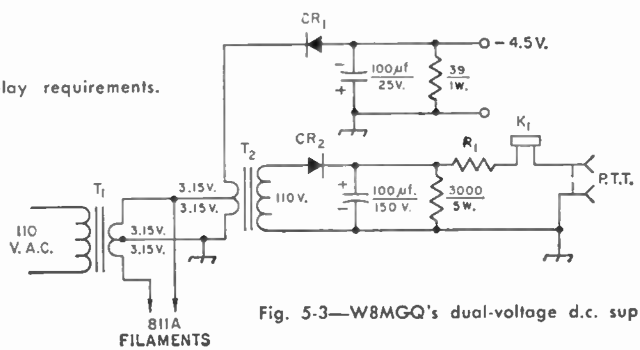


Fig. 5-3—W8MGQ's dual-voltage d.c. supply.

EQUALIZING THE LOW-VOLTAGE REQUIREMENTS OF THE HW-12 AND THE SB-100

After reading W9LSZ's hint in *QST* for May 1966 on using the HP-23 a.c. power supply with both the HW-12 and the SB-100, I feel that it should be pointed out that there is an easier and safer way to accomplish the desired results. The HW-12 will operate from a low B-plus source as high as 325 volts (250 volts is normal) if the voltage supplied to the screens of the driver and final-amplifier tubes is dropped to the proper value. As pointed out in the HW-12 instruction book and as shown in Fig. 5-5, it is only necessary to add two resistors and change a couple of jumpers to do this. The resistors required for the modification are a 1000-ohm, 5-watt unit and a 10,000-ohm, 7-watt unit.

The above modification has an added advantage over the previously described hint: if either transceiver is operated mobile, the low B-plus tap in the HP-12 d.c. supply may be set at 300 volts, and the rigs will be interchangeable without attention to the power supply. Also, there is no switch that could be inadvertently left in the wrong position, permitting too high a voltage to be applied to the HW-12 and possibly burning out three tubes.—*Robert C. Clark, K9IIVW/WA4VYL*

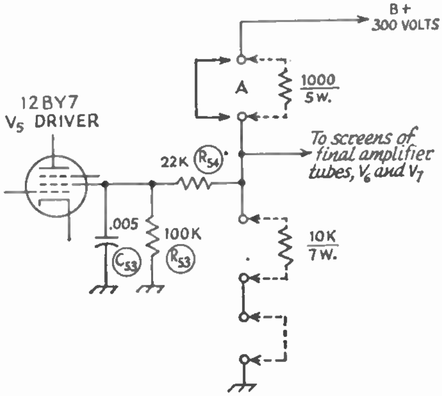


Fig. 5-5—To operate the Heath HW-12 from a low B-plus source of 300 volts, it is only necessary to remove the jumper from A and install the components shown in the dotted lines.

DUAL-VOLTAGE POWER SUPPLY HAS INCREASED EFFICIENCY

Conventional dual-voltage power-supply circuits require either a precisely tapped transformer with a separate rectifier and filter for each voltage output, or dropping resistors, which waste power and result in poor regulation. A simple circuit employing a full-wave rectifier connected to two passive branches from which the d.c. voltages are taken is shown in Fig. 5-6.

The primary winding of the power transformer is connected to an a.c. source, and the secondary winding is connected to the full-wave rectifier consisting of diodes D_1 and D_2. The unfiltered output from the full-wave rectifier is fed in parallel to a conventional choke-input filter branch and a diode-capacitor branch. The diode, D_3, in this branch conducts on the peaks of the full-wave rectifier current and charges capacitor C_1 to the peak voltage across one half of the secondary winding of the power transformer. The voltage at terminal B will be approximately 40 per cent greater than at terminal A with normal component values. Both outputs should have low ripple and good voltage regulation. For maximum voltage output at terminal B, a high-conductance diode should be used in this branch. The required peak inverse-voltage rating of diode D_3 is only one-half the peak voltage across the full secondary winding of the transformer.—*NASA Tech Brief 66-10002*

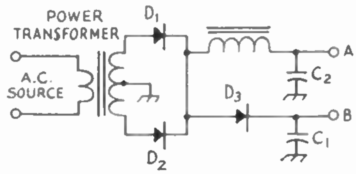


Fig. 5-6—Circuit of dual-voltage power supply.

CLEANING TRANSFORMER LAMINATIONS

The insulation from old transformer laminations can easily be removed by soaking the laminations in carburetor cleaner for about 15 minutes and then rinsing them off in clean water.—*Bill Waters, K4YZD*

(Be sure to shellac each lamination as the core is put back together. Otherwise, the eddy-current losses in the core will be quite large.—*Editor*)

USING THE HP-23 WITH THE HW-12 AND THE SB-100

The Heathkit HP-23 a.c. power supply has a low-voltage winding that is tapped to ultimately supply either 250 or 300 volts d.c. Depending upon the needs of the equipment to be used with the HP-23, the builder wires the power supply in the appropriate fashion. Since the low-voltage requirements of the HW-12 are different from those of the SB-100, a few connections have to be unsoldered when changing from one transceiver to the other. The modifications shown in Fig. 5-7 make this unnecessary.

Install a s.p.d.t. toggle switch on the power-supply chassis and connect the common contact of the switch to the negative terminal of electrolytic capacitor, C_3. Connect either of the remaining contacts to the brown transformer wire and the other one to the brown-yellow transformer wire. The supply will now provide 300 volts d.c. with the switch in the "brown" position and 250 volts d.c. with the switch in the "brown-yellow" position.

Since only one power cable came with the supply, I chose to wire the cable to the 8-prong female connector supplied with the HW-12. A short adaptor cable was then constructed for the SB-100. It consisted of an 8-inch cable with an 8-prong male plug on one end, to mate with the HP-23 power cable, and an 11-prong female socket on the other end, to attach to the SB-100.—*Charlie Becht, W9LSZ*

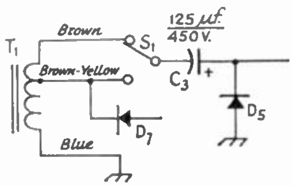


Fig. 5-7—Schematic of HP-23 modification. C_3, D_5, D_7 and T_1 are components already existing in the power supply. S_1 is a s.p.d.t. toggle switch.

TRANSIENT PROTECTION FOR POWER SUPPLIES

Damaging transients are often set up in a power supply when the a.c. power fails momentarily. A circuit that offers automatic transient protection is shown in Fig. 5-8. When switch S_1 is closed, the a.c. current passes through a 25-ohm resistor, reducing the voltage at the primary of the power transformer. After about 30 milliseconds relay K_1 will close, shorting out the resistor, and the power supply operates normally. This delay in K_1 is partly due to the time it takes for the normal mechanical action of closing to take place, and partly because the voltage drop across R_1 makes the relay action a little sluggish.

When a power supply with a high capacitance filter is turned on, the charging surge is often many amperes, which may result in damage to the turn-on switch unless it is rated for the surge current. The circuit in Fig. 5-8 will also help this problem because the turn-on surge is reduced; a switch with a lower current rating may be used safely.—*William Watson, K7JHA*

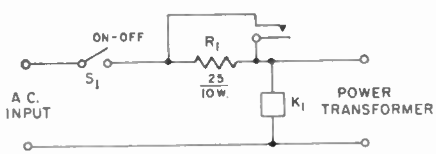


Fig. 5-8—K7JHA's circuit for transient protection.

K_1—Power relay, s.p.s.t. contacts (Potter & Brumfield MR3A suitable for up to 10 amp.).

R_1—25-ohm, 10-watt w.w. resistor.

S_1—S.p.s.t. toggle switch.

REGULATOR-TUBE PROTECTION

Electronic-regulated power supplies usually use low-mu triodes or triode-connected pentodes as control tubes. Dial lamps may be used as self-adjusting resistances placed in the cathodes of these tubes to prevent damage from heavy currents. The brilliance of each lamp will give an idea of the relative current through each section or tube. If an overload becomes extreme, the lamps are a good fuse. The lamp type is determined by the resistance desired in the cathode and the normal current drawn. Type Nos. 47 and 44 are useful with the 6AS7 or 6L6 tubes.

Since the thermal change in the bulbs is sluggish, motorboating will sometimes occur. This trouble can be cured with a capacitor connected as shown by the dotted lines in Fig. 5-9.—*Liz Deck, K6MTQ*

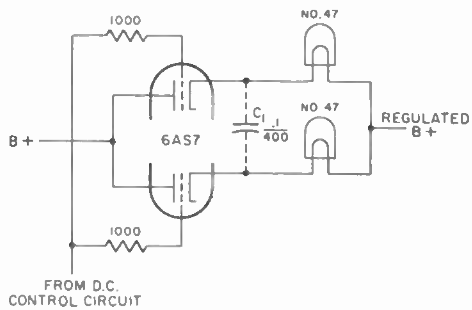


Fig. 5-9—A protection circuit for regulator tubes by placing a pilot lamp in each cathode. If oscillation occurs, it may be cured with C_1, typically a 0.1-µf. paper capacitor of sufficient voltage rating for the power supply used.

TRANSFORMER WINDING JIG

After reading W1ICP's article on transformer winding (*QST* for February, 1964), I decided to make a plate transformer. To make the winding job easier, I constructed the jig shown in Fig. 5-10. It is made from aluminum sheet and angle stock. I then wound the transformer beside the jig which has dual primary and 1250-volt 1-amp. secondary. A jig will reduce the winding time on large transformers by many hours!—*Leon O. Beasley, WA5ENP*

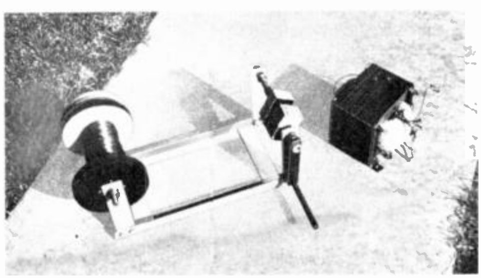


Fig. 5-10—WA5ENP's transformer winding jig.

JUNK-BOX ZENERS

Recently I was in need of a low-voltage Zener diode and decided to check out all the transistors I had in my junk box. Some types worked fine; you even get two Zener voltages with one transistor as the Zener point of the base-collector junction is different from the base-emitter junction. A handful of transistors will provide quite a range of Zener voltages, but on most types the current through the transistor can only be a small value. It should follow that the high-wattage transistors can be utilized in a like manner for high-wattage Zeners, but I have not tried them.—*Cal Enix, W8ZVC*

VOLTAGE REGULATION?

In *QST* for October, 1964, K6UGA shows there is a good deal more to VR-tube characteristics than one often thinks, and the same goes for Zener diodes. It is dangerous to take these devices for granted. An effect which puzzled me for a few hours concerns the *worsening* of the voltage/frequency coefficient of a v.f.o. due to the introduction of a Zener diode. I had constructed a 1.7-MHz. transistor v.f.o. and had succeeded in getting this to function within 200–300 Hertz with a variable power supply from 16 volts all the way down to 2 volts. Thus the addition of a Zener diode represented a bit of lily painting but was thought worthwhile for mobile operation.

You can imagine my surprise when I found that the situation got violently worse with a Zener. A check showed the voltage remained constant at 9 volts, when the supply was varied from 16 to 11 volts, but the frequency changed several kHz.

After some thought I came to the conclusion that the Zener diode, whose impedance is both quite low and distinctly variable with voltage, was acting as a variable shunt across the 0.1-μf. bypass used to complete the collector return path. There may also have been some variable capacitance with change of current, but this would have been quite small compared with the 0.1 μf. The reactance of a 0.01-μf. disk on 1.7 MHz. is about 1 ohm, which is not by any means low enough to allow one to ignore the impedance of the Zener diode which can be as low as 5 ohms.

My solution was to separate the diode from the bypass capacitor by a small r.f. choke, which removes the variable Zener impedance from the r.f. path.—*Reg Hammans, G2IG*, from RSGB Bulletin

REGULATED POWER SUPPLY

In the March 1967 issue of *QST* (page 32) W1YDS described a very useful transistor power supply. However, he reported some difficulty in obtaining a precise output voltage. The following note is offered as a possible improvement.

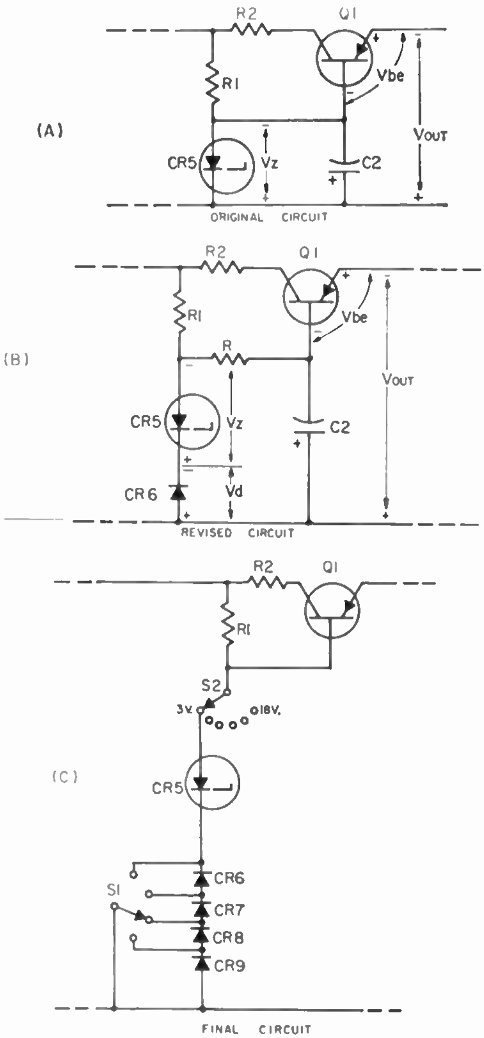


Fig. 5-11—(A) Series regulator used in March 1967 circuit (Gimmicks & Gadgets) with (B) addition of diode in series with Zener reference to effect a small change in reference voltage and thus in the output voltage. (C) Adding several diodes which can be switched in as required to adjust the output voltage. This switch can be used to compensate for voltage variations which result from load changes.

In the original circuit, part of which is reproduced in Fig. 5-11A, the output voltage is equal to the Zener voltage minus the base-to-emitter voltage of the regulator transistor, as stated by W1YDS.

In the revised circuit of Fig. 5-11B, two components have been added: a forward-biased diode in series with the Zener diode and a resistor *R* (which will be discussed later).

From Fig. 5-11A, the output voltage is now equal to the sum of the Zener voltage and the voltage drop of the forward-biased diode minus the base-to-emitter voltage of the transistor. For a forward-biased diode, the voltage drop is usually between 0.4 and 0.7 volt, depending on the type of diode (either germanium or silicon) and on the current flowing through it. The ratings of this diode are not particularly critical, so long as the diode is capable of carrying the full Zener current.

For purposes of illustration, assume the Zener voltage to be 11.6 volts, the base-to-emitter voltage of the transistor to be 0.3 volt, and the diode voltage drop to be 0.6 volt. In the original circuit, the output voltage would be 11.6 — 0.3 = 11.3 volts. In the revised circuit, the output voltage would be 11.6 + 0.3 = 11.9 volts, under the same conditions. This is closer to the desired output of 12 volts.

If more variation in output voltage is desired, more diodes of adequate rating may be added in series with the Zener diode. Fig. 5-11C illustrates a possible arrangement. Switch S_1 allows any or all of the diodes to be inserted for any output voltage. The range of S_1 will be from zero to about 2 volts in approximately 0.5-volt steps. These diodes also add some temperature compensation to the circuit.

Under certain combinations of load and current drain, the power supply may tend to oscillate at a high frequency. The 0.01-μf. capacitor in the original circuit should take care of this. But, in any case, a 100-ohm resistor at *R* will serve as a "stopper" resistor.

It is sincerely hoped that these ideas will help in overcoming any problems.—*R. W. Mouritsen, VE3GIM*

ZENER-REGULATED LOW-CURRENT TRANSISTOR SUPPLY

In many transistor applications a d.c. power supply having very good voltage regulation is required, and while dry batteries may meet this requirement nicely when fresh, they become less "stiff" as they wear out. If a.c. can be used the regulation can be maintained indefinitely, and the first cost is the last cost. The supply shown in Fig. 5-12, built to power an experimental conversion-type v.f.o., is useful either as test-bench equipment or as a component that can be dropped into a chassis assembly.

The circuit, Fig. 5-13, is not at all novel; it is simply a voltage doubler working from a 6.3-volt filament transformer, plus a filter and a Zener voltage-regulator diode. By selecting the appropriate diode the output voltage can be placed at practically any desired value in the 6- to 12-volt range. (Diodes are available in 1-volt or smaller steps in this interval.) The load current was not expected to be more than 30 or 40 ma. in the writer's case, and for currents of this order the filter capacitances are adequate, in conjunction with the smoothing contributed by the diode regulator. (The advantage of the minimal capacitances is that the capacitors are physically small.) For larger currents all capacitances should be increased in proportion to the increase in load current.[1]

R_1 and R_2 in series act as a current-limiting resistor for the regulator diode. In addition, R_1 doubles as a filter resistor between the input and output capacitances; although it could be omitted entirely, it does help filter out the higher harmonics of the rectified a.c. In general, R_2 should have the lion's share of the total

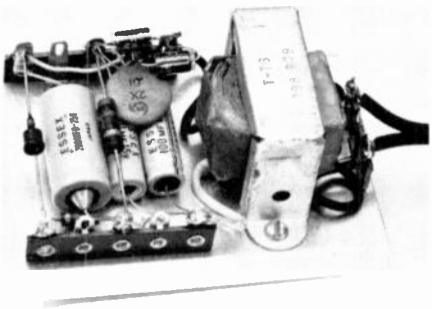


Fig. 5-12—Transistor power supply with regulated output voltage. This circuit is useful for up to 12 volts output at load currents of 50 ma. or less. It is assembled on a piece of aluminum measuring 3¾ by 2½ inches on top, with ⅜-inch side lips. The three screws holding the three tie-point strips are longer than the lips are deep; this allows mounting the assembly on a chassis as a unit. The regulator diode is at the left in this view.

[1] An effective method for larger currents is the "electronic filter," used in the power supply described by the writer in June 1962 *QST*. However, the output of that supply was not regulated.

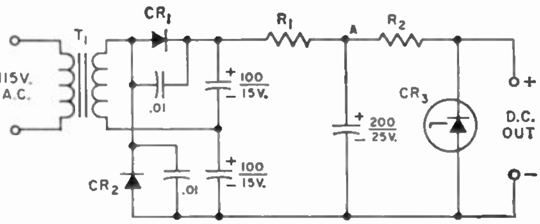


Fig. 5-13—Circuit of the regulated power supply for transistors. Capacitances are in μf.; 0.01-μf. capacitors are disk ceramic (a dual unit may be used); others are electrolytic.

CR_1, CR_2—Any silicon diode having a p.i.v. rating of 50 volts or more; current rating 75 ma. or more.
CR_3—Voltage-regulator diode; see text.
R_1, R_2—½-watt resistors; see text.
T_1—Filament transformer, 6.3 volts, 1 amp.

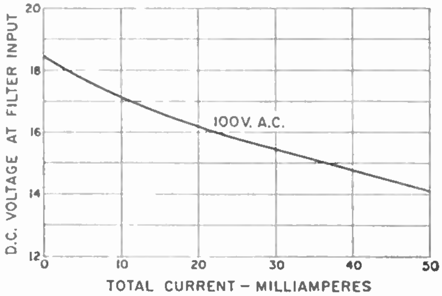


Fig. 5-14—This curve is useful for determining R_1 and R_2 values as related to load current and regulated voltage. Some variation is to be expected in practice because of component differences. The filament transformer used as a power source in making these curves had an output voltage of 7.5 at no load and 7.0 at a d.c. load of 100 ma., although rated at 6.3 volts.

resistance—at least two thirds of it—because there must be an appreciable voltage drop between point *A* and the positive output terminal if the 200-μf. capacitor is to contribute much to the filtering.

Fig. 5-14 can be used to find a first-approximation value for the sum of R_1 and R_2, provided the capacitances are as given in Fig. 5-13, and assuming that the regulation is to hold for line voltages down to 100. For example, if the maximum output current needed is 25 ma., the total current can be assumed to be 30 ma., allowing a minimum of 5 ma. for the diode. As shown by the solid curve, at 30 ma. the approximate d.c. voltage at the filter is 15.5 volts. If the diode regulates at 8 volts, the difference, 7.5 volts, must be dropped in R_1 and R_2. At 30 ma. this requires a total resistance of $7.5/0.03 = 250$ ohms. R_1 could take 75 ohms of this total, and the nearest standard value, 180 ohms, could be used for R_2.

The results obtained using Fig. 5-14 will not be exact, for a number of reasons, but will give a fair approximation of the amount of resistance needed. If the range of line voltage over which regulation must be maintained is critical, the resistance values should be adjusted experimentally to fit. Usually, R_1 as calculated above can be used without change, R_2 alone being adjusted to the required value.

Voltage-regulator diodes may differ among themselves considerably, even when rated for approximately the same Zener voltage. A couple of bargain-counter unbranded diodes originally tried in this power supply gave very disappointing results; the output voltage varied over a range of about a volt when the line voltage was swung between 100 and 130. Subsequently, a number of branded diodes were tested, and although uniformly much superior to the "bargain" ones, still showed variations between types. The difference appears to be in the "break" characteristic; a "soft-break" diode will show a smooth variation in voltage and a somewhat indeterminate transition between regulating and nonregulating. The "sharp-break" type will hold the output voltage more constant over its useful current range, and will go out of regulation quite suddenly. This is the more desirable type for the purpose. Of the low-priced ones, the writer has found the General Electric Z4XL series to be excellent.

The precise voltage at which a diode regulates depends on its temperature, increasing slightly as the temperature increases. The regulated voltage is therefore tied in with the power dissipation in the diode. It is advantageous to work the diode at a relatively-low current compared with its maximum rating, since the temperature variations will be lessened over the operating range of primary voltage. A 1-watt diode operated at ¼-watt maximum dissipation will run cool and the temperature variations will be negligible under ordinary conditions. If the diode is a sharp-break type, it can be expected to hold the output voltage constant within about ±0.05 volt over a ±10 percent variation from the nominal 115 volts a.c. on the primary. The change will be considerably less if the primary voltage excursions are more reasonable.

Manufacturing variations are such that the regulated voltage can be given only in terms of a specified tolerance. The tighter the tolerance the more you pay. It is worthwhile to get the 10 percent type if you use the GE diode mentioned earlier, since it costs only a few cents more. Of several of these tried, the actual voltage was much closer to the nominal value than the rated tolerance would indicate, but this is, of course, not guaranteed.

If the rectifier diodes, CR_1 and CR_2, happen to have a sharp transition from nonconduction to forward conduction, r.f.-type hash noise is generated. The filter used for smoothing will not suppress this, but the 0.01-μf. capacitors shown in Fig. 5-13 across the diodes will eliminate it.

Although the hash may not be present with all diodes, the suppressor capacitors are worthwhile insurance.—*W1DF*

Hints and Kinks . . .

for Keying and Monitoring

IAMBIMATIC KEYING FOR THE "MICRO-TO KEYER"

After completing the "Micro-TO Keyer" described by K3CUW in *QST* for August, 1967, I decided that I would like to add the Iambimatic keying feature.[1] I accomplished this by adding a J-K flip-flop as shown in Fig. 6-1. The additional circuitry was mounted on a 2⅜ × ⅞-inch circuit board inside a 3 × 4 × 5-inch utility cabinet. The resulting Iambimatic keyer performs very well, and I can certainly recommend the two-paddle keying technique to anyone interested in better keying with less effort.—*C. W. Anderson, VE4WA*

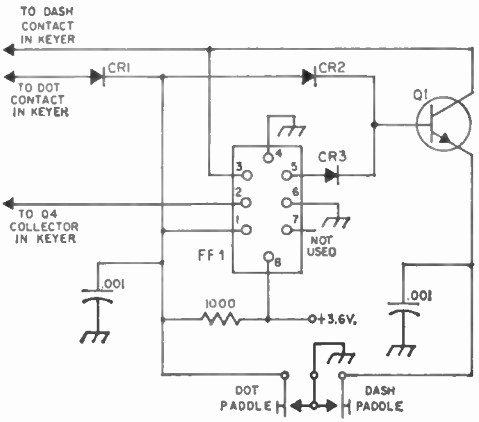


Fig. 6-1—Iambimatic adapter for "Micro-TO Keyer." Resistance is in ohms; resistor is ½ watt. Capacitors are ceramic; capacitances are in microfarads (μf.)

CR_1, CR_2, CR_3—Germanium diodes (1N64 suitable).

FF_1—J-K flip-flop (Fairchild μL923).

Q_1—N-p-n silicon, small-signal audio type (2N5127 used).

GMT FOR THE 12-HOUR DIGITAL CLOCK

For years I have had a 12-hour digital clock in my station. I've always liked the clock because I've found that it is easier to read local time on it than on my wristwatch; however, it has been a nuisance to convert the indicated figures on either timepiece to GMT. Then the other day I received a sample card of self-sticking numerals meant to be used by electricians and technicians to identify wires and instruments. Suddenly I thought of a way these markers could be used to solve my GMT conversion problems.

By sticking the numerals, 00 to 24, at appropriate locations on the hour wheel as shown in Fig. 6-2, I had a clock that not only indicated 24-hour GMT, but 24-hour time as well. The particular markers that I used are about ⅛ inch square, which is just about the right size to conveniently fit near the original numbers on the clock.

Three markers were affixed near each original hour figure on the hour wheel. Twenty-four hour local time was provided by sticking the numeral 13 to the right of hour 1, 14 to the right of hour 2, and so forth. The GMT markers corresponding to the original hour figures were affixed to the wheel so that the markers would be visible in the upper left corner of the hour window, and the GMT markers corresponding to the added local hour figures were affixed to the wheel so that the markers would be visible in the lower left corner of the hour window. Labels were attached to the clock to indicate the meaning of the figures.

To prevent "day" errors, I used a felt marker pen to paint the 00 to 05 GMT hours red. The colored markers serve as a warning that the day at Greenwich has moved to "tomorrow" while the day at my location has not changed.—*Floyd Fellows, WA8ZJH*

Fig. 6-2—By modifying a 12-hour digital clock as described in the text and shown above, you can read 24-hour GMT and 24-hour local time without any calculating.

VIBROPLEX KEY

By placing a Vibroplex semiautomatic key inside a plastic bag (household Baggie), you can prevent dirt from getting on the contacts. The key can be operated easily through the plastic container.—*Fred Elser, W6FB*

[1] Gensler, "The 'Iambimatic' Concept," *QST*, Jan., 1967.

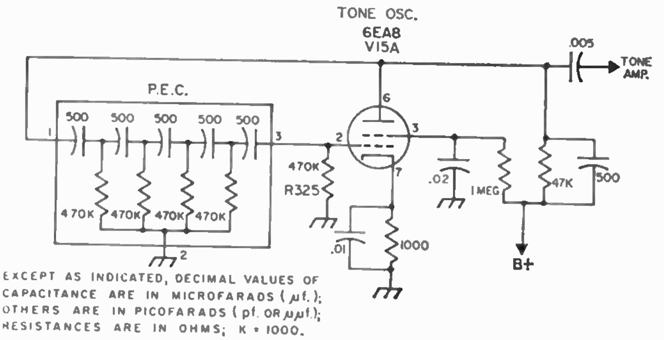


Fig. 6-3—Schematic diagram of the c.w. monitor in the Heath SB-101. By increasing the value of R_{325}, the user can lower the pitch of the oscillator. The P.E.C. is discussed in the text. Resistors are ½ watt.

LOWERING THE PITCH OF THE C.W. MONITOR IN THE SB-101

The c.w. monitor (Fig. 6-3) in the Heath SB-101 operates at 1000 Hertz, a higher frequency than many operators are accustomed to copy. The tone is generated by a conventional phase-shift oscillator, V_{15A}, which has its feedback components, except R_{325}, a 470,000-ohm resistor at the grid of the tube, enclosed in a printed electronic circuit (P.E.C.) Increasing the value of R_{325} lowers the monitor frequency. For example, with R_{325} at 1 megohm, the monitor output is about 850 Hertz, and with the resistor at 1.5 megohms, the frequency is approximately 760 Hertz. A convenient way to adjust the oscillator is to lift one end of R_{325} and place a 2-megohm potentiometer in series with the resistor. Vary the control until the desired tone is obtained and then replace the two series resistances with a fixed resistor equal to their combined resistance.

Perhaps with a suitable bracket, the control could be permanently installed so that different tones would be available. However, I didn't elect to drill the additional mounting holes.

Along with the lower tone, the modified monitor seems to key better—a little harder. Although not verified, the modification is probably applicable to other transmitters and transceivers that use a similar monitor oscillator.—*Stewart D. Lyon, W6CUX*

GMT CLOCK FACE

In DX work the use of Greenwich Mean Time is a must. There are various time conversion charts, but all leave something to be desired. Each time you wish to use GMT, you have to read the time on the station clock and then do some figuring. Twenty-four-hour clocks are available, but they are quite expensive.

Since most hams have 12-hour clocks in their stations, why not modify these clocks to indicate 24-hour GMT? I solved this problem by developing the clock face shown in Fig. 6-4.

Fig. 6-5 shows the parts that make up the gadget. Cardboard, plastic, metal or thin wood can be used. After the parts are assembled, part 2, a movable ring, indicates the correct time division when its tab is set above the proper label (i.e., DAY or NIGHT). When the tab is moved to DAY, the GMT hours corresponding to 6 A.M. to 6 P.M. EST are shown; when the tab is moved to NIGHT (Fig. 6-4), the GMT hours corresponding to 6 P.M. to 6 A.M. EST are shown. To build the face, proceed as follows:

1) Disassemble your station clock, and paint out the figures 1 to 12. Be sure not to cover the hash marks that indicate minutes. Reassemble the clock and measure the diameter of the clock face. The diameter is indicated by "D" in Fig. 6-5.

2) Using a protractor to measure 30-degree angles, lay out part 1. Cut out twelve ⅜- by ⅜-inch rectangular openings and one circular opening with a diameter equal to "D."

3) Using a protractor to measure 15-degree angles, lay out part 2. Cut out a circular opening with a diameter equal to "D" plus ⅜ inch. Label the ring. The times shown are for Eastern Standard Time (i.e., 1700 GMT will be in the 12 P.M. slot when the ring tab is at DAY, and 0500 GMT will be in the same slot when the

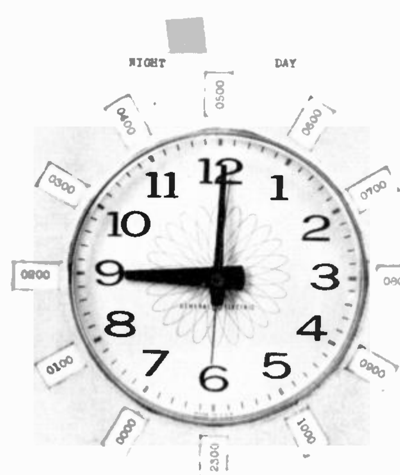


Fig. 6-4—The GMT clock face installed on the kitchen clock. The original numerals on the clock have yet to be painted over as described in the text.

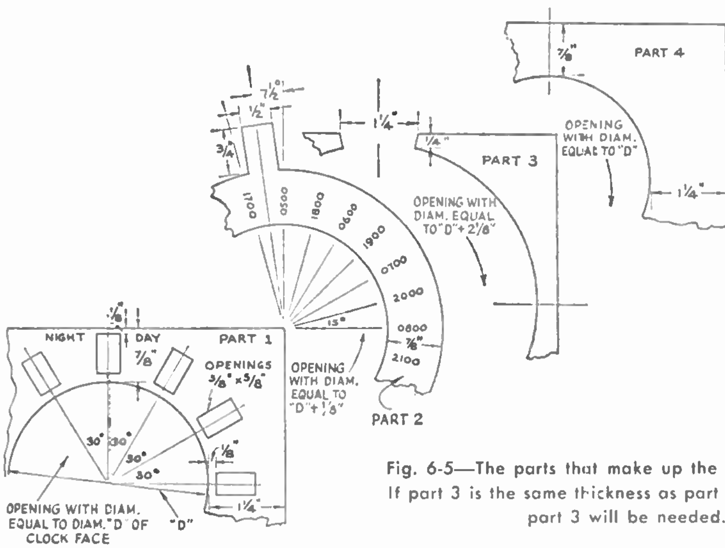


Fig. 6-5—The parts that make up the GMT clock face. If part 3 is the same thickness as part 2, two copies of part 3 will be needed.

ring tab is at NIGHT). For CST move all figures 30 degrees counterclockwise from where shown, for MST move all figures 60 degrees counterclockwise from where shown, and so forth.

4) Make two copies of part 3. Since the ring rotates inside part 3, two thicknesses of material must be used to provide room for the ring to rotate.

5) Make one part 4.

6) With the ring in place, temporarily put all the pieces together. Make sure that the ring rotates easily. Do not settle for a sloppy fit; otherwise your GMT figures will not show properly through the openings in part 1.

7) If everything fits well, glue parts 1, 3 and 4 together (with part 2 in place). As shown in Fig. 6-5, label part 1 "NIGHT" and "DAY."

8) Arrange a suitable mounting to hold the face on the front of your station clock.

When you operate in the daytime, reach over to the clock and move the tab to DAY. At night, move the tab to NIGHT. Since there aren't any figures on the clock face itself, you now should be able to read GMT at a glance.—*W. R. Carruthers, VE3CEA*

IMPROVED PERFORMANCE FOR THE HD-10 KEYER

The Heath HD-10 is an inexpensive, dependable, compact and good-looking solid-state keyer. When the Heath unit came on the scene a year or two ago, I threw caution to the wind and retired my 25-year old semiautomatic speed key. KH6IJ's suggestion,[1] that a few weeks of practice is needed with any keyer before an on-the-air trial, was followed.

Success was immediate, and soon my sending speed with the HD-10 was faster than with the old bug. However, some errors did occur. Although the frequency of mistakes decreased with practice, I felt that too much time and concentration was being required to achieve errorless sending; at times I was even tempted to try s.s.b.

My trouble turned out to be a variable dot-to-space ratio. The dot-width and space-width controls on the HD-10 are concentric variable resistors that are connected by friction. A single knob controls both potentiometers. Not only does the dot-to-space ratio change somewhat with the rotation of this knob but, furthermore, the friction connection is overridden when the knob is turned fully counterclockwise.

To overcome these difficulties, it seemed best to mechanically divorce the two concentric potentiometers and to use two control knobs instead of one. Then a dot-to-space ratio of 1:1 or any other ratio could be employed. Since the concentric potentiometers in the HD-10 could not be taken apart and used separately, the volume control was replaced with a 1000-ohm resistor, and a new 100,000-ohm space potentiometer was installed in the volume-control location. Although the monitor now operates only at full volume, the speaker can be disabled by plugging a headset in the PHONES jack. The shafts of the two potentiometers were fitted with dial scales and pointers, and then the dials were calibrated. The instruction manual tells how this can be done for a 1:1 dot-to-space ratio.

Before the keyer was modified, the dot-to-space ratio was apparently less than 1:1 at times. After the changes, a surprising improvement in my sending skill was noticed when dot-to-space ratios of 1:1 or 1.2:1 were tried. I had a much wider range of errorless code speeds, and the stuff spewed out correctly with little concentration on my part. My microphone has been gathering dust ever since.—*John S. Reddie, W7FVI*

[1] Nose, "High Speed Code," *QST*, November 1965.

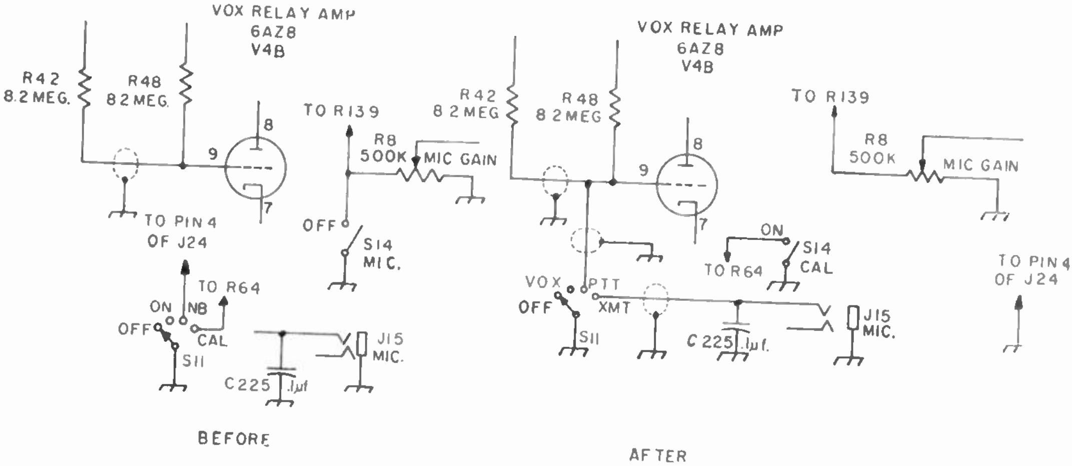


Fig. 6-7—Modification of the KWM-2 for ease in going from VOX to push-to-talk or manual operation. Reference numbers are Collins' part numbers. Resistances are in ohms (K = 1000) and resistors are ½ watt.

PROTECTING THE TRANSISTOR SWITCH IN THE HD-10 KEYER

In the instruction manual for the Heath HD-10 electronic keyer, it states that the open circuit or spike voltage across the keyed line should never be allowed to exceed 105 volts, or the 2N398A transistor switch, Q_8, may be damaged. A simple and effective means of protecting Q_8 is shown in Fig. 6-6. The installation of CR_1, a 91-volt Zener, prevents the collector-to-emitter voltage rating of the 2N398A from being exceeded.—*Gilbert A. Herlich, W2AZG/6*

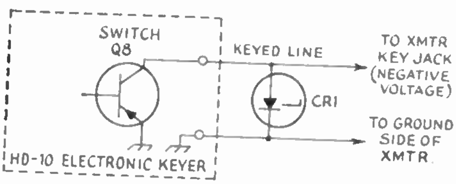


Fig. 6-6—CR_1 is a 91-volt Zener (1N3043 or equivalent) and Q_8 is a 2N398A.

VOX-TO-P.T.T. MODIFICATION FOR THE KWM-2

Changing from VOX to push-to-talk with the Collins KWM-2 requires that the lid be opened and the VOX controls adjusted. As shown in Fig. 6-7, a simple modification can be made which will allow a front-panel switch to be used to select VOX, push-to-talk or manual control (XMT).

The modification consists of rewiring the FUNCTION switch from OFF-ON-NB-CAL to OFF-VOX-PTT-XMT and rewiring S_{14} from MIC GAIN on-off to CAL on-off. The only switch function that is lost is NB (noise blanker). However, if the noise blanker is installed, it can be left running all the time, if the user grounds the noise-blanker control wire as to be described.

Once the transceiver has been modified, the CAL function can be activated by rotating the MIC GAIN control fully counterclockwise.

The steps to be completed in the modification are as follows:

1) Remove the wire which connects the ungrounded end of the MIC GAIN control, R_8, to the MIC GAIN on-off switch, S_{14}.

2) Disconnect the white wire with orange and green tracers from the CAL contact of the FUNCTION switch, S_{11}, and connect it to the free lug of S_{14}.

3) Disconnect the white wire with black tracer from the NB contact of S_{11} and tuck it back out of the way. If the noise blanker is installed, ground the wire.

4) Connect two shielded wires to S_{11} as shown in the schematic. Route the wires along the existing cable which goes down through the chassis, and lace the new wiring to the cable.

5) Carefully scrape the old lettering from the front panel and apply new lettering around the FUNCTION switch. However, if the transceiver might be returned someday to its unmodified state, the original lettering can be left on the panel. In this case, paint a small plate gray to match the coloring of the panel, letter the plate, and place it under the hex nut that bolts the FUNCTION switch to the panel. Matching spray paint, part No. 097-6162-00, is available from Collins.—*Robert W. Lewis, K8KNI*

RECORDING HINT

To neatly and positively thread recording tape into a reel, clip a miniature alligator clip onto the end of the tape at right angles as shown in Fig. 6-8. Then drop the end of the tape into the hub, using the clip as a handle. The clip not only makes flimsy tape easy to thread but also keeps the end of the tape from pulling out of the hub during the first few revolutions of the reel. Before completely rewinding the tape, be sure to remove the alligator clip or you might break the tape.—*Charles W. Kram, Jr., W5TFZ*

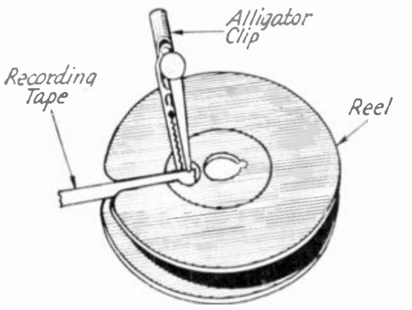


Fig. 6-8—Sure method of threading recording tape.

OSCILLATOR KEYING

Obtaining satisfactory oscillator keying has its problems as pointed out in the *Handbook* section on that subject. Cathode, blocked-grid and screen keying of the writer's 7- to 7.5-MHz. v.f.o. all produced detectable chirp at the fourth harmonic. Even more bothersome was the cyclical heating and cooling of the oscillator tube caused by the cathode current change from zero milliamperes with the key up to ten milliamperes with the key down. This was evidenced by a slow drift in frequency during the first thirty seconds of each transmission until the oscillator temperature stabilized at a new value. Although operation of the oscillator at low screen and plate voltages with a high value of grid-leak resistance minimized these difficulties, it did not eliminate them.

The keying system shown in Fig. 6-9 solved the chirp and cyclical drift problems. Plate current, screen current and hence total cathode current remain unchanged during key-up and key-down conditions. The oscillator is a conventional series-tuned Colpitts in an electron-coupled arrangement. With the key up, the 1N34A diode is biased in the conducting state, effectively putting C_1 in parallel with C_2. This reduces feedback below the value needed to sustain oscillations. When the stage stops oscillating, no grid current flows and grid-leak bias becomes zero. However, the flow of current from ground to B-plus through cathode resistor R_2, RFC_1, the 1N34A diode and R_3 biases the cathode sufficiently to limit tube current to the normal operating value. When the key is depressed, the 1N34A diode is biased in the non-conducting state, C_1 is effectively disconnected from the cathode, and feedback increases to its normal value causing oscillations to begin. Grid-leak bias rises to its normal value also, but simultaneously the cathode bias is reduced by the cutoff of diode current. The value of R_2 is adjusted experimentally to produce no change in total tube current between key-up and key-down states.

With thermal dissipation held constant, no change in oscillator frequency results from extreme changes in the duty cycle. Other precautions of good v.f.o. construction must be observed, of course.—*Charles E. Rider, WB2ZNT*

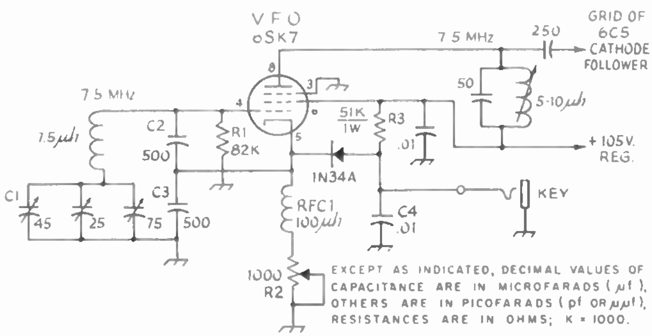
ANOTHER REMEDY FOR SLIDING KEYS

A key, bug or electronic keyer that won't stay put is most annoying. I found a solution to this problem in 3M "Scotch-Tred," a nonslip surfacing used primarily to insure surefootedness on boat decks, ladders and docks. It is available at most marine supply stores in 6-inch widths at $.50 a foot. A half-foot length is ideal for most keys. It has a pull-off backing, adheres to almost any surface, applies like tape and comes in an off-white color that can be repainted to match any table top. Try "Scotch-Tred"; you'll be pleased with the results.—*S. J. Knox, WB2MRA*

LOW-COST TRANSISTOR AUDIO AMPLIFIER

Where can you get a solid-state amplifier, complete with gain control, speaker and cabinet, for under $5.00 and besides have enough extra parts for a code-practice oscillator, test generator or other project? Six-transistor Japanese radios are selling in discount drug stores and other bargain supply houses for as low as $3.00 apiece. The transistor receiver purchased had two transistors in the r.f.-i.f. circuit and four transistors in the audio section. Between these two portions of the set was the easily identified diode detector, which coupled

Fig. 6-9—Circuit diagram of WB2ZNT's keying system. C_1 is a negative-temperature coefficient ceramic trimmer and C_2 and C_3 are silver mica. Other fixed capacitors are disk ceramic. R_1 is ½-watt composition and R_3 is 1-watt composition. R_2 is a linear taper control. RFC_1 is 100 μh.



to the gain control through a capacitor. Removal of the diode and a shunting capacitor to ground (r.f. filter) gave access to the audio section via the volume control. Battery consumption was minimized by removal of the two unused transistors. If the amplifier is to be used for long periods, flashlight batteries or an a.c. power supply can easily be added.—*Irving S. Mayer, W8ZEB*

KEY BASE

SICK and tired of your key creeping all over the operating desk? One way to keep a key in one place is to mount it on a chunk of iron. And, an excellent base is the sole of an electric iron. The sole is made from cast iron, so it is easy to drill and machine.

In the unit shown in Fig. 6-10, a Brown Brothers paddle for an electronic bug is mounted at one end of the sole. At the other end are three E. F. Johnson insulated jack-top binding posts. Three rubber feet are mounted on the bottom. Depending on the size of the iron, almost any key or bug could be mounted on the sole.—*W1ICP*

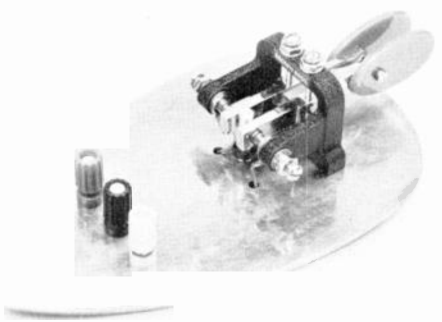


Fig. 6-10—A key base that will stay put.

LOG KEEPING

A SIMPLE convenience in log keeping is shown in Fig. 6-11. It is a stunt that has been used by communications people for many years. One of the outside corners of the log book is cut as pictured. As each page is filled, its corner is cut to agree with the cut in the cover. When the operator wants to make a log entry, he lifts all the pages which are cut, exposing the current page. This method of log keeping results in clean and unsoiled pages, which is not the case if the book is left open at the current page.—*Lewis E. Elicker, Jr., W3ADE*

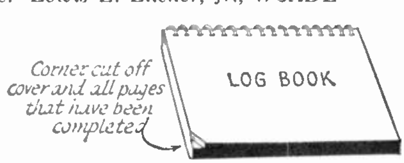


Fig. 6-11—A simple method for keeping the log book neat and clean.

FET CODE PRACTICE OSCILLATOR

THE FET code practice oscillator shown in Fig. 6-12 will provide a loud tone when used with magnetic headphones having an impedance of 2000 ohms or more. Although a P-channel field-effect transistor is used in the circuit, an N-channel type can be substituted if the polarity of the battery is reversed. The frequency of the tone depends mainly on the values of the capacitors and the impedance of the headset. If a different tone is emitted from the oscillator than that desired by the builder, the value of C_1 can be changed accordingly. Any small 9-volt battery should be suitable for powering the unit, as the current drain is only about 0.3 ma.—*Robert E. Flanagan, WA1HAU*

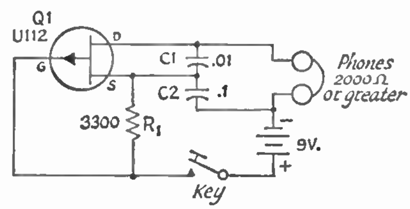


Fig. 6-12—Schematic of the FET oscillator. Resistances are in ohms; R_1 is ½ watt composition. Capacitances are in µf. C_1 is disk ceramic and C_2 is paper tubular. Q_1 is a Siliconix U112. If the battery polarity is reversed, a Motorola MPF104 can be substituted.

TIGHTENING LOOSE SPRING-LOADED TELETYPE KEYS

SPRING-LOADED keys, commonly found on teletype machines, frequently become loose. By reforming the concave dimple on each side of the key, a tight fit can be made between the key and the key lever. As illustrated in Fig. 6-13, a small center punch should be used, the key being placed on its side on a table top and one or two light blows given with a hammer. Do not bend the bottom edge of the key in an effort to correct the looseness. An examination of the key will show that the key lever is grasped above the dimple and not by the bottom edge. When removing a key from the machine, push the key down and rotate it one-quarter turn before pulling the key off.—*Ken Thomson, W5IFH*

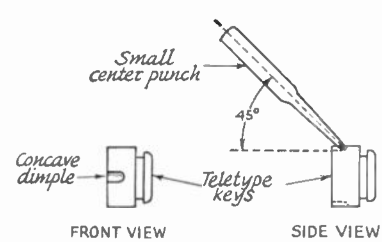


Fig. 6-13—A tighter fit can be had between a teletype key and a key lever by reforming the dimple on each side of the key.

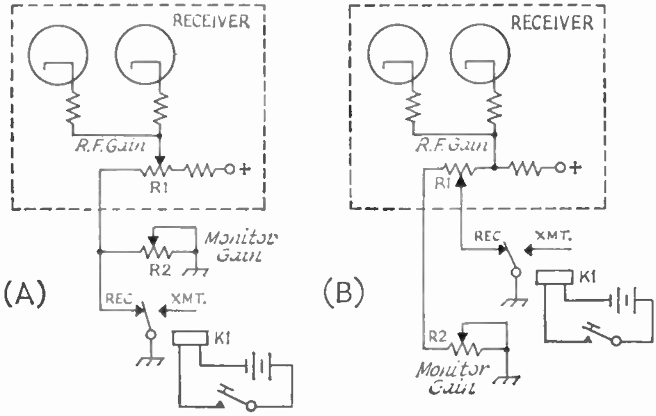


Fig. 6-14—Circuit for full break-in operation, before (A) and after (B) modification for improved monitoring. R_1 is the receiver manual gain control, and R_2 is a 5000- or 10,000-ohm wire-wound control. K_1 is a s.p.d.t. keying relay.

IMPROVED BREAK-IN MONITORING

Fig. 6-14A is an abbreviated version of the circuit for full break-in operation shown on page 239 of the 1967 *Handbook*. If you inspect this circuit carefully, you will see that any change in the setting of the receiver gain control will also affect the monitor gain when the key is down. This can be distracting. When a strong station is tuned in, the receiver gain control will normally be turned down, causing a loss in monitor gain. The opposite also holds true: when a weak signal is being copied, the receiver gain will be increased, causing an equivalent rise in the strength of the monitored signal. If the circuit is modified as shown in Fig. 6-14B, the gain of the monitor will remain the same under all settings of the receiver gain control, a condition conducive to much more pleasant operation. Note, however, that the wires going to the two outer terminals of the receiver gain control must be reversed or the control will work backward.—*K. J. Walton, W5MCI*

M.C.W. WITH A CODE-PRACTICE OSCILLATOR AND A THROAT MIKE

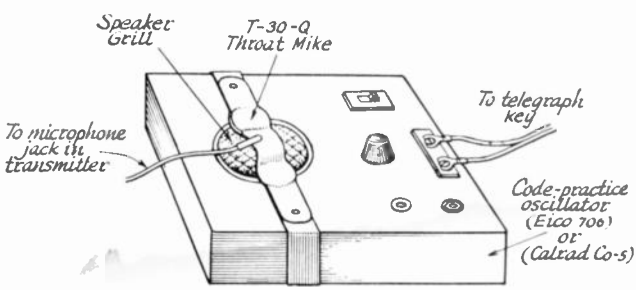
One convenient device that can be used with a phone rig to obtain m.c.w., provided the transmitter uses a carbon-button mike, consists of a transistorized code-practice oscillator with a throat microphone wrapped around it. I use two such gadgets with a pair of 420-MHz. modulated-oscillator transmitters. Each transmitter is combined with a superregenerative receiver in a hand-held transceiver.

The m.c.w. apparatus is shown in Fig. 6-15. The code-practice oscillator has a speaker and is battery powered. Two suitable oscillators are the Eico 706 and the Calrad CO-5. The throat microphone is a war surplus T-30-Q with two carbon elements that are designed to rest on the user's neck near the Adam's apple. Since the microphone cable was rather short, I extended it by adding a three-foot length of audio cable. I soldered one end of the audio cable to a Switchcraft JJ-048 extension jack to accomodate the PL-291 plug on the microphone cable. I connected the other end of the audio cable to a Cinch-Jones P-304-CCT plug to match the microphone-input fitting on my transceiver.

To make the m.c.w. apparatus, tighten the microphone belt so that the throat mike will fit snugly when attached to the code-practice oscillator. Then slip the T-30-Q over the oscillator, letting the carbon elements rest on the speaker grille or the edge of the grille and the case, whichever location permits a louder tone to reach the throat microphone. The installation is completed by attaching the microphone connector to the transmitter, and a telegraph key to the oscillator.

If by chance, the device described above overmodulates your transmitter, the carbon elements may be placed elsewhere on the code-practice oscillator case, so that the tone reaching them will not be quite so intense. A layer or two of cloth, placed between the oscillator case and the carbon elements, may be helpful.—*William C. Bakewell, WB6GHB/6*

Fig. 6-15—WB6GBH's system for m.c.w. operation of his modulated-oscillator transmitter.



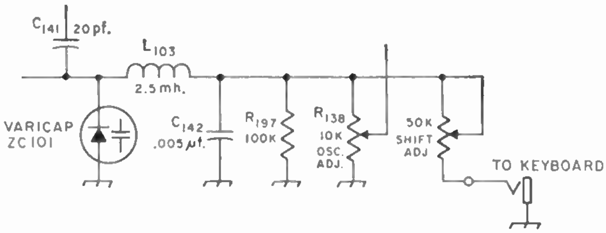


Fig. 6-16—The addition of a 50,000-ohm potentiometer and a phone jack converts the HX-50 to f.s.k.

F.S.K. FOR THE HX-50

Frequency shift keying can be obtained with the Hammarlund HX-50 by varying the bias on the Varicap used to shift the v.f.o. frequency in the u.s.b. position. As shown in Fig. 6-16, all that is needed is a 50,000-ohm potentiometer and a phone jack. This circuit works well if the keyboard contacts are kept clean. The keying comes up right (isn't inverted) on all bands.—*Jim Wilson, WA5BRB*

TELETYPE-PRINTER NOISE REDUCTION

A problem in revamping an old teletype printer for amateur use occurs in reducing the r.f. noise generated by the d.c. motor and governor. Usually most, if not all, of the noise is generated by the governor, which rapidly interrupts the motor circuit. Bypassing and shielding normally does not entirely eradicate this noise. If one does not wish to spend money on an expensive synchronous motor, there is an effective alternative solution using a power transistor. A unit such as the Texas Instruments TI3031 or any similar transistor can be used in the circuit shown in Fig. 6-17. As long as the maximum collector-current and emitter-to-collector voltage ratings are at least 3 amperes and 50 volts respectively, the transistor should be suitable in this application. Be sure to disconnect the other wires from the governor contacts and to mount the transistor on a heat sink.—*Randolph B. Gold, WA8NNR*

(Basically the circuit is effective in reducing noise because the transistor does the heavy switching rather than the governor contacts. As the contacts open and close, they interrupt only the small base current flow of the transistor, causing little arcing. In an unmodified circuit, they would break amperes of current, resulting in much noise. When the governor contacts are closed, the transistor is forward biased and almost all the motor current passes through the transistor. When the contacts are opened, the transistor is unbiased and most of the motor current flows through and is limited by the 200-ohm resistor.—*Editor.*)

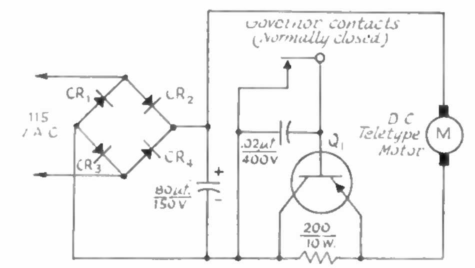


Fig. 6-17—WA8NNR's system to reduce the r.f. noise generated by the governor contacts of a d.c. motor. CR_1, CR_2, CR_3, CR_4—200 p.i.v. 2-ampere silicon. Q_1—Texas Instruments TI3031 or equivalent.

THE CWX CONTROL

I believe that the addition of one silicon diode to W4VQK's CWX control system described in the February, 1966 issue of *QST* will speed up the pickup time of K_2 considerably. As the original circuit stands, K_2 will not come up until contacts K_{1A} close. This delays the turning on of the high-voltage supply, and the operation of the antenna relay.

By adding the diode, as shown in Fig. 6-18, K_2 will be energized simultaneously with K_1. This should reduce the possibility of a missed first dot that W4VQK mentions.

When the diode is used, the contacts K_{1A} are no longer needed to switch V_{1B}, and may be used for some other purpose, if desired.—*Dennis P. Bryan, W2AJW*

(Actually, most of the delay is introduced by the interlock system described in the original article. Thus the improvement brought about by use of the diode may not be too significant. However, the diode does eliminate the need for a two-pole relay.—*Editor.*)

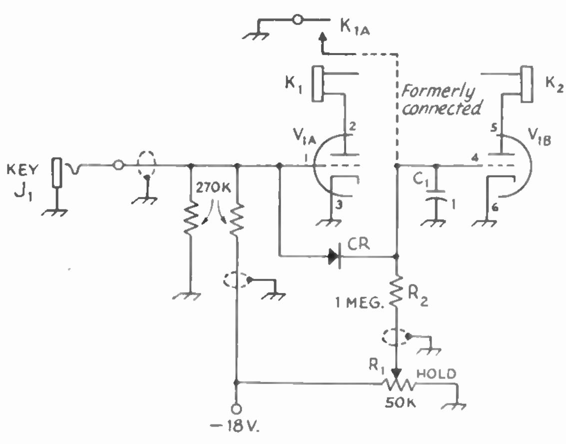


Fig. 6-18—Operation of the CWX control unit was improved by removing the original connection between K_{1A} and pin 4 of V_{1B} and inserting a silicon diode, CR, between pin 1 of V_{1A} and pin 4 of V_{1B}. CR should have a high back resistance (e.g. 1N659A).

RTTY RIBBON REJUVENATION

WHEN the ink in the ribbon becomes dry and can't transfer to the paper, I found that a few drops of glycerin will give the ribbon "new life." Leave the ribbon on the spool and apply the glycerin to the exposed surfaces of the ribbon. Wrap the spool and ribbon tightly in aluminum foil and put it in a warm spot until the glycerin permeates the ribbon. *John L. Kemp, WB6KML*

A HEAVY KEY BASE

A LEAD base will help to keep a brasspounder's key from sliding around the operating table. Find an empty sardine can large enough to contain the key and fill the can with lead (obtainable from fish-line sinkers). Use a kitchen stove to melt the lead. When the lead has hardened remove it from the can. Glue a piece of felt or inner-tube rubber to the bottom of the newly formed base and mount the key on the top side. The key won't walk around so much anymore.—*Roger White, WN2SIJ*

KEEPING THE LOG BOOK FLAT

TO keep my log book from becoming curled up and dog-eared, I cut off the bottom corners of an envelope and slip them over the top few pages of the log book (Fig. 6-19).—*Walter A. Hotz, K6LG*

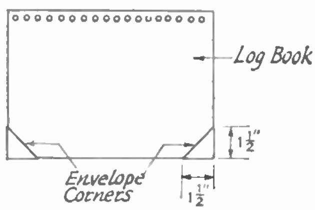


Fig. 6-19—Envelope corners protecting a log book from becoming dog-eared.

HOMEBREW KEYER WEIGHT

AFTER losing the weight from my semiautomatic key, I found that a large ceramic standoff insulator made a suitable substitute (Fig. 6-20). The new weight is fastened to the arm of the key with a large washer and an appropriate machine screw. A metal "wing," soldered to the screw head, makes for ease in repositioning the weight.—*Jim Brenner, WA6NEV*

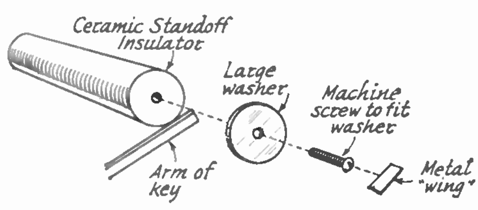


Fig. 6-20—Ceramic standoff key weight.

CODE-SPEED NOMOGRAPH

IT'S easy to determine one's code speed at a moment's glance by using the nomograph shown in Fig. 6-21. Just place a ruler over the nomograph, with the left end of the ruler over the number of seconds required to transmit or copy the selected passage and the right end of the ruler over the number of characters in the text. The code speed is read directly from the intersection of the ruler and the middle scale. —*Lemuel D. Wright, WB2UYF*

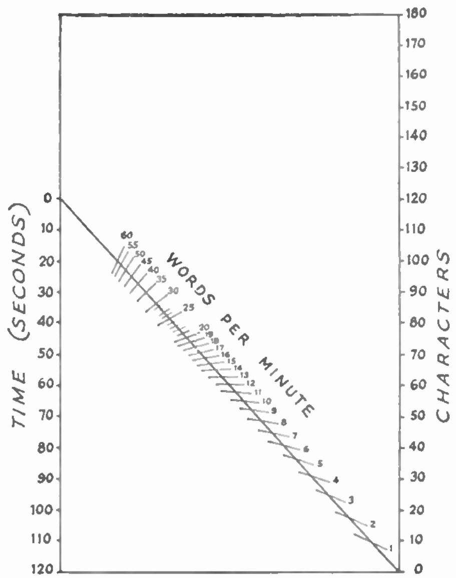


Fig. 6-21—Nomograph for determining code speed.

"STARTER" RTTY CONVERTER

THE "Starter" RTTY demodulator described by W1KLK in *QST* for March 1965 is a simple unit for beginners. The performance of this converter is improved by using a selective audio filter immediately preceding the input transformer, T_1. The FL-8 range filter is ideal for this application and is quite inexpensive when purchased on the surplus market. Also, the sensitivity of the demodulator can be improved by using a different transformer for T_1, one with a higher turns ratio. I suggest a transformer with a 3-ohm primary and 30,000-ohm secondary will allow the operation of the unit without turning the audio gain on the receiver "way up."—*Don Cutright, W5FLY*

TEN-MINUTE TIMER

A TEN-MINUTE timer for s.s.b. operators can be constructed quite easily from an old GE or Telechron electric clock. The time-set knob on the rear of the clock makes one revolution every ten minutes. I soldered a small angle bracket to the knob and bolted a short length of insulation to the bracket, as shown in Fig.

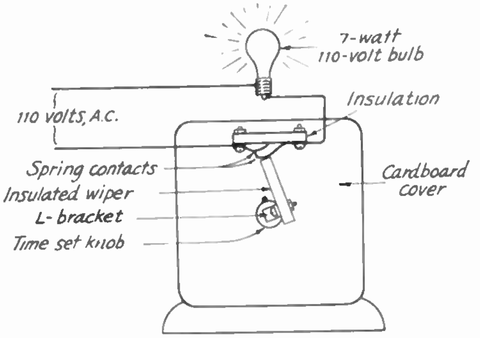


Fig. 6-22—WØRIS's ten minute timer built on the back of an old electric clock. The system is made possible because the time set knob makes one revolution every ten minutes.

6-22. The insulation acts as the wiper arm for contacts that are mounted near the top of the back of the clock. These contacts are wired in series with a 7-watt 110-volt bulb and the a.c. line. Although I use a light to remind me of the ten-minute interval, a buzzer or some other audio indicator could be used. I tried a micro-switch for the contacts, but found that the switch worked too hard for the clock to power, so instead I used two pieces of light springy metal and some insulation from the junk box.

I position the face of the clock toward the wall, not being concerned about time other than ten-minute intervals, and find the timer easy to set at the beginning of each QSO. Once started, the timer lights the bulb every ten minutes and we all stay within the FCC regulations.—*Verlin Karli, WØRIS*

FULL BREAK-IN STATION CONTROL

Fig. 6-23 illustrates the simple full break-in system used at WA8NQC. The ground end of the manual gain control, R_1, is disconnected and an additional potentiometer, R_2, wired as shown. R_2 is adjusted to provide additional bias to the gain controlled stages of the receiver to prevent their overloading during key-down conditions. Gain is returned to normal when the key is up. Since K_1 doesn't handle any r.f. power, it can be any light-duty relay with fast enough action to follow the keying.—*Jim Denby, WA8NQC*

RELAY DRIVER FOR SOLID-STATE KEYERS

Some of today's transistorized electronic keyers will not operate with certain transmitters because of the limitations of the switching transistor in the final stage of the keyer. In many cases, voltages above 100 volts and currents greater than 30 to 40 ma. will damage the switching transistor.

One solution (Fig. 6-24) to this problem is the addition of a one-tube circuit to actuate a keying relay. The relay contacts then key the transmitter. In the normal state, V_1 is cut off by the negative voltage from the power supply and the tube does not conduct, leaving the keying circuit open. When the electronic keyer circuit closes, the grid of V_1 is at zero volts and the tube conducts, energizing the relay and closing the keying circuit of the transmitter.

The keyer was built on a homemade chassis, but any chassis about 4 × 6 × 2 inches will do. A smaller chassis could be used if power for the circuit is obtained from the transmitter. The wiring and layout are not critical. To keep down the noise, the relay should be mounted on rubber grommets or similar cushioning material.

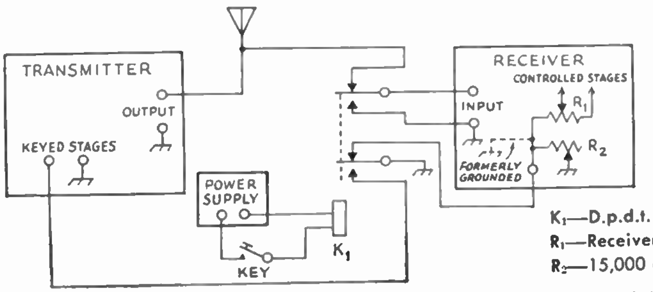
Although other relays will work in the circuit, the one specified is designed for high-speed operation. Most ordinary relays will cause keying problems at high speeds because of contact bounce. The relay used here will have no problem following speeds of at least 40 to 50 w.p.m.

With the addition of three parts, the relay driver can be used to key a transmitter from a tape recorder or other audio source. For contest work, a CQ tape could be made up and a switch would select either the electronic keyer or the tape recorder with the CQ tape.

The circuit (Fig. 6-25) uses the audio voltage from the output of a tape recorder, which is stepped up by T_2 and rectified. The d.c. voltage is then fed to the input of the relay driver and overrides the negative voltage at the grid of the tube.

Parts layout is not critical. The adapter may be put on the same chassis as the relay driver or a 2¾ × 2⅛ × 1⅝-inch Minibox may be used.

To operate, the tape recorder is connected to TB_1 and the output (TB_1) is connected to TB_1 of the relay driver. The volume control of the



K_1—D.p.d.t. keying relay.
R_1—Receiver gain control.
R_2—15,000 or 25,000-ohm potentiometer.

Fig. 6-23—Full break-in station control used at WA8NQC.

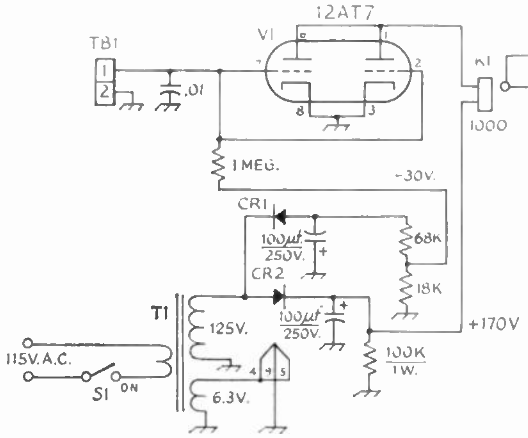


Fig. 6-24—Circuit of the relay driver. Except as indicated, resistors are ½ watt; capacitors with polarity indicated are electrolytic.

CR_1, CR_2—400 p.r.v., 100 ma. or more.
K_1—1000-ohm relay, s.p.s.t. contacts (Sigma 41F 1000S-SIL).
S_1—S.p.s.t. toggle.
T_1—125 volts, 15 ma.; 6.3 volts, 0.6 amp. (Stancor PS-8415).
TB_1, TB_2—2-lug terminal strip (two Millen E-302 or one E-304).

tape recorder should be adjusted to provide enough audio to follow the keying.

Caution: This circuit is designed for use with only those keyers that are set up to switch a *negative* voltage, Heath HD-10, etc.—*Charles Utz, W1DEJ*

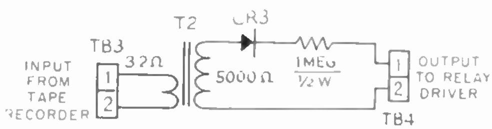


Fig. 6-25—Adapter for use with tape-recorded code.

CR_3—200 p.r.v., 100 ma. or more.
T_2—5000 to 3.2 ohm universal output trans.
TB_3, TB_4—Same as TB_1, Fig. 6-24.

KEY BASE

I use the bottom portion of an old electric flat-iron, smooth side up, as a base for my transmitting hand key. The heavy weight, plus three rubber feet attached to the base, give the combination "stay-put" stability, and it looks good, too!—*H. C. Nenstiehl, W2EAT*

BREAK-IN PLUS SIDETONE

The addition shown in Fig. 6-26 to the c.w. break-in muting system described in recent *Handbooks* provides a sidetone as an added feature. Key-down creates a positive voltage across R_1. This voltage is sufficient to trigger a simple neon-bulb oscillator whose output is fed to the first audio stage. Key-up shorts out R_1, which cuts off the sidetone and restores normal gain in the receiver. Varying R_1 changes the frequency of the oscillator, but not the volume. The receiver at W6ZGM is homemade, but the circuit should be adaptable to practically any receiver, with possible minor modifications in the values of R_1, R_2, R_3, and C_1. This circuit tends to swamp out transient clicks in the receiver caused by breaking the voltage across R_1.—*Donald F. Meadows, W6ZGM*

KEY SPRING

Lose the spring from your J-38 key? The springs in most FT-243 or CR-1 surplus crystal holders will make a good replacement.—*Everett G. Taylor, K7YSE*

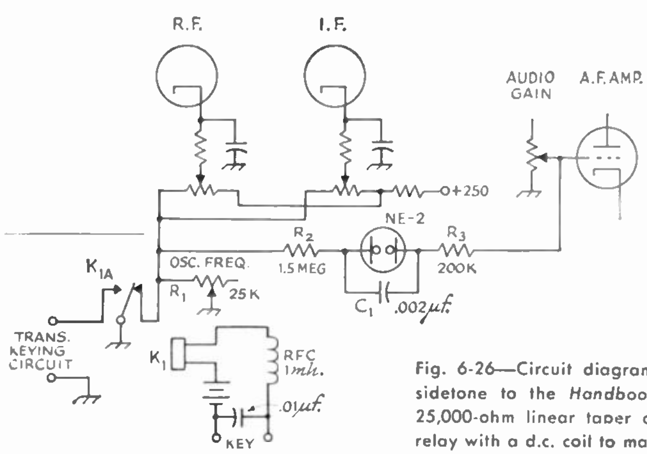


Fig. 6-26—Circuit diagram of the changes to add a sidetone to the *Handbook* break-in circuit. R_1 is a 25,000-ohm linear taper control, and K_1 is a keying relay with a d.c. coil to match the battery voltage used (Sigma 41FZ-35-ACS-SIL or equivalent).

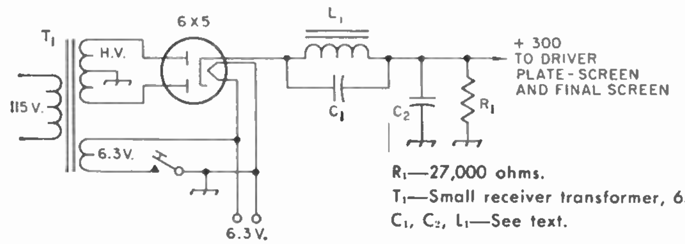


Fig. 6-27—A relayless screen-grid keying circuit, using primary-keying and resonant-filter principles.

RELAYLESS SCREEN-GRID KEYING CIRCUIT

The screen-grid keying circuit shown in Fig. 6-27 eliminates the relay usually associated with keying a 300-volt circuit. The old principle of transformer primary keying is used, but at a safe 6.3-volt level. L_1 and C_1 resonate at 120 Hertz. I grabbed an old choke out of the junk box, metered the output (without C_2) for a minimum a.c. reading, and came up with something like 0.087 μf. for C_1. Then you use the minimum possible amount of C_2 to wash out the 240- and 480-Hertz components. I found 0.5 μf. about optimum for a 50-ma. load; less drain would require less capacitance.

If the waste of the unused 115-volt winding bothers you, it can always be used to light an "ON THE AIR" sign!—*Rod Newkirk, W9BRD*

HEATH SB-400

Owners of the Heath SB-400 who want full break-in without keying the VOX relay can make this simple modification. Remove the yellow lead from Pin 3 of MS1F. Install a 14,000-ohm resistor from Pin 5 of V12 to Pin C of MS1F. When the transmitter is put in the c.w. position the VOX relay will close and stay closed, but will act normally when using s.s.b. It will be necessary to use a separate antenna when operating c.w.—*W1BGD*

O-T SPECIAL

Old-timers who long for the music of a Morse sounder will find the circuit in Fig. 6-28 of interest. The 6SN7 functions as a diode rectifier and clamp tube to give a voltage rise across the VR tube when an audio signal is applied. The VR tube conducts, activating K_1, which keys the sounder. R_2 should be adjusted for best operation of the relay. (Those who do not wish to go inside their receivers may use an output transformer with the low-impedance side connected to the receiver terminals, and the high-impedance side substituted for R_1.—*Editor.*)—*Jack Proefrock, K6QEQ*

R.F. TRIGGERED KEYING MONITOR

Perhaps the most convenient c.w. monitor is the audio-oscillator type turned on by r.f. voltage picked up from the final amplifier of the transmitter. The unit to be described uses this principle, and includes improvements not heretofore utilized.

Referring to the circuit diagram of Fig. 6-29, it will be noted that the oscillator is of the multivibrator type. This circuit was chosen over others because, in the experience of the author, the characteristic note is particularly suitable for monitoring. The variable resistance R_1 has been included as a part of the resistance in the base circuit of Q_1 so that the pitch of the oscillator may be changed to suit the individual operator.

Following the oscillator is a conventional audio amplifier. This amplifier has been included to bring the speaker output up to adequate level. The output transformer is a Japanese import having an impedance ratio of 2,000/3.2 ohms. The primary impedance value is not critical and other values in this general range will be found satisfactory. The value of the resistor

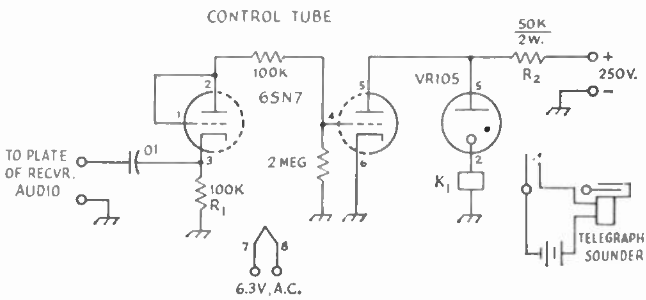


Fig. 6-28—Circuit diagram of the adapter for telegraph sounders.

K1—S.p.s.t. relay, 10,000-ohm coil. R1, R2—Composition resistors.

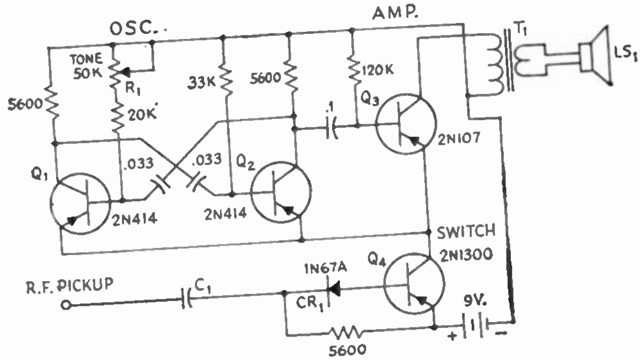


Fig. 6-29—Circuit of the r.f.-triggered c.w. keying monitor. Capacitances are in µf.; resistances are in ohms (K = 1000). Capacitors are paper or Mylar; fixed resistors are ½ watt. C_1 is a "gimmick" capacitor (see text). LS_1 is a small speaker with 3.2-ohm voice coil. T_1 is a small output transformer approximately 2000 ohms to voice coil. The battery is of the transistor-radio type. Other component designations in the diagram are for text-reference purposes.

in the base circuit of Q_3 has been chosen so that the total current drawn from the battery will be about 9 ma. when the monitor is triggered into operation. Other types of p-n-p. audio transistors are suitable for Q_3 and it is necessary only to change the value of the base resistor to suit.

The oscillator and the amplifier are powered by a 9-volt transistor-radio battery. However, lower voltage may be used, and the output volume may be decreased by this method.

The battery circuit is turned on and off by means of a switching-type transistor Q_4 whose base, in turn, is turned on and off by rectified r.f. picked up from the transmitter. Since only enough r.f. need be coupled out of the transmitter to provide base current for Q_4, very loose coupling to the transmitter may be used. This loose coupling is particularly desirable for reasons of safety if the r.f. is to be picked up in the proximity of high-voltage circuits. The coupling capacitor C_1 consists of two insulated No. 20 solid-conductor wires twisted together for approximately 1¼ inches. This capacitor should be included even if the transmitter is equipped with a monitor jack where r.f. may be picked up. In any case, coupling should never be tighter than that required to make the monitor function.

Although no conventional switch has been included in series with the battery, one will be required if the transmitter is to be used on phone. If c.w. only is used, no switch is required because the leakage through Q_4 will not significantly shorten the life of the battery.

The unit may be assembled on any suitable insulating material. Its layout is entirely noncritical and the circuit itself is not critical in any way. Caution in one respect is in order, however. The polarity of the diode must be correct; otherwise transistor Q_4 may be destroyed.—*Floyd A. Trueblood, K6ORS*

COMBINATION SELECTIVE AUDIO FILTER AND C.W. KEYING MONITOR

While s.s.b. transceivers are superb in the mode for which they were designed, many leave something to be desired for convenient c.w. operation. For example, a fixed bandwidth of 2 or 3 kHz. is often too wide for satisfactory c.w. reception amid QRM, and usually there is no provision for monitoring one's keying. The circuit described here is offered to solve these and several other problems which c.w. enthusiasts may encounter.

The handy thing about the device shown in Fig. 6-31 is that one simple circuit offers all the following functions and features:

1) *Selective audio filter:* The circuit has a passband of only a few hundred Hertz, greatly reducing interfering heterodynes.

2) *Keying monitor:* The unit provides a stable, clean tone which is heard over the same set of headphones used for the received c.w. signal.

3) *Code-practice oscillator:* Since the entire circuit is battery-powered, it is usable at any time as a portable oscillator.

4) *Features of convenience:* The unit and the transceiver are keyed simultaneously, without the need for a keying relay. The only connection to the transceiver is by means of the normal headphone jack, so that no internal modifications or wiring are necessary.

The circuit, shown in Fig. 6-30, is a transistor bridged-T audio oscillator through which the received c.w. signal is applied. This configuration operates on the principle of providing maximum selectivity just before the point of oscillation (regeneration). The filter bandwidth at the nose of the characteristic is less than 100 Hertz, but because of the wide shape factor, the bandwidth, for all practical purposes appears to be several hundred Hertz. In spite of this, the circuit offers a vast improvement over any fixed transceiver bandwidth.

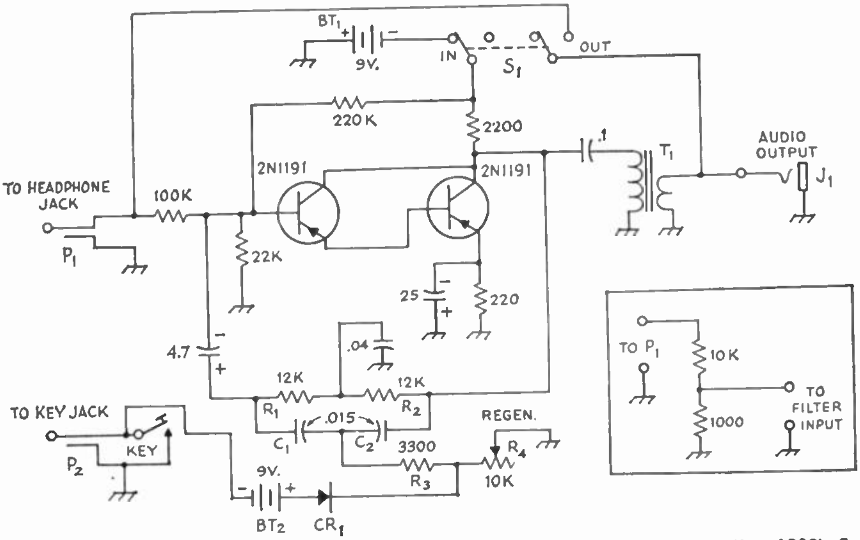


Fig. 6-30—Circuit of the filter/monitor. Capacitances are in µf.; resistances are in ohms (K = 1000). Capacitors are paper, except where polarity marking indicates electrolytic. Fixed resistors are ½-watt. Diagram component indicators not found below are for text-reference purposes. Inset shows circuit of optional input attenuator.

BT_1, BT_2—9-volt dry battery.

CR_1—Silicon diode, p.i.v. about 50 percent greater than transmitter negative blocking voltage, 10 ma. or more.

J_1—Open-circuit headphone jack.

P_1, P_2—Plugs to fit transceiver key and headphone jacks, or other appropriate connectors.

R_1—Linear-taper control.

S_1—D.p.d.t. toggle switch.

T_1—Output transformer, 8000 ohms to 3.2 ohms.

With the values specified in the bridged-T network, the center of the audio passband will be at approximately 800 Hertz, which provides a pleasing c.w. note for most ears. If another frequency is desired, the values need merely be changed. For example, increasing the values of C_1 and C_2 to 0.02 µf. and R_1 and R_2 to 15K will result in a center frequency of approximately 600 Hertz; values of 0.01 µf. and 10K will increase the center frequency to approximately 1 kHz. Several of these combinations were tried and no problems were encountered. As shown, the input circuit is satisfactory for use with the low-impedance output of the Drake TR-3. However, it has been found by Charlie, W7EAX, that a high-impedance receiver output, or an output of considerably more audio voltage, might require a voltage-divider arrangement, as shown in the inset in Fig. 6-30. The resistance values should not be critical.

The use of the device as a keying monitor is simple. As the transceiver is being keyed, the key contacts provide a ground path to short out R_1. With R_1 shorted out, the only resistance left from the junction of capacitors C_1 and C_2 to ground is that of R_3. This loss of resistance causes the circuit to break into oscillation. Diode CR_1 is used to isolate the transceiver negative grid-blocking voltage from the filter/monitor circuit. The sole purpose of battery BT_2 is to provide enough voltage across CR_1 to cause it to conduct to ground when the key is closed. The diode will not conduct in either direction with the key up, since there is too much resistance to ground through the transceiver. The current drain from BT_2 in the key-down condition, with normal adjustment of R_1, is only about 3 ma.

The point of maximum selectivity is found by adjusting R_1 (with key open) until the circuit breaks into oscillation, then backing off until oscillation just ceases. With the filter in use, the transceiver should be tuned until the

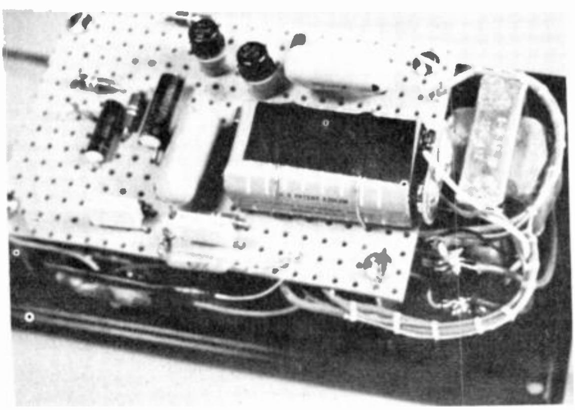


Fig. 6-31—This model of the filter/monitor built into a small molded instrument case. Most of the components of the unit are mounted on a perforated board spaced from the panel to clear panel controls. T_1, to the right, is mounted directly on the panel.

ignal peaks at the filter frequency. After a little practice in making this adjustment, the use of the in/out switch will demonstrate the merit of the filter. It will be found that many nearby signals will disappear completely with the filter in use. S_1 not only serves as an in/out switch, but also turns the unit off in the out position. Make sure that the filter circuit is connected to the key exactly as shown; that is, the battery lead connected to the hot, or ungrounded, side of the key. If connections are reversed, the monitor signal will be on at all times.—*Don R. Tyrrell, W7AZG/W9JTN and Alex K. Tinker, Jr., K7UXG*

"TATTOO" CONTROL FOR THE HT-37

I HAVE been operating an HT-37 for a year now, and upon reading an article by W6EVX in an earlier issue of *QST*, describing how he modified his HT-32 for an automatic changeover in c.w. operation,[1] I decided to try something similar in my rig. Operating c.w. becomes a real joy because you don't have to throw any switches—just start sending. Upon stopping, the relay will open and switch your antenna from transmitter to receiver.[2] The addition of push-to-talk control adds the last refinement.

The diagram of the control circuit is shown in Fig. 6-32. With the controls in the MOX and c.w. positions, and the added potentiometer, R_1, with its series-connected switch S_1 turned to the OFF position, the operation is unaltered from the original, the operating being controlled by manual standby-to-MOX switching. With R_1 turned to close the switch, R_1 provides a control of the length of relay hold-in. With the first light contact of the key or bug, the blocking bias on the grid of the relay tube V_{15B} (stored in the 0.22-μf. capacitor C_{85}) is discharged through the low forward resistance of diode V_{14A}, and the VOX relay immediately closes. When the key is opened, however, the 0.22-μf. capacitor must charge slowly through the high resistance of R_1 and R_2 until a blocking voltage for the relay tube V_{15B} is reached. The adjustment of the potentiometer provides proper "hold" so that the relay remains closed during average sending, but opens promptly when the operator stops sending. This hold adjustment is made after setting the VOX control, which has a unilateral interaction with it. The added hold control is disconnected in all but the c.w. position, however, and does not affect the VOX hold adjustment.

With this modification, closing the key, or the bug-shorting switch, grounds the VOX diode plate and disables the VOX circuit. This can be very useful when you may have a sudden outburst of noise, say, from your harmonics. Closing the key contacts disables the VOX circuit quickly, and push-to-talk can be used.

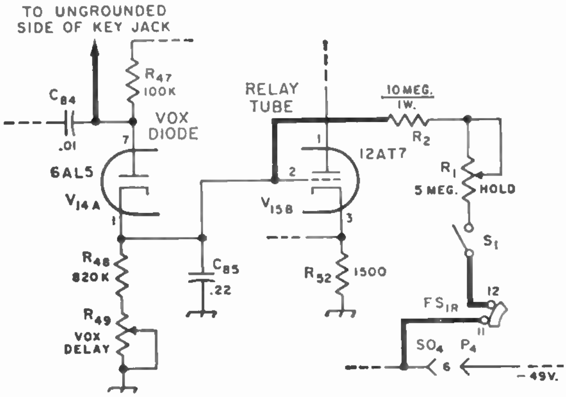


Fig. 6-32—Circuit modifications in the HT-37 for "Tattoo" operation. The heavy lines indicate added wiring. Dashed lines indicate connections to original wiring which is not disturbed. Original connections to FS_{1R}, Contacts 11 and 12, are removed and tied together before the new connections shown here are made. R_1 is a linear control with s.p.s.t. switch S_1 attached.

Mount a 5-megohm potentiometer, R_1, with switch, S_1, in the unused hole of the correct size in the rear of the chassis, between SO_7 and the coax output connector.

The main modification is done inside the sideband-generator subassembly shield. Remove this shield to gain access to the function switch.

I used the portion of FS_{1R} that connects Contacts 11 and 12 in c.w. only, without modification. This switch seems to be superfluous, since the key connected through it in c.w. only is connected through OS_{1R} in MOX only, and the key line to which it is connected is grounded through the VOX relay contacts, which are closed in MOX in all positions except c.w. anyway.

Remove the two wires on Contacts 11 and 12 of FS_{1R} and connect the wires together. This will free the contacts needed to connect the —49 volts. Run a wire from SO_4, Terminal 6, to one of the open switch contacts, 11 or 12. Now run a wire from the other open switch contact through the hole in the sideband shield to the 10-megohm fixed and the 5-megohm variable resistors. From the resistors, run a wire to Pin 2 of the relay tube, V_{15B}. The wiring is completed by making a connection between Pin 7 of the VOX diode, V_{14A}, and the ungrounded side of the key jack.

To add push-to-talk operation, all that is necessary is to substitute a two-prong microphone connector for the original one-prong unit. The second terminal of the two-prong unit is connected to Terminal 6 of P_3, the grounding of which will provide the push-to-talk operation.

After making the modifications, I have found c.w. operation much more enjoyable, and a high-quality push-to-talk microphone is used to its fullest extent.—*Fred M. Ruzick, WA8GQQ*

[1] Godwin, "Some Simple HT-32, Modifications," *QST*, February, 1960.
[2] Campbell, " 'Tattoo'—Automatic C.W. Transmitter Control," *QST*, August, 1956.

Hints and Kinks . . .

for V.H.F. Gear

NOTES ON THE KNIGHT-KIT TR-108

In the October *QST* write-up of the TR-108 transceiver, it is mentioned that the spotting signal is very weak. The low spot output is due, I believe, to some errors on pages 24 and 25 of the assembly manual. R_{55}, a 68-ohm resistor, is shown connected between pin 3 of V_8 and pin 1 of TS_{11}. The latter pin is eventually connected to the spot switch and the send-receive relay. However, part of this hookup does not agree with that shown on the schematic diagram.

Referring to Fig. 7-1, remove one end of R_{55} from pin 1 of TS_{11}, and connect this lead to ground lug C or D of V_8. TS_{11} and the orange wire going from it to pin 1 of TS_4 can be removed or left intact; they serve no useful purpose. As a result of this modification you should have a spotting signal of more than adequate output.

An improvement can be made to the TR-108 receiver by regulating the plate voltage of the tunable oscillator, V_{1B}. As shown in Fig. 7-2, connect a Zener between the plate of the tube and chassis ground and change R_7 to a 2-watt unit. Prior to this modification, during mobile operation my receiver drifted whenever the battery voltage changed.—*Frank Morrisino, K1LMY*

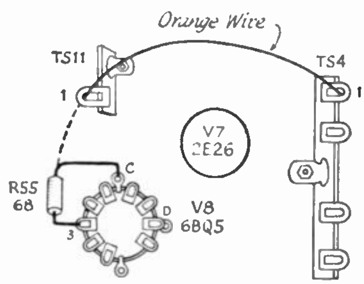


Fig. 7-1—Sketch showing part of the underside of the TR-108. Spotting in the transceiver is greatly improved by disconnecting one side of R_{55} from TS_{11} and returning the lead to ground lug C or D of V_8.

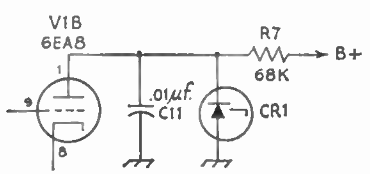


Fig. 7-2—Circuit for regulating the tunable oscillator plate voltage in the TR-108. C_{11}, R_7 and V_1 are original parts. CR_1 is a 67-volt, 1-watt Zener (Sarkes Tarzian VR67).

ANOTHER METHOD OF COPYING C.W. WITH A V.H.F. RECEIVER LACKING A B.F.O.

In the August 1967 "Hints & Kinks" column of *QST*, W1HDQ described a method of receiving c.w. and s.s.b. on a v.h.f. transceiver that didn't have a b.f.o. By using the v.f.o. in the spot position and beating the output of the v.f.o. with the incoming signal, one could receive these two modes. However, some v.h.f. operators do not have a v.f.o. In that case, the following method might appeal to them.

If the v.h.f. transceiver has a squelch circuit, the circuit can be used as a substitute for a b.f.o. To receive a c.w. signal, turn the squelch control to a position where the receiver is muted. Then, with the receiver tuned to the signal, back off the control to a spot where the signal breaks the squelch when the signal is keyed. Although there is no audio note, the background hiss that is evident during key-down will contrast with the quietness of the receiver during key-up. This method works well with a rig, such as the Gonset Communicator, that has a fast attack, fast release squelch circuit.—*Thomas W. Bridges, K6DLY*

COPYING C.W. AND S.S.B. WITH A V.H.F. RECEIVER LACKING A B.F.O.

Users of the many simple a.m. transceivers for 50 and 144 MHz., miss out on much of the v.h.f. fun because their equipment is unsuitable for copying c.w. and s.s.b. Manufacturers of those rigs have a point in their contention that enough stability to do a good receiving job on these modes is impractical in a moderately-priced unit. If you've tried putting a conventional b.f.o. into one of these units, you've already found this out, but there are ways to do the job.

One of the best methods is to inject a signal at the frequency of the c.w. or s.s.b. station. If you have a good v.f.o. with a spotting switch you have a usable system. If there is a "spotting level" control you really have it made, as optimum reception does require that the level of injection be set with some care, and the injection may need to be varied somewhat for different signal levels. It should be no great problem to rig up some method of controlling the injection level to the receiver.

The prime advantage of signal-frequency injection using a v.f.o. harmonic is that it eliminates the stability of the receiver as a factor in beat-note reception. If the signal is stable, and the v.f.o. has a good slow tuning rate, you can

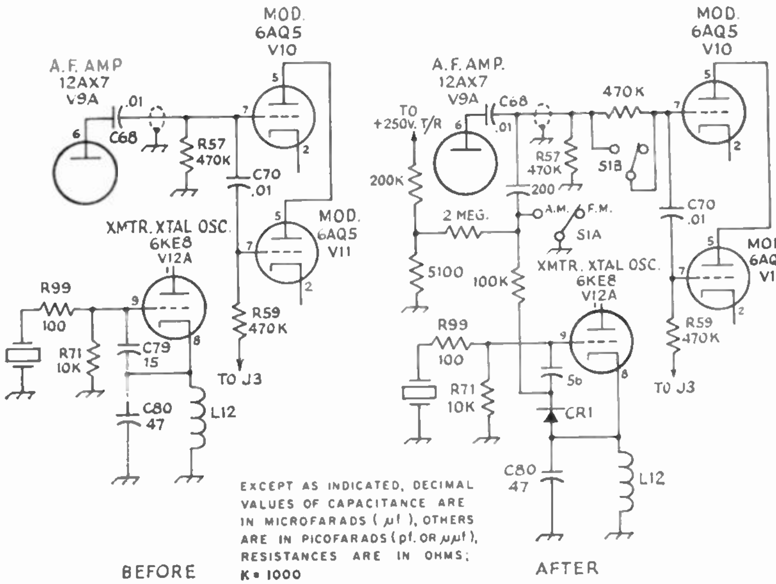


Fig. 7-3—Modifications to the Clegg 22'er for f.m. operation. With the exception of CR_1, a 1N2071 or 1N3182 diode, and S_1, a d.p.d.t. toggle or slide switch, components with designators are original parts. Resistors are ½-watt composition, and capacitors are disk ceramic.

zero-beat the signal easily and get quite good sideband or c.w. reception, even with considerable oscillator instability in the receiver. Using a v.f.o. in this way may give you a better chance of working "cross-mode" with the s.s.b. fraternity on 6 or 2, but don't use it for voice transmission when the station you're listening to is below 50.1 MHz.!—*W1HDQ*

F.M. FOR THE CLEGG 22'ER

Adding f.m. operation to the Clegg 22'er is very easy. Fig. 7-3 shows how the transceiver is modified to permit frequency modulation of the transmitter crystal oscillator. Instant selection of a.m. or f.m. can be achieved by installing a slide or toggle switch under the accessory control jack, J_2, on the rear of the 22'er. No changes to the receiver are necessary to copy f.m. signals: slope detection can be accomplished by careful tuning.—*Dave Porter, K2BPP*

STABILIZING THE THREE-BAND 4CX250 AMPLIFIER

The 4CX250A amplifier for 144, 220 and 432 MHz., originally described in *QST* for February 1957 and now appearing in *The Radio Amateur's V.H.F. Manual*, has been built by many v.h.f. enthusiasts and used in all classes of service. The original served its builder, W1VLH, and W1DXE for several years as a 2-meter a.m. linear, and it has been used at W1HDQ on all three bands. Though this unit operates stably without neutralization, some builders have experienced oscillation trouble when attempting to operate similar amplifiers as AB_1 linears. In a recent OVS report, Bob Reif, K9AQP/1, Acton, Mass., tells how he cleared up the instability in his amplifier.

"When I converted my 4CX250 amplifier to linear service, after using it for a long time in Class C, it oscillated. The nature of the two-band grid circuit made neutralization a special problem, as it was not immediately obvious where an out-of-phase r.f. voltage could be taken off. I drilled a small hole next to the grid line's bypass capacitor, C_3, and soldered a piece of stiff wire to the capacitor lead. I brought the wire up into the plate compartment and bent it so that it runs parallel to the plate line, L_3, for about 1 inch at a distance of ½ inch below the line."

The length of the wire and its nearness to the line depend on the value of C_3. If 1000 pf. is used at C_3, the neutralizing capacitance will be about twice that required with a bypass capacitor of 500 pf., since this is, in effect, a capacitive-bridge system. The wire's position should be adjusted or its length trimmed for minimum r.f. feed-through, using a 50-ohm dummy load on the amplifier and applying drive, but no plate or screen voltage.—*W1HDQ*

U.H.F. TUNED LINES WITH PISTON TRIMMERS

The 432-MHz. preamplifier by W1HDQ in *QST* for February, 1966, pages 36 and 37, uses tuned lines with piston trimmers. The lines in this instance are ¼-inch copper tubing, drilled out to fit over the ends of the trimmers. A impler arrangement is possible if you have ,-inch thinwall brass tubing, as this material lides over the end of the piston trimmer with- ut drilling.

Some piston trimmers have the metal sleeve xtending down close to the chassis, in which ase the full range of capacitance variation rings the screw very close to the point where he trimmer will fall off. This condition can be orrected by filing or grinding away part of the netal sleeve at the mounting end. The mini- num capacitance is thus lowered markedly, nd the danger of the trimmer coming apart is educed. This corrective step is most needed vith the higher-capacitance trimmers, as the maller values already have an appreciable ength of ceramic below the metal sleeve.—*'rank Greene, K5IQL*

'INAL TUNING KNOB FOR THE IEATH "SIXER"

THE final-amplifier tuning capacitor in the Heath Twoer and Sixer happens to be a eramic trimmer not normally accessible from he outside of the cabinet. In order to dip the nal, one of two methods is usually used to each the trimmer; either the unit is removed rom the case or a screwdriver is inserted in a ole drilled in the side of the cabinet. However, his is not always so easily done, especially if ne is working mobile. The author solved this roblem by making a built-in self-retracting nob which is always handy, but which is not n the way during removal of the unit from the ase. As shown in Fig. 7-4, the knob is not astened to the trimmer and thus will not put ny strain on the capacitor or its associated viring.

Begin the modification by drilling a ½-inch liameter hole in the case directly in line with he trimmer adjusting slot. Make a 1-inch square late from 16 gauge aluminum stock and drill n 11/64-inch hole in the center of the square. Drill two ⅛-inch holes in the plate for mount- ng the plate to the case. These holes should e a little bit on the sloppy side for the screws hat will be inserted in them, since the trimmer does not always return to the exact same spot each time the unit is put back in the cabinet. I used screws from an old Command receiver to fasten the plate to the case. Drill two holes in the cabinet to mate with the mounting holes on the plate, being careful to make the holes small enough to allow the screws to self-tap.

Chuck ¼ inch of a 1¼-inch length of ¼-inch diameter bakelite rod in an electric drill. Use a file to turn down the diameter of the remaining 1-inch length of rod to 5/32 inch. File a screw- driver bit on the face of the ¼-inch diameter portion, as shown in Fig. 7-4. Mount the plate on the case and insert the bakelite rod through the plate. Slip a 5/32-inch i.d. washer over the shaft, along with a small ⅜-inch long coil spring and a suitable knob, such as the antenna trim- mer knob from a Command receiver. Make sure there is enough compression on the spring to keep the rod retracted. After all the parts are assembled and the unit is installed in the cabi- net, it is only necessary to push in the knob and rotate it until the shaft bit engages the slot of the trimmer.—*Frank M. Wing, W4TUO*

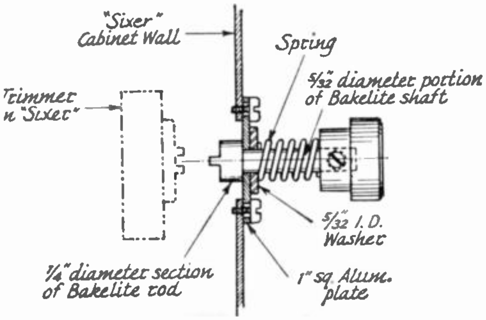


Fig. 7-4—Details for assembling a final-amplifier tun- ing control for a Heath Sixer or Twoer.

STRENGTHENING FEEDTHROUGH CAPACITORS

MOST v.h.f. feedthrough capacitors are easily damaged if bumped or subjected to undue strain. By coating the ceramic part of the unit with epoxy cement at each side of the mounting flange as shown in Fig. 7-5, the fragile portion of the capacitor body is reinforced. Drying time takes about 24 hours.—*W1CER*

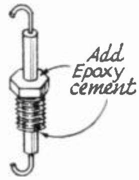


Fig. 7-5—W1CER's method for strengthening feed- through capacitors.

IMPROVING OUTPUT FROM DIODE MULTIPLIERS

A DIODE multiplier can be made to produce considerably more harmonic output if it is biased, as shown in Fig. 7-6. This is particularly effective when the order of frequency multipli- cation required is high, as it frequently is in converters for 220 MHz. and higher bands. For example, the 220-MHz. converter in the *Hand- book* requires quadrupling from 51.5 to 206 MHz.

Particular attention should be paid to the by- pass capacitor C_1; preferably it should be a button mica, standoff or feedthrough ceramic type. The tuned circuit LC should have

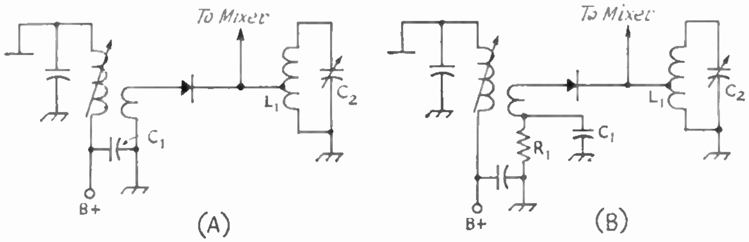


Fig. 7-6—(A) Typical diode multiplier circuit. (B) Modified multiplier circuit for increased harmonic output.
C_1—Button mica, standoff or feedthrough ceramic.
L_1C_2—Tuned circuit, set to desired harmonic.
R_1—Bias resistor, value determined experimentally.

high Q at the desired frequency to discriminate against unwanted multiples of the driving frequency as much as possible.—*Frank Greene, K5IQL*

(Several factors determine whether biasing a multiplier diode will increase the level of a particular harmonic. Important considerations include the amount of drive available, the value of the bias resistor, the order of frequency multiplication, the type of mixer and the method of mixer injection. The usefulness of diode multiplier bias in any circuit is best determined empirically.—*Editor.*)

QUICKIE ANTENNA FOR 2 METERS

A LOW-COST 2-meter mobile antenna can be made from a Millen 37001 high-voltage connector and a 19-inch length of small-diameter brass rod, such as brass welding rod, as shown in Fig. 7-7. Once the whip has been soldered to the male connector, epoxy cement can be used to fill the top of the cap, making the unit quite rugged. The antenna can be mounted any place on the car and will be weatherproof as long as a rubber gasket is placed between the Millen fitting and the car body. This scheme is particularly useful for center-roof installations. Brass screws are recommended for securing the mount so that rust will not form. When desired, the antenna can be unscrewed from its mount and stored inside the car.—*W1CER*

POWER FEED FOR ANTENNA-MOUNTED PREAMPLIFIER

AN r.f. amplifier mounted at the antenna is a low-cost way to beat the line-loss problem in u.h.f. reception. Since the overall system noise figure is determined almost entirely by the first r.f. stage, putting this amplifier at the antenna permits use of ordinary coaxial line for the run between the station and the antenna. This is particularly effective for crossband work, as with Oscar IV, where no switching from transmit to receive is required.

Pete Radcliffe, VE8BY, solved the problem of feeding voltage up to such an amplifier in a simple manner in his Oscar IV monitoring system. He connected a coaxial T fitting at the station end of the coax, and fed the d.c. for the preamplifier into one end of the fitting through an r.f. choke. The collector circuit of his antenna preamplifier is capacitively coupled to the output terminal. Therefore, the d.c. for the amplifier is taken off through another r.f. choke, connected to the inner conductor of the coaxial fitting.

Much of the time since this preamplifier was installed, the temperature at Yellowknife, N.W.T., was between 40 and 50 dgrees below zero, which put Pete's 2N3399 transistor out of business, but on "warmer" days the antenna-mounted preamp helped markedly in reception of Oscar IV.—*W1HDQ*

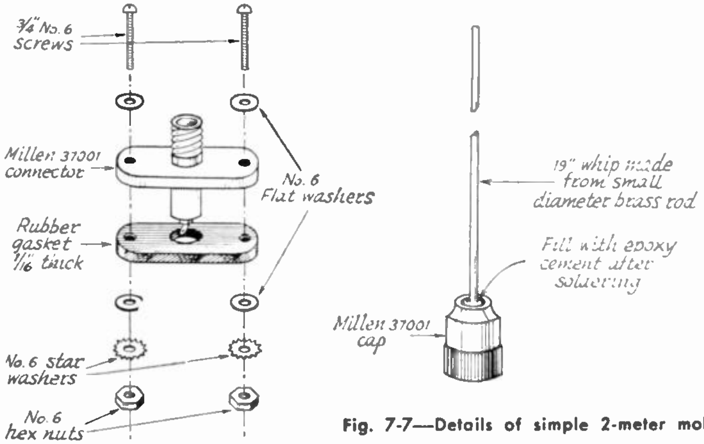


Fig. 7-7—Details of simple 2-meter mobile antenna.

IMPROVED C.W. WITH THE "TWO-BAND V.H.F. STATION"

A simple change can be made in the power supply and control unit of the "Two-Band Station for the V.H.F. Beginner" (July through October, 1961, *QST* and *The Radio Amateur's V.H.F. Manual*) to increase the output of the transmitter when c.w. is used. The "monitor" switch, S_3, was removed, and in its place a d.p.d.t. toggle switch was mounted. One side of this switch is used to short out the secondary of the modulation transformer, T_1. The other opens the screen lead of the 6L6G modulator, cutting off the plate current to that tube. The first switch section protects the modulation transformer during keying, and the second, by removing the drain of the 6L6G, raises the plate voltage available for the r.f. portion of the transmitter. A helpful increase in transmitted power results.—*Martin J. Feeney, Jr., K1OYB*

USING 8-MHZ. CRYSTALS WITH THE SR-42 AND SR-46

Because an overtone oscillator is used in the Hallicrafters SR-42 and SR-46 transceivers, 8-MHz. fundamental crystals will not perform satisfactorily in these units. The transmitter output frequency will not be an exact multiple of the crystal frequency because of the oscillator's overtone mode. Furthermore, most 8-MHz. crystals do not permit the oscillator to deliver sufficient power output to properly excite the next stage in the Hallicrafters units. The manufacturer recommends the use of 24- to 25-MHz. overtone crystals. Although TVI reduction is the purpose behind this scheme, the 24-MHz. crystals are somewhat more expensive than the 8-MHz. war-surplus species. Many v.h.f. operators have an existing supply of 8-MHz. "rocks" and would like to be able to use them.

A practical solution to this problem can be achieved by the use of an outboard oscillator assembly (Fig. 7-8) connected to the transceiver's power supply through the v.f.o. accessory socket at the rear of the transceiver chassis. The 24-MHz. output of the outboard unit is fed to the transceiver through the v.f.o. socket. The outboard oscillator, a grid-plate type, triples in the plate circuit, producing r.f. output energy in the 24- to 25-MHz. range. Because of the accessory socket wiring, "spotting" is made possible with the outboard unit in the usual manner.

The outboard oscillator was constructed on a 2¼ × 2¼ × 4-inch Minibox. No TVI troubles have been experienced while operating with 8-MHz. crystals.—*W1CER*

OSCILLATOR INSTABILITY IN V.H.F. TRANSMITTERS

Instability in crystal oscillators using tubes with high values of grid-cathode (input) capacitance, C_{gk}, is often caused by too much feedback. In many tubes, C_{gk} is on the order of 10 or 15 pf., a sufficient amount of capacitance to permit the crystal to oscillate. If additional capacitance is added to the circuit, often 10 or 15 pf., too much feedback will result and the oscillator will self-oscillate independently of the crystal. This effect is all too common in v.h.f. exciters using circuits similar to Fig. 7-9.

The cure is simply to remove the external capacitor, C_1, from the circuit and employ only the internal capacitance (C_{gk}) of the tube.

Instability of the oscillator circuit can be detected by pulling out the crystal, applying operating voltage to the stage, and coupling an indicating-type wavemeter to the tank coil. If h.f. energy is present with the crystal removed, remove C_1 from the circuit.—*W1CER*

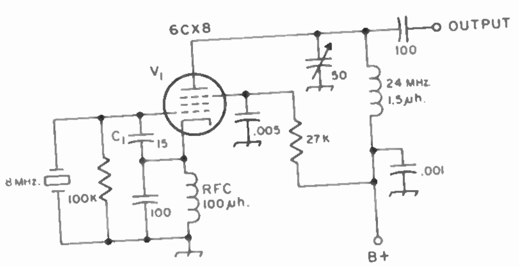


Fig. 7-9—Typical first stage in a v.h.f. transmitter. V_1 may be the pentode section of a 6CX8, a 5763, 6CL6, or other popular types.

LOW-COST PISTON TRIMMERS

Many builders of v.h.f. equipment desire to use piston trimmers in various parts of the circuit. Commercially-manufactured units are quite expensive. Homemade units can readily be fashioned from surplus slug-tuned coil forms

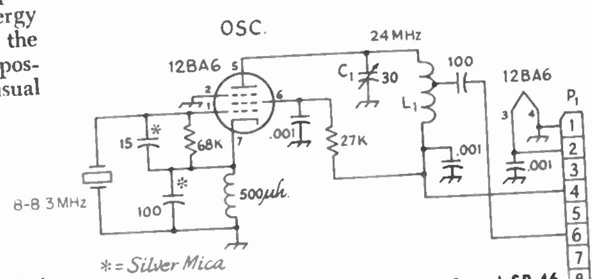


Fig. 7-8—W1CER's oscillator for the SR-42 and SR-46 Except as noted, capacitors are ceramic and resistors are ½-watt composition.

C_1—30-pf. variable (Hammarlund MAC-30).
L_1—14 turns No. 18, ½-inch diam., 8 turns/inch tapped at 8½ turns from the bottom end (B&W Miniductor 3002).
P_1—Octal plug.

Fig. 7-10—W1CER's method of making piston trimmers from slug-tuned coil forms.

by removing the powdered-iron slug and replacing it with a similar length of brass or aluminum rod. The rod can be drilled and tapped to accept the same stud that held the original slug. After the stud is threaded into the new slug, a drop of glue can be placed at the junction of the two units to fasten the stud.

The outer element of the capacitor can be made from flashing copper or bass shim stock, as shown in Fig. 7-10. This operation can be performed on a mandrel that is slightly smaller in diameter than the main body of the coil form used. By doing this, the outer plate of the capacitor will fit snugly over the coil form when attached. Larger-diameter coil forms will permit greater values of maximum capacitance.—*W1CER*

EXPERIMENTAL U.H.F. OSCILLATOR

The 420–450-MHz. oscillator shown in Fig. 7-11 was built for the purpose of experimenting with the overlay transistor, a new type u.h.f. transistor introduced by RCA in 1964. The overlay transistor has low lead inductance, better collector isolation, and improved thermal conductivity.[1] The circuit of Fig. 7-12 was empirically developed while using the RCA 2N3553, but other overlay types were tried and delivered comparable performance.

The oscillator can be put to use by the experimenter in many interesting ways: as a signal source for u.h.f. antenna experiments; as a demonstration device for ham-club talks; for low-power ATV transmission; or as a modulated oscillator for short-range 420-MHz. voice communication.

The oscillator (Fig. 7-12) uses a half-wave line, L_1, tuned to resonance at the desired frequency by C_1. The operating voltage, 9 to 12 volts d.c., is brought into the copper box through C_5 and is applied to the cold point of the collector side of the line, L_{1B}, through RFC_2 Bias current for the base of Q_1 is established by R_1 and is fed into the box through C_4. RFC_1 isolates the base of Q_1 from the supply voltage.

L_2, the output link, is tuned to resonance by C_3, which is a 10-pf. piston trimmer. R.f. output is taken from J_1, a BNC connector. C_2, a 5-pf silver mica capacitor, was necessary to insure oscillation each time the unit was turned on.

With the constants given in Fig. 7-12, the overlay oscillator tunes from 420 to 460 MHz. and delivers enough r.f. output to light a No. 49 bulb beyond normal brilliance.

The oscillator is built in a 1 × 1 × 5-inch copper trough (Fig. 7-13). Although light-gauge flashing copper was used, brass or aluminum could be substituted. The box was formed in a bench vise and the ends were soldered to assure good electrical contact. A high-wattage soldering iron was needed for that part of the job.

L_1 is supported at one end by the stator terminals of C_1, and at the opposite end by a polystyrene block 1 inch square and ¼ inch thick. The conductors are 3-inch lengths of No. 10 bus wire.

The case of the 2N3553 is internally connected to the collector, so as to keep lead lengths to a minimum and to provide a heat sink. Q_1 is mounted directly on the end of L_{1B} by means of a copper ring (Fig. 7-13) which is soldered to the end of L_{1B}. The diameter of the copper ring is such that Q_1 fits snugly into it.

C_4, C_5, and J_1 are soldered to the copper trough to assure good electrical contact.

L_2 is insulated by spaghetti tubing, and is spaced approximately 1/16 inch away from the

[1] Carley, McGeough, O'Brien, *Electronics*, August 23, 1965, p. 71.

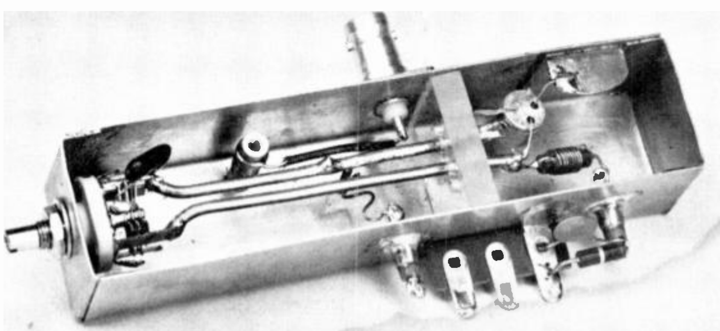


Fig. 7-11—A close-up look at the u.h.f. oscillator, Q_1 is just to the right of the plastic support block and is mounted on the end of L_{1A}. The tuned line serves as a heat sink for the transistor.

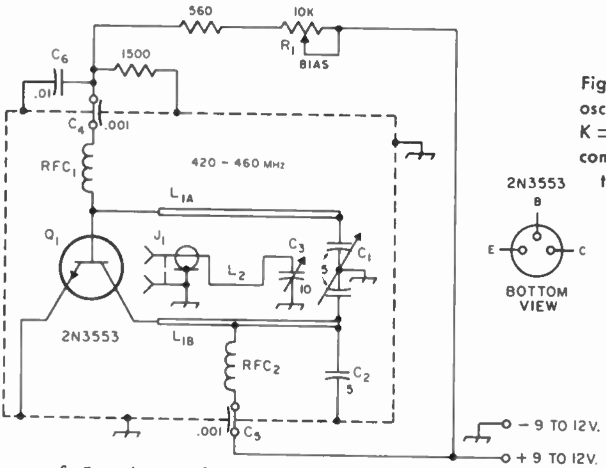


Fig. 7-12—Schematic of the 432-MHz. oscillator. Resistances are in ohms; K = 1000. Fixed resistors are ½-watt composition. Decimal values of capacitance are in µf.; others are in pf.

C_1—5-pf. butterfly variable (Hammarlund MACBF-5).
C_2—5-pf. silver mica.
C_3—10-pf. piston trimmer.
C_4, C_5—Feedthrough capacitor.
C_6—Disk ceramic.
J_1—BNC chassis connector.
L_1—3-inch parallel-conductor line of No. 10 bus wire.
L_2—1½-inch length of No. 20 bus wire.
Q_1—RCA 2N3553 (RCA 40280 usable).
R_1—10,000-ohm ½-watt control, linear taper.
RFC_1—8 turns, close-wound, No. 22 enam., ⅛-inch diam.
RFC_2—3 turns, close-wound, No. 22 enam., ⅛-inch diam.

cold area of L_{1B} (near the tap point). It is mounted between J_1 and C_2.

To keep the emitter lead as short as possible, a copper tab is soldered inside the trough near Q_1. Better efficiency results when the emitter lead inductance is kept as low as possible.

To test the unit, connect a No. 49 bulb to J_1. This will serve as a dummy antenna and will give visual indication of output during tuneup. Set R_1 at maximum resistance and insert a 200-ma. meter between the power supply and the plus-d.c. terminal of the oscillator. Any d.c. voltage between 9 and 12 volts will be suitable for this circuit. The negative supply lead should be connected to the outer wall of the copper trough. With the power on, adjust R_1 for a meter reading of 80 ma. The dummy load will be lit if the oscillator is working. Next, adjust C_3 for maximum brilliance of the pilot lamp, which should be near normal brilliance at this power level, about 1 watt input at 12 volts.

A word of caution: Do not allow the collector current to exceed 80 ma. when adjusting R_1. If oscillation should stop, the current will soar to unsafe limits and could destroy the transistor. When the unit is adjusted as outlined, the collector current will rise to approximately 200 ma. in the absence of oscillation, a safe figure for the 2N3553.

If a calibrated wavemeter is not available, the oscillator can be adjusted to frequency with the aid of Lecher wires,[2] or while listening to it with a 432-MHz. receiver. If on-the-air operation is planned, it would be wise to stay either well above or below 432 MHz., so the broad signal from the oscillator will not interfere with the DX "purists" who haunt the portion of the band near 432 MHz.

No attempt was made to measure the power output, but 100 milliwatts or more should be easy to secure. Increased collector voltage (up to 25 volts d.c.) was applied and considerably more power output was secured. Similarly, by increasing the base bias, greater collector current flowed and the output increased. The author does not recommend such an increase in power because the transistor could go into ther-

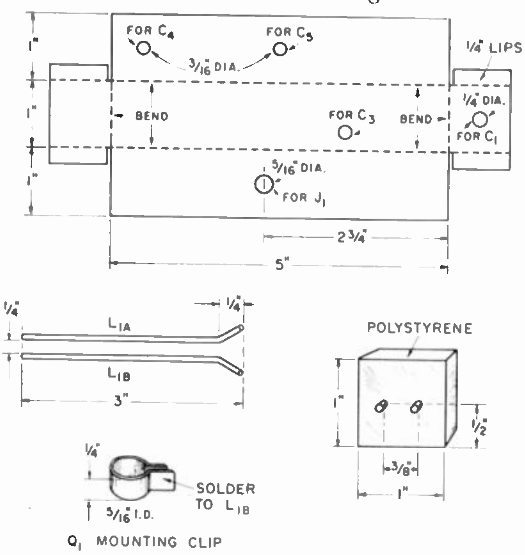


Fig. 7-13—Layout for the copper trough, the tuned line, and the polystyrene insulating block. Hole diameter for C_4 and C_5 is dependent upon type of feedthrough ...

[2] The Radio Amateur's V.H.F. Manual, p. 291.

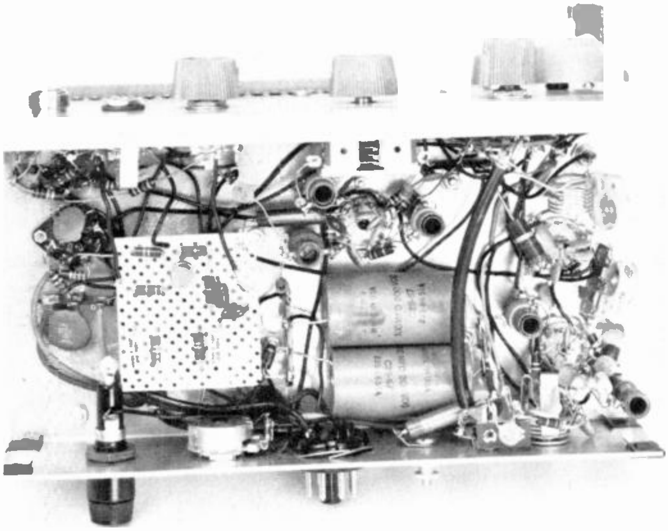


Fig. 7-14—The tone oscillator is shown mounted just to the rear of the volume control. Note the addition of the coaxial lead between the band-switch and the output jack, at the right-hand side in this view.

mal runaway if oscillation ceased. This would destroy the transistor almost immediately.

The oscillator can be used on f.m. by applying a small amount of audio in parallel with the base of Q_1. Audio from a carbon microphone was applied at the junction of RFC_1 and C_1, through a blocking capacitor, and the resultant f.m. signal sounded excellent on a 432-MHz. superregen receiver. For ATV use, video modulation could be applied to the collector supply voltage; however, a combination of a.m. and f.m. would no doubt result.—*W1CER*

MODIFICATIONS FOR THE HEATH SIXER AND TWOER

THE well-known "Benton Harbor Lunchbox" is a mainstay of activity on 6 or 2 meters in many localities. Here are several modifications of these popular little rigs that will add to their versatility.

Because both the Sixer and Twoer use superregenerative receivers, it is practically impossible to copy normal c.w. (A1). However, a superregen will receive A2 with no difficulty at all. In order to transmit A2 it is only necessary to add a tone modulator, circuits for which are shown at A and B in Fig. 7-15.

The A2 modulator is a transistor audio oscillator, capable of generating a sine-wave audio tone of approximately 1000 Hertz.[1] By connecting the output of the oscillator to the arm of the volume control the keyed tone will modulate the transmitter, and when the transceiver is switched to the receive position the oscillator can be used for code practice. Also, in the transmit position a slight amount of the audio tone is fed to the speaker, permitting the operator to monitor his own "fist."

The tone oscillator is mounted on a 2 × 2¼-inch piece of perforated unclad circuit board. This type of board is available from all mail-order radio-parts distributors and in most radio stores that have an experimenter section. The board is $\frac{1}{16}$-inch thick and is perforated with $1\frac{1}{16}$-inch diameter holes spaced approximately ⅛ inch apart. Flea clips are available for making connections, but in the units shown the connections were made by soldering the component leads together.

There is nothing critical about the construction of the oscillator. The emitter of Q_1, and one side each of C_{101}, R_{101} and R_{102} (and C_{102} in the 2-meter unit) are connected together and a lead run from this connection to the chassis of the transceiver. This provides a common ground for the oscillator. The key jack, J_{101}, must be insulated from the panel, and either insulating washers or electricians' plastic tape can be used for this purpose. The jack is mounted on the panel between the microphone connector and the volume control. The oscillator circuit is supported by its own leads. When installing the board, be careful that none of the connections on the bottom touch any leads in the transceiver (Fig. 7-14).

In order to monitor your own sending, a 330-ohm, ½-watt resistor should be connected between terminal 4 of the transmit-receive switch and the chassis. This feeds a very small amount of audio from the transmitter to the speaker. When transmitting A2 turn the volume control full on; otherwise, the audio oscillator output will be short-circuited to ground. For receiving or using the oscillator for code practice, the volume control should be set at a comfortable listening level. A switching circuit could be used so that the volume control setting wouldn't have to be changed, but this would have complicated the conversion and didn't seem worth the expense or crowding of components.

[1] Cheek, "A Simple Two-Tone Test Generator," *QST*, August 1966.

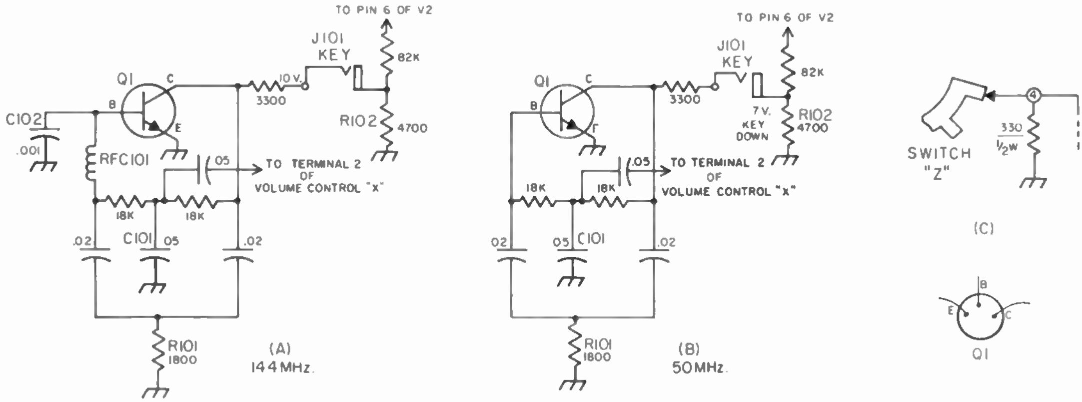


Fig. 7-15—Circuit diagram of the code oscillator. A is the 144-MHz. unit and B is for 50 MHz. Fixed resistors are ½ watt; resistances are in ohms (K = 1000) and capacitances are in μf. Capacitors are paper or Mylar, 25 volts working voltage or more. Component numbers under 100 refer to the original Health circuit; those over 100 are the added components. C is the circuit for the monitor addition.

C_{101}—0.05 μf., disk ceramic, paper, or Mylar.
C_{102}—0.001 μf., disk ceramic.
J_{101}—Single-circuit phone jack or phono jack.
Q_1—N-p-n, RCA type 40314 or similar.
R_{101}—1800 ohms, ½ watt.
RFC_{101}—2.7 μh. (Millen 34300-2.7 or similar).

Another drawback to the Twoer and Sixer is that an external meter is required for tune-up and there is no constant metering of the output. As an additional modification, a low-cost milliammeter connected as a relative output indicator was installed in each unit. This provides constant monitoring of the power going to the antenna.

Fig. 7-16 shows the circuit. The meter is an edgewise miniature S meter. There is adequate space on the panel for both the meter and control R_{103} just below the nameplate. The ungrounded end of R_{103} is connected to the meter-jack side of R_{13} (a 3300-ohm, ½-watt resistor) by an insulated wire fed under the chassis through a grommet below the meter.

Another simple improvement can be made by changing the output tank circuit from capacitive to inductive coupling to the antenna. This reduces the possibility that undesired signals generated in the multiplier stages will reach the antenna.

The first step in this modification is to remove the coupling capacitor that goes from the tank coil (L_3 in the Sixer and L_4 in the Twoer) to terminal 11 of the transmit-receive switch. In the 2-meter unit, one side of a 3-30 compression trimmer capacitor is mounted under the nut that holds the tube socket for V_4 at the chassis-edge side. The new coupling loop, L_{101} in Fig. 7-17, is made of insulated No. 14 or 16 solid wire. The loop for the Twoer consists of one turn the same diameter as the tank coil, and is inserted between the first and second turns of the tank coil at the feedthrough capacitor end. One end of the loop is connected to terminal 11 of the transmit-receive switch and the other end to the ungrounded side of the 3–30 compression trimmer. Keep these lead lengths as short as possible.

Using the lamp dummy load that comes with the kit, tune the tank capacitor and the compression trimmer for maximum lamp brilliance. You'll also note that the output meter will read maximum when the lamp is the brightest. It may be necessary to reduce the sensitivity by means of R_{103} to keep the meter pointer from going off scale.

Try moving the loop in relation to the tank coil, shooting for maximum brilliance of the lamp load. Be sure to turn off the power to the transceiver when making this adjustment because the B-plus voltage is present on the tank coil and you could get a nasty or dangerous shock.

The 6-meter installation is slightly different. The trimmer capacitor is mounted on a 3-lug terminal strip with the center terminal grounded. The strip is mounted between the crystal socket

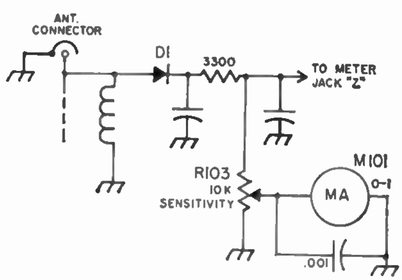


Fig. 7-16—Addition of the metering circuit modifications.

M_{101}—0-1 milliammeter (Radio Shack 22-004, World Radio Labs 99M194).
R_{103}—10,000-ohms, ¼-watt control.

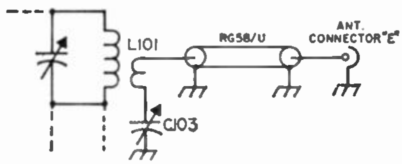


Fig. 7-17—Circuit diagram of the tank-circuit modification.

C_{103}—For 144 MHz., 3-30-pf. compression trimmer; for 50 MHz., 8-50-pf. trimmer (Centralab type 822-AN or similar).

L_{101}—See text.

and the socket for V_4, using the unused coil mounting hole as the mounting point. A 2-turn link, with the turns just slightly smaller in diameter than the tank coil, is made from insulated No. 16 or 18 solid wire. The link is positioned just inside the tank coil at the feed-through capacitor end. The adjustment procedure is the same as with the 2-meter unit.

The last change in the tank circuit requires removing the bus-bar wire from terminal 12 of the transmit-receive switch and the antenna output terminal. A length of RG-58/U is substituted for this lead, grounding the outer shield at both ends.

A last modification consists of mounting a crystal socket on the front panel. This makes crystal changing much easier. The crystal goes on the front panel alongside the meter, and a short length of either 300- or 70-ohm Twin-Lead, fitted with a crystal socket plug (Millen type 37412), is used to connect it to the chassis-mounted crystal socket. If you have a defunct crystal, the crystal can be removed and the Twin-Lead soldered to the holder pins. The crystal holder is then used as a plug.—*W1ICP*

V.H.F. GROUNDS

Securing short ground-return paths around tube sockets in v.h.f. equipment can prove troublesome, when using aluminum chassis material. Brass rings can be fashioned from sheet stock by cutting out a circle of material with a socket punch. The diameter of the circle should be about one inch larger than the tube socket you intend to use. The inner hole can then be made with a socket punch of the correct diameter to allow the tube socket to pass through. Mounting holes are drilled so that the ring may be mounted below the chassis with the same bolts that hold the tube socket. It is then possible to make direct solder connections to the brass ring when returning bypass capacitors and related circuit elements to ground.—*W1CER*

IMPROVED MODULATION FOR THE NOVEMBER QST TRANSISTOR RIG

The writer and K3LQM recently completed printed-circuit versions of the transistor portable station for 50 MHz. described by W1HDQ in *QST* for November, 1964. If trouble is experienced with the crystal oscillator cutting off on negative modulation peaks, an idea that K3LQM came up with and shown in Fig. 7-18 should be helpful.

These units are working out very well, and we plan to get seven more built for AREC use. *—Milo H. Frey, K3MSC*

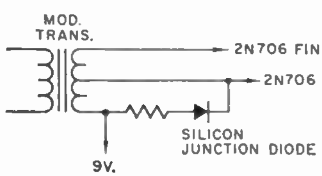


Fig. 7-18—K3LQM's circuit for improved oscillator performance.

HEATH "TWOER"

To peak the final in the Heath "Twoer," it is necessary to use an insulated tool and probe through a hole in the side to find the final's tuning capacitor. This is a difficult procedure at best, and almost impossible when operating mobile.

By gluing an insulated rod to the tuning capacitor and placing a knob on the end of the shaft, a permanent tuning control is available on the Twoer's side. I used a plastic alignment tool cut to ¾ inch length, and joined the rod to the capacitor with epoxy cement. In order to move the unit in and out of the cabinet, a slot was cut in the cabinet just below the license holder.—*Harvey Mandell, WA2AAE*

Hints and Kinks . . .

for the Antenna System

DETERMINING THE LENGTH OF AN INVERTED V

A SEARCH through the literature on inverted V antennas doesn't reveal any hard and fast formula for determining antenna length. This is understandable because so many factors can get into the act from one installation to the next.

One simple way around the problem is to make the inverted V so that its length can be easily adjusted. Fig. 8-1 shows a simple way of changing the overall length at both ends of the V. The ends of the antenna are fed through the end insulators, and then the wires are clipped back on themselves. Once the correct or resonant length is found, the guys are made permanent.

The adjustment method consists of installing an s.w.r. bridge in the coaxial feed line, tuning up on the desired frequency, and then changing the length of the V until the s.w.r. is reduced to minimum. The point where the s.w.r. is lowest is the approximate resonant frequency of the V. As a starting point for the overall length use

$$\textit{Length}\ (\text{feet}) = \frac{515}{\textit{Freq.}\ (\text{MHz.})}$$

For example, for 3.8 MHz. the overall length would be 136 feet and each leg, of course, would be half of this (68 feet).—*W1ICP*

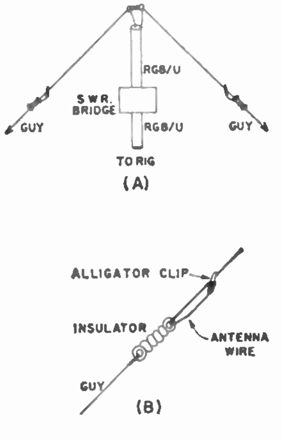


Fig. 8-1—Setup (A) for resonating an inverted V antenna, and a closeup (B) of one of the end insulators and shorting clips. The clips are used to progressively shorten each side of the antenna by an equal amount until the s.w.r. is reduced to a minimum.

GROUND ROD REMOVAL

I HAVE had good luck in removing ground rods by taking an 18- or 24-inch pipe wrench and rotating the rod several times before starting the pulling process. This seems to effectively break the adhesion between soil and rod and polishes the rod somewhat, with the result that the pulling process is made less difficult.—*N. E. Loofboro, W9IQB*

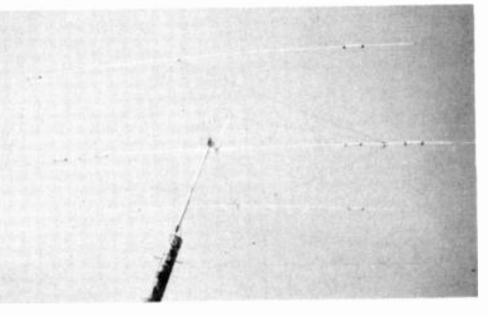


Fig. 8-2—KØCOU's 50-pound beam mounted atop a utility pole.

SIMPLE METHOD OF MOUNTING A ROTARY BEAM ON A UTILITY POLE

IN some areas of the country used utility poles are available to amateurs at little or no cost. However, it's a problem to mount a large antenna on a pole, and little information is available from antenna or rotator manufacturers, except on mounting beams on towers.

The antenna system shown in Fig. 8-2 has been in service for one year, and it has withstood the test of the elements, including a severe sleet storm and several summer storms, one with winds gusting to 90 m.p.h. No problems have yet been encountered with the antenna, a 50-pound Mosley TA3340, or the rotator, a Ham-M. Overall height of the system is 40 feet.

After consulting with several metal firms, I located a 15-foot length of 2-inch o.d., ⅜-inch wall aluminum tubing for the mast. Aluminum was picked because of its light weight (the mast weighs only 20 pounds), and durability. A thrust-bearing type of mounting was chosen to avoid excessive sideways strain on the rotator by the lever action of the antenna and mast. A 3-foot, 2⅛-inch i.d. aluminum tube was used for the bearing.

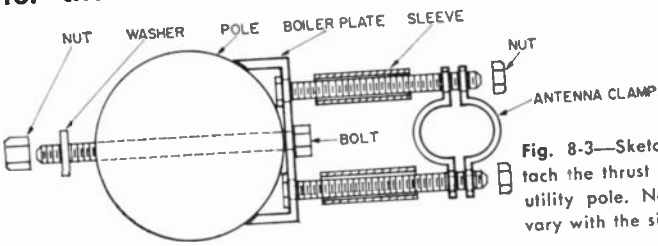


Fig. 8-3—Sketch showing the hardware used to attach the thrust bearing and rotator pipe to a wooden utility pole. No dimensions are given as they will vary with the size of the pole and the materials available to the builder.

After the hardware (Fig. 8-3) and thrust bearing were mounted on the pole as shown in Fig. 8-4, the 15-foot section of aluminum tubing was pushed through the 3-foot thrust bearing, and the antenna was attached to the top of the mast. Then a 3-foot section of pipe was attached to the base of the rotator. Next the mast was pushed up to the position shown in the photographs, the rotator clamped to the mast, and the pipe at the base of the rotator secured. Lightning protection was provided for the installation by running a ground wire directly from the base of the rotator to a ground rod buried at the foot of the pole.—*William N. Kendall, KØCOU*

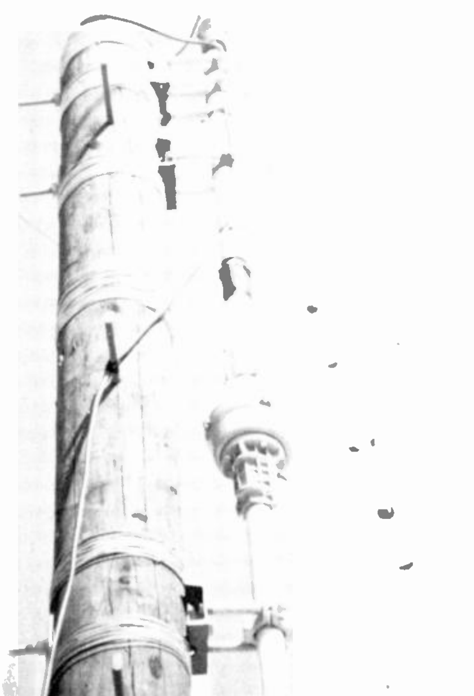


Fig. 8-4—A closeup of the installed rotator and mast.

FINDING WIRE LENGTH FOR HELIX ANTENNAS

How much copper tubing or wire L will you have to purchase to make a helix antenna (Fig. 8-5) when the coil length a, coil diameter d, and number of turns n are known? Answer:

$$L = \sqrt{a^2 + (n\pi d)^2}$$

—*W1CUT*

TOWER SAFETY

Recently I had occasion to make some minor repairs on my quad, which necessitated climbing the tower and drilling new holes in the face plate. Since the plate is heavy gauge steel, an electric drill was needed to complete the job. The decision confronting me was whether to take a chance on drilling only two holes, which would not take over five minutes, or to postpone the job until a safe extension cord could be purchased. The only extension cord I had of sufficient length was a heavy-duty two-wire cord with no ground wire.

Like most hams, I only have time to make antenna repairs on weekends, so I decided against postponing the work. My thoughts were on how to use the available equipment with no risk. Taking a four-foot length of heavy gauge aluminum guy wire, I strapped one end securely to the metal handle of the electric drill with a U bolt. After mounting the tower, I secured the other end of the wire in the same fashion to the tower itself. This wire served two purposes: first, to hold the drill in the event that I dropped it, and second, to act as a good, safe ground connection. Confidently I drilled the two holes, knowing that now, if any defect did manifest itself, the tower and not I would take the brunt of any short.—*Peter Donchik, WB2VFR*

PREVENTING WIND-WHISTLE IN HY-GAIN TRAPS

Some owners of Hy-Gain trap vertical and trap triband antennas experience annoying whistling from the traps, even in a gentle breeze. This can be cured by applying masking tape over the drain holes and then, with a pencil, puncturing holes in the tape where it covers the original holes. The irregular edge of each hole will stop the "piccolo" action.—*Katashi Nose, KH6IJ*

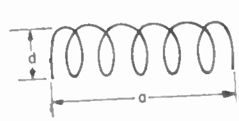
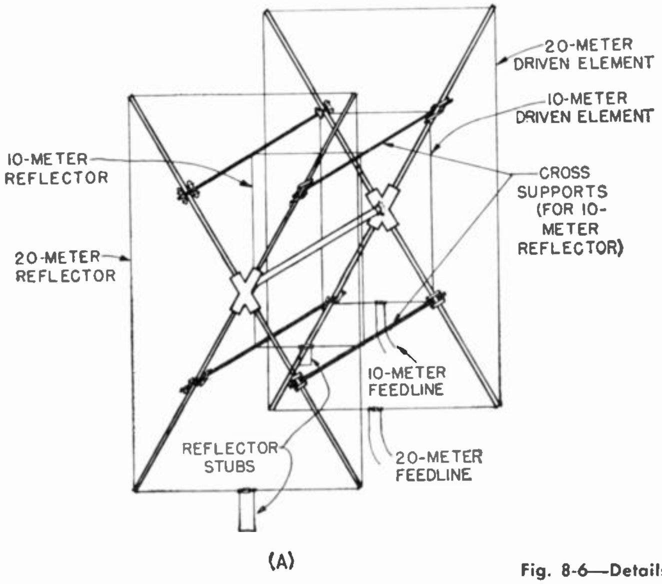
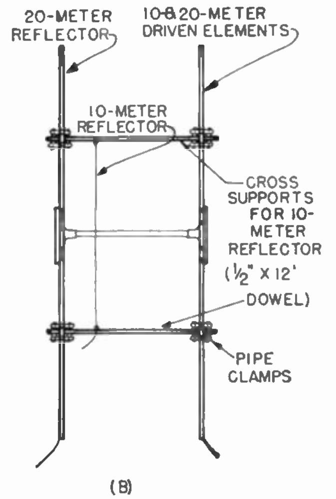


Fig. 8-5—Coil dimensions used in the formula for finding the wire length of a helix antenna.





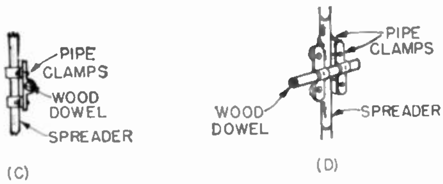


Fig. 8-6—Details of the quad modification. A—corner view of antenna; B—side view of quad; C—end view of dowel mount; D—side view of dowel mount.

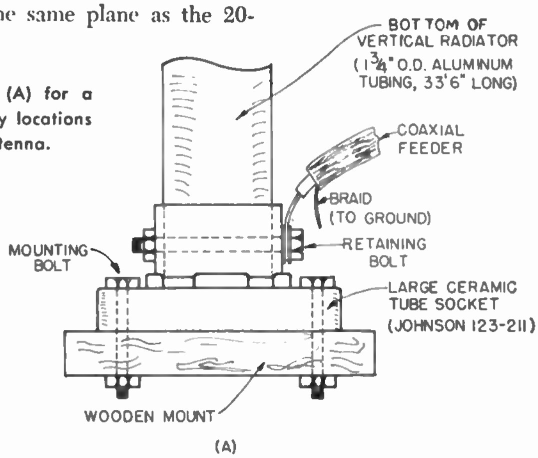
CONVERTING A MONOBAND QUAD TO A MULTIBAND ANTENNA

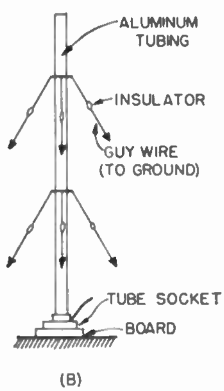
With the opening of the 10-meter band, I decided to add 10-meter elements to my 20-meter quad. I wanted to have optimum spacing of the 10-meter elements, but not at the expense of rebuilding the original structure. I finally found an excellent way to achieve this. As shown in Fig. 8-6, four dowels were attached with pipe clamps to the spreader arms. Then the 10-meter reflector was added, and the dowels (cross supports) were adjusted to center the element. Finally the 10-meter driven element was strung in the same plane as the 20-meter radiator. Note that the cross supports required to modify the quad add strength to the whole structure, and that optimum-spaced 15-meter elements can be installed by using the same method.—*Jim Brenner, WA6NEV*

ANTENNA INSULATOR

I had been having difficulty locating a suitable base insulator for the 40-meter vertical I was constructing. Then I came across a large ceramic four-pin tube socket that I had used with a 250TH. By removing the four contacts, I had an excellent insulator for the 1¾-inch diameter aluminum tubing that would make up the antenna. As shown in Fig. 8-7A, the bottom end of the tubing fits nicely inside the socket. Note that as illustrated in Fig. 8-7B, guy wires or a support must be used with the antenna.—*Jim Brenner, WA6NEV*

Fig. 8-7—Base insulator (A) for a 40-meter vertical and guy locations (B) for the same antenna.





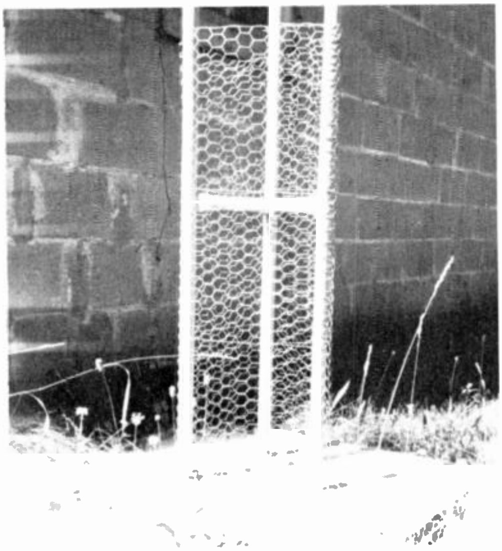


Fig. 8-8—Screening used to keep small children from climbing an antenna tower.

TOWER SAFETY

To keep the kids from climbing the radio tower and getting hurt, enclose the lower portion of the structure with chicken wire as shown in Fig. 8-8.—*Robert C. Mayne, WA8KRH*

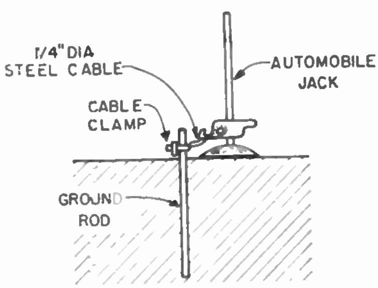


Fig. 8-9—Removing old ground rods with an automobile jack.

RECOVERING OLD GROUND RODS

On several occasions I have wanted to pull ground rods back out of the ground. I finally discovered that a car jack, with a 2- or 3-foot length of steel cable looped through it and attached to the ground rod with an appropriate-sized cable clamp, has never failed to get the ground rod out. If there is a rod holding the two sides of the lifting mechanism together, it is best to loop the cable around the rod as shown in Fig. 8-9. I have used the hook on the end of the mechanism, but it has bent. Regardless of how you connect the cable to the jack, caution is urged in case something slips.—*John T. Deines, K8QOJ*

NYLON-LINE INSULATORS

There have been several articles in *QST* on "invisible" antennas of small wire and various ingenious supporting insulators. For several months this writer has used an 80-meter antenna of No. 28 wire with three-foot lengths of nylon fish-line leader as end insulators. This nylon line is more "invisible" and stronger than the 28-gauge wire. A square knot ties the two together, and the wire will break or need to be replaced, due to stretching, long before an insulator gives up.—*Edgar L. Parkhurst, W6IY*

A SIMPLE 80- and 10-METER ANTENNA SYSTEM

The low antenna system shown in Fig. 8-10 allows effective high-angle radiation on 80 meters and low-angle radiation on 10 meters; only one feed line is required. To keep interaction between the 80- and 10-meter antennas at a minimum, a lower-band antenna length that is an odd number of electrical half waves at the desired 10-meter frequency should be avoided.

The 80-meter antenna is omnidirectional because of its low height. At the writer's metropolitan residential location, signal reports of S7 have been received from like-distant contacts (W1 and KL7 call areas) off the end and broadside to the antenna. This is with a transmitter input of 100 watts.

Being a vertical dipole, the 10-meter antenna is also omnidirectional. It has performed better than a ground-plane vertical which has four radials and is mounted at the same height (16 feet) above ground. Considerable DX has been worked as well as many North American stations.

Obviously, antennas can be combined that have other frequency relationships than the system described. If this is done, a high-impedance point for the frequency in use should be arranged to occur at the center of the antenna not in use.—*Dave Hardacker, W6PIZ*

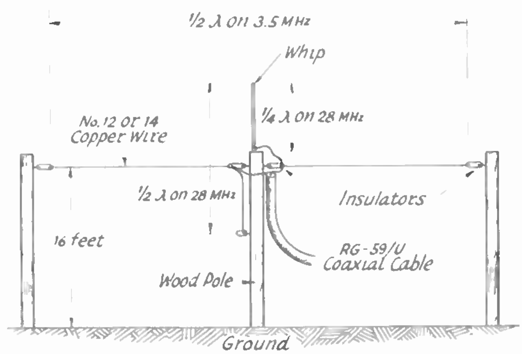


Fig. 8-10—W6PIZ's 80- and 10-meter omnidirectional antenna system (not drawn to scale).

EMERGENCY COAX CONNECTOR

Many times a ham wishes to connect two lengths of coax together but doesn't have the proper type connector. On the other hand, coax chassis fittings can be joined together to make a connector. In order to weatherproof the unit shown in Fig. 8-11, the two inner pins were first soldered together; then a piece of copper flashing was formed around the chassis fittings and soldered at all open points. When used outdoors, the entire connection can be taped to seal off the joints from moisture.—*W1ICP*

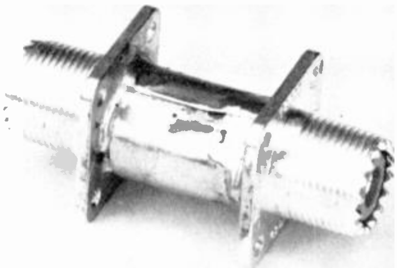


Fig. 8-11—Emergency coax connector made from two SO-239 chassis fittings and a scrap of copper flashing.

USING SCAFFOLDS FOR ANTENNA WORK

If you are planning to erect, tune or repair a beam, you might simplify the job by renting a plasterer's sectionalized scaffold to put up alongside your tower or mast. If the tower is one of the crank-up variety, a three-section scaffold will give a working platform area at the "collapsed" 20-foot level. This allows antenna work to be done at a more desirable height above ground than that afforded by a stepladder and also gives sufficient room to install the equipment necessary for tune-up.

In addition to the advantages listed above, a scaffold is easy to erect, provides safe working conditions, can be used in a variety of applications and is inexpensive to rent. One person working alone can put up a 20-foot scaffold, consisting of three "knock-down" cells or compartments, in about 15 minutes. The platform working area, a minimum of 3 by 5 feet, can be fenced in with guard rails. Working from such a platform is much safer than making antenna adjustments while balancing on a ladder or clutching a tower. The scaffold can be erected alongside the tower, or it can be put up so that the tower itself is inside the framework of the scaffold. If the tower is adjacent to your house or garage, you can lay planks from the scaffold to your roof to form a walkway. If your roof is too low, build it up with scaffolding astride the peak of the roof and then install the walk-way planks between the two scaffolds. This makes element adjusting a cinch.

Rental cost depends on what you use. A 3 × 5 × 6½-foot section rents for about $1.50 per month per section plus a dollar or so apiece for the planks used for the work area and walkway. This amounts to roughly $10 per month for a 20-foot scaffold. Compare this to *one* visit of a "cherry picker" which may cost $25 or so. There probably will be a delivery charge if the rental company transports the pieces to your house.

Certain precautions should be observed if you intend to use a scaffold. Be sure that the scaffold is either separately guyed or well secured to the tower, if the tower itself is perfectly stable. Guying of the scaffold is recommended by the rental people (mine did anyway) if the height gets to be much more than 20 feet or so. Ask the rental company for complete instructions and possibly assistance for erecting and guying their particular equipment in the arrangement you want. Also, it's advisable to check with your local building inspector concerning regulations on the erection of scaffolds.

Check the yellow pages of your telephone directory for the scaffold rental company nearest you.—*W6ISQ*

ALTERNATIVE WHIP FOR WINDOW-SILL ANTENNA

If you plan to follow W1NXY's design for a window-sill antenna, as described on pages 20 and 21 of *QST* for April 1967, and are unable to find an AN-131A collapsible whip, you might consider using mast sections MS-49, -50, -51 and -52 which are plentiful in the surplus stores, at least in the Chicago area, for a total cost of about $1.30 for the four sections. The masts measure about 40 inches long; when assembled together, they form a 12-foot, 8-inch whip which weighs only slightly more than the AN-131A. At the stub end of an MS-52 base section is a ⅜-inch diameter rod which can be threaded with an inexpensive die available from Sears and most hardware stores. The top section, MS-49, can be trimmed if required. Apartment dwellers may well find this antenna what they have been looking for. If desired, the disassembled whip can be stored easily in a closet. —*Herb Clark, W9FKV*

COAX CABLE GUIDE

The use of a plastic drinking straw as a guide or sleeve to assist in installing small coaxial cable in window frames is a great help. Often the hole that is drilled in the frame does not pass through continuously solid material, and the coax ends up in the wall space. The straw guides the wire easily. Use the large milkshake size.

LIGHTWEIGHT INSULATORS

While recently working with "invisible" antennas, as described by W6RVQ in *QST* for November 1965, the use of porcelain insulators was found awkward because of their weight and size. The problem was solved by constructing insulators from expendable plastic bottles such as those used to contain bleach or liquid detergent. The bottles are cut lengthwise into strips of various lengths and widths, depending upon the desired use.

Fig. 8-12 shows two versions of the plastic insulators. The insulators required for an invisible antenna system do not have to support much weight, since the wire used is normally 28 gauge or smaller. A hole is drilled in both ends of each plastic strip and the wire looped through twice to prevent the antenna from cutting into the plastic. Larger insulators are reinforced on each end with an eyelet of the type commonly found in the XYL's sewing basket. Doubling the thickness of an insulator by paralleling two strips will give enough added strength to satisfy the requirements of most long-wire installations.—*H. A. Rideout, WA6IPD*

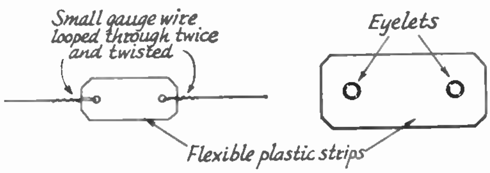


Fig. 8-12—Sketch showing antenna insulators made from discarded plastic bottles. The smaller insulator is employed in "invisible" antenna systems where the weight of the wire is not too great.

CONNECTION WEATHERPROOFING

Like many other amateurs, I run RG-8/U coax out through the yard to keep my little antenna farm supplied with r.f. One run of line, which is buried a couple of inches in the ground, goes to a tower supporting my beam. It required a coupling which was made up with standard coaxial fittings. About a year ago, a high s.w.r. problem was observed on this line. The coupling was dug up and found to be thoroughly waterlogged. Green-copper corrosion extended along the braid a couple of feet on each side of the connectors, causing a partial short circuit between the braid and the center conductor. This problem occurred within six months despite a quadruple layer of black vinyl electrical tape tightly wound around the connectors and adjacent coax. Ground moisture had readily seeped through the tape windings by capillary action even though both the adhesive layer and the tape are relatively waterproof.

The connection was repaired, wound with a single spiral winding of vinyl tape, then wrapped with a double layer of 11-inch wide Dow Saran Wrap (obtainable at any supermarket), and covered over with another winding of vinyl tape. I recently had occasion to examine the repaired connection after it had been buried in damp ground for over a year. It was still in perfect condition with no evidence of moisture penetration or corrosion.

This method of protection is recommended for weatherproofing connectors or assemblies that will be used either above or below ground. Saran Wrap will be much more efficient for this use than other plastic films, such as polyethylene or polypropylene. Saran film (polyvinylidene chloride) is by far the best of the common organic dielectric films with respect to having a low rate of moisture vapor transmission per unit thickness.—*Richard G. Rowe, WA2OJD*

USING THE HAM-M ROTATOR WITH LONG CONTROL LINES

One of the problems that I faced in using the Cornell-Dubilier HAM-M rotator was a 120-foot run between the rotator and control unit. Approximately half the time, especially during the summer when the line voltage sagged due to the heavy electrical load of the air conditioner, the antenna would not rotate when the control lever was pushed. A second or third push on the lever would invariably start the rotator moving. Apparently, the voltage drop on the long lines was such as to provide marginal operation of the brake solenoid. In every case, once the brake released, the antenna always rotated, indicating that the motor had a much wider tolerance to low voltage than the brake.

There are two solutions to the problem. The obvious answer is to run heavier copper leads to the brake solenoid. Carrying out this solution may not be so easy with the rotator already installed at the top of a 60-foot tower. Another solution may be simpler—that of installing a booster transformer in the brake solenoid circuit to make up for the voltage drop in the line.

Fig. 8-13 shows a 6.3-volt filament transformer connected in series with terminal 2 of the control unit. The transformer should have a minimum rating of 3 amperes.

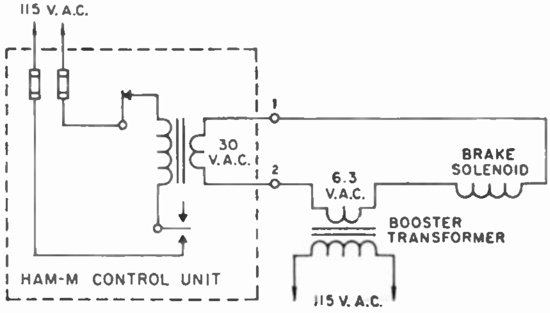


Fig. 8-13—A booster transformer makes up for the voltage drop in a long cable run between an antenna rotator and control unit.

The primary of the 6.3-volt booster transformer can be energized initially and left on during the operating period. There is no need to turn the primary voltage of the 6.3-volt transformer on and off as the control lever is pushed. Most of the 6.3 volts of the booster transformer will be absorbed across the 30-volt transformer when the rotator is not being used. Almost no voltage will appear across the brake solenoid because its impedance is practically a short circuit compared to the open circuit impedance of the 30-volt transformer. Because of this fact, no modification whatsoever is required to the control unit. The 6.3-volt booster transformer can be conveniently hidden and leads run to the control unit. The 115-volt power plug on the booster transformer may have to be reversed to permit the 6.3 volts to add to the 30 volts rather than subtract.

The booster transformer will have no effect upon the motor or indicator circuits if connected as described.—*H. Lukoff, W3HTF*

(Booster power can be used successfully on any rotor as long as a bit of common sense is mixed in. The best way to judge is to operate the rotor with short direct connections and measure the operating voltage with a good a.c. meter. Then do not exceed these values, *measured at the rotor,* in the actual boosted system. When it is desired to increase the voltage to the motor as well as the solenoid, the booster transformer is always connected in series with the common motor lead on any rotor (Lead No. 1 in Fig. 8-13). The 115-volt primary of the booster transformer can be paralleled with the primary of the transformer in the rotor control box so that power is applied to both when switched in the normal manner.)—*Bill Ashby, K2TKN*

ALL-BAND ANTENNA

With reference to the article on a Center-fed Zepp for 80 and 40 in May 1966 *QST:* I set out to accomplish several things with an antenna to be installed on a California lot which runs east-west:

1) One pole.
2) No guys.
3) Good for short skip up and down the West Coast on 80, 75 and 40 meters.
4) Throw lobes across populated DX areas on 20 and 15 meters with a fairly low radiation angle.
5) Allow some omnidirectional DX on 40 meters.
6) Keep away from anything with critical antenna length or critical tuning.
7) Minimum cost.

Fig. 8-14 shows the arrangement I ended up with. Results have been exceptional for a simple system of low height.

I use No. 14 wire for the antenna. The feeders are also No. 14. The center is mounted on an unguyed wooden pole about 34 feet high. Each section of the antenna is 65 feet long and the ends are only 14 feet high. Thirty-foot feeders are used with series tuning on 80 and 40 and parallel tuning on 20, 15 and 10 meters. Loading from 3.5 to 30 MHz. is excellent and not at all critical in tuning. The fact that the feeders are less than ⅛ wave on 80 allows reactance to be tuned out in the feeder-tuhing arrangement on that band. The antenna is a bit long for the high end of 75 meters, but tuning there is good (this length was picked because of the slightly longer physical length required on the upper bands for end effect).

I have the antenna itself running east-west, giving some directivity north-south for QSOs with short skip up and down the west coast on 80 and 40 meters (it was found in an earlier

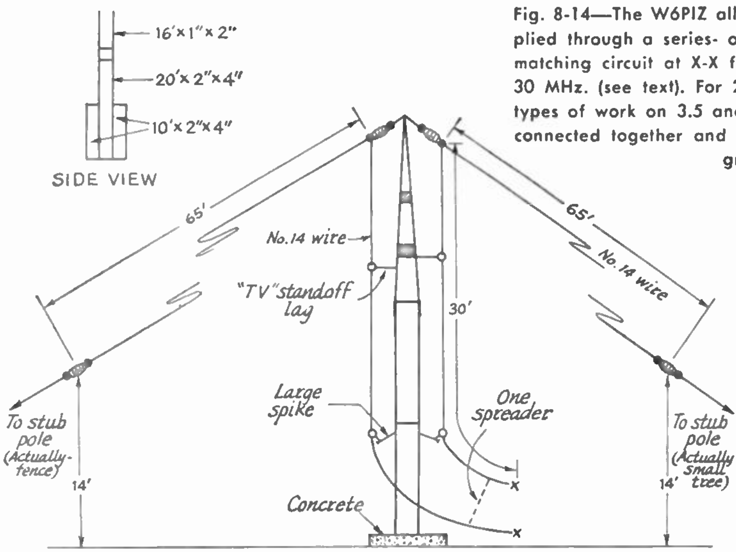


Fig. 8-14—The W6PIZ all-band antenna. Power is applied through a series- or parallel-tuned link-coupled matching circuit at X-X for operation on 3.5 through 30 MHz. (see text). For 2 MHz., and also for certain types of work on 3.5 and 7 MHz., points X-X can be connected together and the antenna worked against ground.

antenna . . . vertical . . . that a vertical was not satisfactory for high-radiation-angle short-skip operation). On 20 and 15 the lobes tend to cut across major population DX areas. The tilt of the wire, which lowers the vertical radiation angle plus apparently some lobe addition, seems to give better results in the desired DX directions on 20 and 15 meters than 33-feet-high half-wave horizontal antennas oriented in the correct directions. Quite a bit of omnidirectional DX has been worked on 40 meters, undoubtedly because of the antenna tilt. DX operation on 15-meter c.w. has been really exceptional. Quite often I hook a DX station through the pileup when local beam stations miss (power output is about 150 watts). Since 10 has opened up I have used the antenna quite a bit on that band with very good results for both North American and DX contacts.

As a result of playing around on 160 meters with the bottom of the feeders connected together and working the antenna as a "T" against ground, I decided to see what happened when it was operated as a top-loaded vertical on 80 and 40 meters. The feeders were tied together and the antenna worked against a ground consisting of two 8-foot rods in water-soaked earth. On 80 this places the maximum-current point directly at the top of the vertical section (⅛ wave long) and on 40 gives the effect of a ¼-wave vertical with maximum current at the bottom. This arrangement gave much better results than the Zepp where low-angle radiation was required, and less effective results than the Zepp where medium- and high-angle radiation was required. An exception is directly off the ends on 80 meters, where the vertical and Zepp seem to give the same results. The Zepp arrangement is therefore now used for short and medium skip on 80 and 40 and the vertical arrangement for long skip or DX. In receiving, the signal-to-noise ratio decreases greatly with the vertical arrangement (vs horizontal), thus somewhat offsetting the overall advantage of the vertical for DX operation. If this condition is extreme, I use the Zepp for receiving and the vertical for transmitting, for DX operation. It appears that the vertical transmitter and horizontal receiver is by far the best DX arrangement for metropolitan areas, but most likely the vertical for both would be best for rural areas where the QRN is lower.—*Dave Hardacker, W6PIZ*

INEXPENSIVE TOWER SUPPORT

With warm weather not too far off, many hams will be thinking about putting up towers or refurbishing existing installations. Fig. 8-15 shows a very simple but rugged way to secure a small tower to a house or garage without the use of guy wires or heavy concrete base. The total cost of such an installation shouldn't exceed $3.00 for the turnbuckle, L-brackets and small hardware. The screw eye going into the

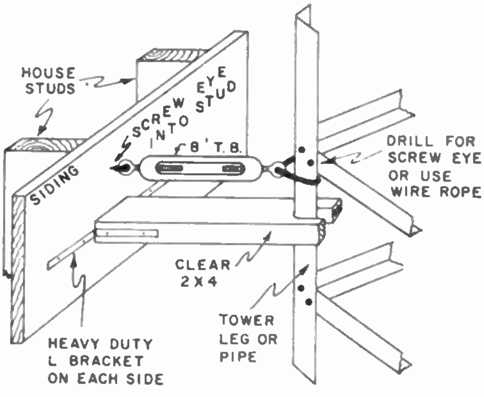


Fig. 8-15—Details of W9SCD's inexpensive tower support.

stud should be at least four inches long and should be opened up and the turnbuckle inserted before mounting. This will permit closing the eye in a vise. After installing the tower support, run a locking wire through the turnbuckle eyes and slot to keep the turnbuckle from working loose.—*Chas. A. Hudson, W9SCD*

ROTOR OPERATION FOR THE HANDICAPPED

It is generally thought that a visually-handicapped operator must "make do" with a TV-type rotor of the automatic type, or some other makeshift arrangement to indicate beam direction. By simply removing the plastic face cover on the meter of the HAM-M or TR-44 rotors, the gifted touch of these amateurs can "read" directions with great accuracy. The meter pointer is quite rugged and safe to touch.

A four-inch square of plastic sheet can be fastened along the top edge of the control box with a glass-tape hinge to protect the meter movement from dust, or a plastic food bag can be dropped over the whole cabinet when not in use.—*Bill Ashby, K2TKN*

PREVENTING LOOSE ROTATOR BOLTS

On numerous occasions the four bolts which hold together the two bell-shaped sections of my Cornell-Dubilier Ham-M antenna rotator have worked loose. As a result, the lower section fell off along with many of the ball bearings. I tried to hold the bolts in place by sealing the space into which they sank with wax, putty and similar material, but nevertheless they freed themselves. In desperation I did the following: First I removed the bolts which came with the motor. Then I drilled the holes directly through the top of the upper casing and tapped them. Next I screwed longer rust-proof bolts into the new holes, firmly fastening both sections of the casing together. Finally I placed lock nuts on top of the bolts and sealed the area around them with a special putty used for air conditioners. I defy the bolts to come loose now!—*Gay E. Milius, W4NJF*

BOOM DRILLING AIDS

In the construction of Yagi antennas where round booms are used, the problem frequently occurs of properly drilling the booms for attachment of the elements in the same plane. In order that all holes in the boom are drilled in line, I have employed the two simple drilling aids illustrated below. Fig. 8-16A shows the leveling aid that is clamped on › the boom and held level during the drilling of the attachment holes. The wooden jig in Fig 8-16B is clamped to a drill press and the leveled boom drilled as it passes through the guide slot.—*George A. Barry, Jr., W5UQR*

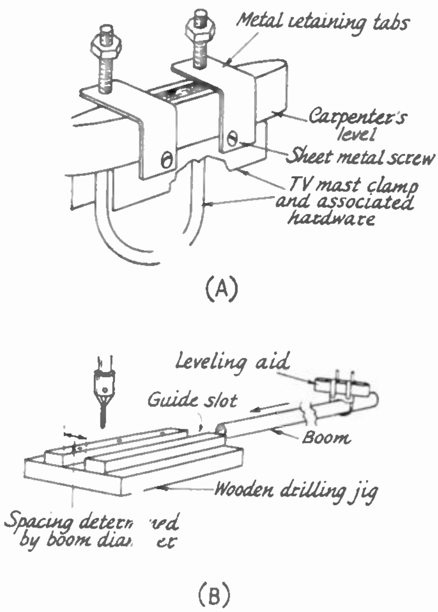


Fig. 8-16—W5UQR's boom drilling aids.

DIPOLE CENTER INSULATOR

A combination of Series 83 coax connectors can be used to make an excellent center insulator for coax-fed dipoles. Fig. 8-17 shows the assembly of the connectors. The PL-259 on side A has its inner shell sawn off. The antenna wire is run through the cone feedthrough and soldered to the center pin. Side B has the center pin of the PL-259 removed. A type 83-168 adapter is used to reduce the inside diameter of the connector. The antenna wire on this side is folded over, inserted, and soldered. Once assembled, the entire unit is given a coat of Scotch-Kote, or similar protective compound, to prevent moisture seepage.

At first glance, it would appear that the solder joint on side A would not be strong enough to support long dipoles. This has not proven true, for no difficulty has arisen in several years of supporting an 80-meter dipole with a long run of RG-8 feed line.—*Kenneth G. Kopp, WA4HAA*

FIRE HAZARD

An incident happened to me recently, which, in the interest of safety, it might be well to report.

I was awakened by a sputtering sound and a flicker of light from the radio shack, in an adjoining room. Rushing into the shack I found the control box of my TR-44 rotator ablaze with a noisy arc. After pulling the plug and assuring myself that no further danger existed, I returned to bed. Post mortem was held the next morning.

Apparently the small wire spring which holds the switch lever in contact position had rubbed against the primary contacts on the wafer. That side of the switch was completely burned away. What remained of the spring was fused to the shaft bushing, with a little ball of metal on the end to show where the arc had flared.

The 3-amp fuse in the line was still intact—with the odds being 50-50, it was in the grounded side of the line! My rig draws power

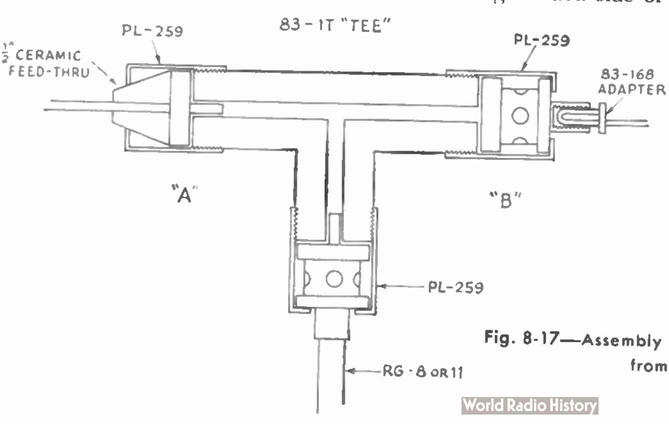


Fig. 8-17—Assembly of the center insulator constructed from coax connectors.

from a separate 220-volt circuit, with No. 6 wire from a 100-amp. entrance. The 30-amp. breakers in that circuit will stand up under considerable load. I was fortunate to come out with nothing more serious than a charred wafer switch and a badly-singed control box.

After this incident I checked into my Ham-M rotator. I find that it is fused in both sides of the primary circuit. Needless to say, when the TR-44 is repaired, it will be also.—*Frank Greene, K5IQL*

(Accidental grounds can be a real hazard, as too many amateurs have found out, to their sorrow. Fusing both sides of the line, and using a double-pole switch to break both sides when the equipment is not actually in use, is the only really safe procedure.—*Editor*)

KEEPING FEEDLINES UNTANGLED

KEEPING the feedlines of my two beams from getting tangled in the top rotator clamp continued to plague me until I "borrowed" one of my XYL's large plastic flower pots, removed the flower(of course), cut a hole in the bottom and placed the pot over my rotator as illustrated in Fig. 8-18.—*H. H. Lewis, K3GSJ*

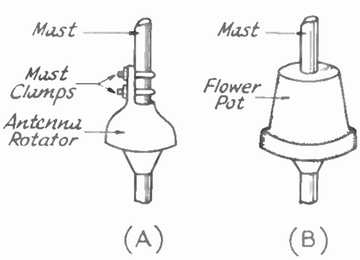


Fig. 8-18—K3GSJ's antenna rotator (A) before and (B) after modification.

ICE-BREAKING INSULATORS

WHERE there's much icing on an antenna, I have found that instead of using, say, a seven-inch insulator, it is better to connect two four-inch insulators in series. This combination makes a hinge which, with the action of the antenna in the wind, breaks the ice.—*Eric S. Holden, VO1BH*

EMERGENCY COAX CONNECTOR

ACCORDING to my calculations the adapter described by W1ICP in the "Hints & Kinks" section of April *QST* has a characteristic impedance close to 100 ohms. Generally speaking, the discontinuity presented to a 50-ohm transmission line by the adapter will be small at h.f. and v.h.f. and one should obtain good v.s.w.r. characteristics. However, for use in the u.h.f. region the mismatch will be more significant.

An improved match can be attained by soldering a sleeve over the two inner conductors such that the ratio of outer to inner coaxial conductor diameters will be approximately 2.3 to 1. This will result in an adapter with a 50-ohm characteristic impedance.—*Dennis J. Kozakoff, W4AZW*

RUGGED COAXIAL SWITCH

ONE application of the new Millen highpower r.f. switch[1] that particularly interests us is for switching separate coaxial lines. As the switch is rated for 13,000 volts (!) and has silver-plated 20-amp. contacts, it should more than handle any amateur transmitter, even with a high s.w.r. in the line.

Before constructing the coaxial assembly shown in Fig. 8-19 there was some apprehension that because of the size of the switch and the wide spacing between contacts, the completed unit might cause an appreciable mismatch in the line. However, with the construction method

[1] New Apparatus, *QST*, July, 1966, p. 29.

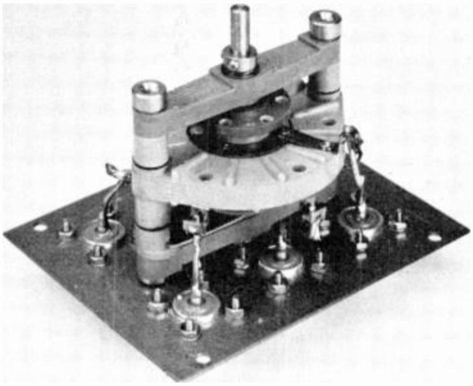


Fig. 8-19—The leads from each of the SO-239 coax fittings are kept short to reduce any impedance mismatch. After this assembly is installed in the box, the switch is secured to the front plate with two screws.

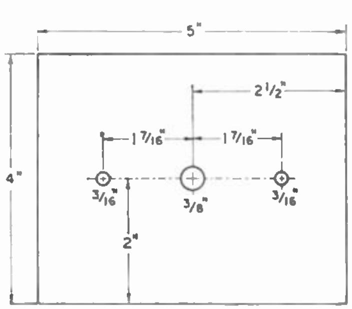


Fig. 8-20—The front and back panels of the utility box are both drilled as shown above. Then additional holes are drilled on the back plate for the coax fittings.

used it turned out that there was no need to worry. Testing the switch into a flat 50-ohm load showed that no observable mismatch was introduced, at least not at frequencies up through 30 MHz.

A 3 × 4 × 5-inch Bud aluminum utility cabinet is used to house the coaxial assembly. Special care must be taken in lining up the holes in the front and back covers of the box because the switch is mounted between these two covers. The switch that we had came with six contacts, but only five were used. There is adequate room for the coaxial connectors on the back of the box if the number of lines to be switched is held to five.

Drill the front and back panels as shown in Fig. 8-20. The switch shaft extends about ⅛ inch out the back, so a clearance hole is required. Then drill holes on the back plate for the coax connectors; make sure that the edges of the coax fittings are ½ inch in from the edge of the cover, otherwise the mounting screws won't clear the lip around the inside of the cabinet. If you use a painted utility box, remove the paint from under the coax fittings in order to get good ground connections. An unpainted box will save trouble.

No. 12 solid copper wire is used to make the connections from the switch terminals to the coax fittings. Keep the leads as short as possible. All soldering and wiring can be done with the switch mounted on the back panel, and when the connections are completed install the assembly in the box and mount the front panel. Don't forget to mark or letter the various sockets, because it is easy to make a mistake as to which is the common terminal.

As with other switches, don't change feeders with power going through the lines. With a switch as rugged as this one you probably could, but it isn't recommended.

Total cost of the complete assembly is about \$15–less than that if you use surplus coax connectors.–*W1ICP*

V.H.F. LAZY-H ANTENNA

Getting an indoor antenna to perform satisfactorily is not always easy. Certain sacrifices will result from any attempt to install an indoor antenna. Yet, by taking advantage of broadband antennas and effecting the best possible impedance match to them, worthwhile results can be secured from an "attic special."

The 2-meter Lazy H described in this article is an old standby which should bring back a few nostalgic memories to 10- and 20-meter operators who have dabbled with combinations such as this. The entire system, including 40 feet of 300-ohm ribbon line, cost the author less than two dollars. It took about 45 minutes to cut the wire to length, tack the system to the attic wall, and adjust the matching transformer for an s.w.r. of 1:1. At optimum efficiency this antenna theoretically should be capable of a maximum gain (bidirectional) of about 5.9 decibels. The overall efficiency will be governed by the placement of the array with respect to house wiring, water pipes, gutters and downspouts. The antenna should be kept as far away from such things as possible, to lessen the chance of pattern distortion, detuning effects, and absorption of the signal.

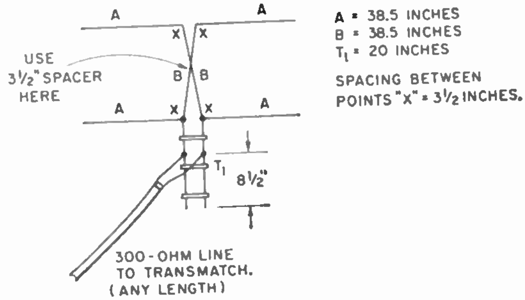


Fig. 8-21—Dimensions for the 2-meter Lazy-H antenna. Make certain that the center sections, B, are transposed as shown.

Of any number of simple indoor antennas tried for operation on 6 and 2 meters, the Lazy-H has been superior to all others used.

A 10-foot length of a.c. zip cord was used for the Lazy-H. The cord was split at one end and the two conductors were pulled apart, making two 10-foot lengths of insulated wire. Each wire was pruned to a length of 115.5 inches and pinned to the attic wall in the configuration shown in Fig. 8-21, so that their center sections *B-B*, crossed. A piece of cardboard, 3½ inches square, was used as a spacer at the point where the two are transposed, permitting uniform spacing to be maintained between the phasing line. The insulation was stripped from the wires at the points marked *X*, permitting the matching transformer to be soldered into place. The matching transformer was fashioned from a 20-inch length of 450-ohm open-wire line.

A Transmatch[1] is used at the author's station for coupling the v.h.f. equipment to the 300-ohm transmission lines which feed the antennas. Initial tests were made by terminating the transmission line with a 300-ohm noninductive resistor and applying a few watts of transmitter output power to the line through an s.w.r. bridge. The Transmatch was adjusted for a 1:1 s.w.r. reading and the dial settings were noted on paper. Next, the terminating resistor was removed and that end of the feed line was tapped along T_1, experimentally, until a 1:1 match was obtained at the same setting of the Transmatch controls that gave a 1:1 match with the 300-ohm termination. The dimensions given in Fig. 8-21 should be well within the "ball park" and should provide a close match at 145 MHz. The matching transformer should be adjusted for your favorite portion of the band.

[1] *The Radio Amateur's V.H.F. Manual*, 1st. edition, pp. 188-189.

Frequency excursions to other parts of the band will be possible, but the s.w.r. will rise somewhat as you depart from the part of the band to which T_1 has been tuned. The Transmatch will permit matching the transmitter to the line and will disguise the slight mismatch at "off" frequencies, enabling the transmitter to load up normally. If coax line is preferred, a balun transformer[1] can be attached to T_1 in place of the 300-ohm transmission line after the system has been tuned as just described. This will permit the use of 75-ohm coaxial line, if desired.

Since the Lazy-H is a bidirectional array, it should be oriented for maximum radiation in your favorite direction. In the author's case, north-south directivity was desired so the array was tacked to the south wall of the attic. Although maximum radiation is at right angles to the plane of the antenna, some side response exists, making it possible to work in all directions but with reduced efficiency off the ends of the antenna.

An antenna of this type should deliver comparable performance on 6 meters, provided careful attention is given to the dimensions and to the matching. Complete data covering antennas of this variety is given in the *ARRL Antenna Book*, Chapter 4. An outdoor version of the Lazy-H could be fashioned by mounting the elements on 1 × 1-inch lumber support arms. It would then be possible to rotate the array, and greater efficiency should be possible since the antenna would then be out in the clear.—*W1CER*

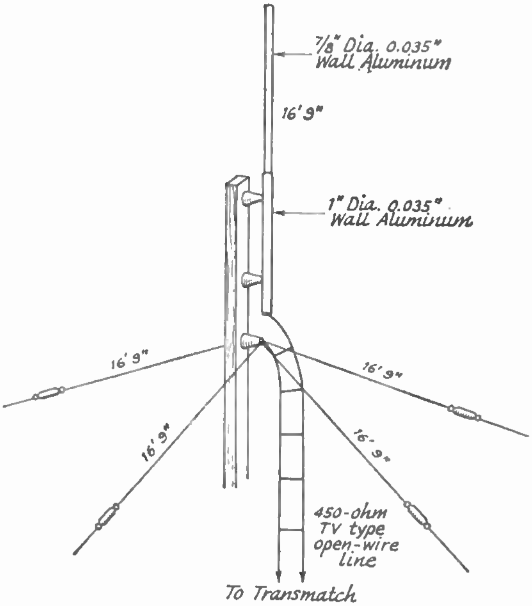


Fig. 8-22—Sketch of W4VON's simple multiband antenna.

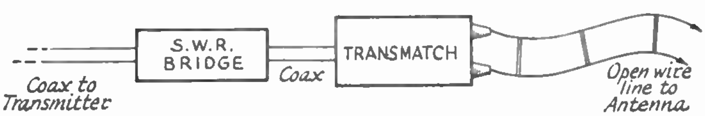


Fig. 8-23—Recommended setup for coupling antenna line to low-impedance transmitter output.

MULTIBAND GROUND-PLANE VERTICAL

In recent years, the multiband tuned-line center-fed antenna has enjoyed a return to popularity. Yet, few amateurs realize that the same principle may be applied to a vertical ground-plane configuration. For several years, the author has experimented with several versions of this antenna and has found them to be most satisfactory. The antenna shown in Fig. 8-22 provides not only outstanding performance on 10, 15 and 20 meters, but performance on 40 and 80 meters equivalent to most mobile-antenna installations. Full efficiency on these latter bands can be realized by making the vertical and radial portions proportionately longer.

The antenna system consists of the radiating element, ground-plane radials, an open-wire feeder of any convenient length, a transmatch capable of either series or parallel tuning, and an antenna s.w.r. bridge. This combination is shown in Fig. 8-23.

The author preferred to cut the antenna for resonance on one particular ham band (20 meters), but it is not necessary that the antenna be resonant on any band. Efficiency will suffer, of course, on bands where the length is significantly shorter than ¼ wavelength. Whatever the length chosen for the antenna, the radials should be of about the same length.

Constructional details are shown in the sketch of Fig. 8-22. In the event the specified aluminum tubing is not available, thin-walled galvanized electrical conduit, aluminum conduit, or copper pipe may be used.

It is recommended that the vertical element not be supported by drilling holes through the tubing, as this will substantially weaken the

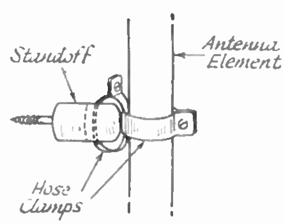


Fig. 8-24—Suggested method of mounting radiator element without drilling holes in aluminum tubing.

structure. An alternative mounting arrangement is shown in Fig. 8-24. The insulators are procelain standoff types with a lag-screw insert. They will be found at electrical supply houses (also at Sears), and are sometimes referred to as "saddle"-type insulators. The hose clamps are stainless-steel gear type.

Operation of the antenna is simple. The transmatch (a suitable one, including s.w.r. bridge, is described in the 1966, 1967, and 1968 *ARRL Handbooks*) and s.w.r. bridge are connected, and the tuning network adjusted for maximum forward and minimum reflected power. Initially, it will be necessary to determine experimentally whether series or parallel tuning is required for the particular combination of band, feeder length, and antenna length selected.

The tuned-line-fed ground-plane vertical antenna gives excellent performance, can be easily constructed in just a few hours even by a beginner, requires a minimum of installation space and costs less than five dollars, excluding the transmatch and s.w.r. bridge. The tuned circuit of the transmatch provides excellent discrimination against harmonic output from the transmitter. Ease of construction and portability make this antenna an ideal one for Field-Day use.

In case one wonders about the mismatch between the line and the antenna, the secret is in the use of open-wire line. The loss in such a line with an s.w.r. of 25:1, at 10 meters, is less than the loss in RG-58/U when the latter is matched.—*Arthur S. Gillespie, Jr., W4VON*

Hinks and Kinks . . .

for the Mobile/Portable

STORING HUSTLER RESONATORS

I HAVE a Hustler mobile antenna which consists of a 54-inch mast and separate resonators for each of the amateur bands from 10 through 80 meters. To keep the unused resonators from getting damaged, I store them as shown in Fig. 9-1. Small clips for holding the shorter coils are mounted on the door post, and a large clip for holding the 80-meter coil is mounted on the rear base of the front seat. The clips, which can be found in most hardware stores, are normally used to mount broom handles and the like.—*Richard Werner, WAØDKQ*

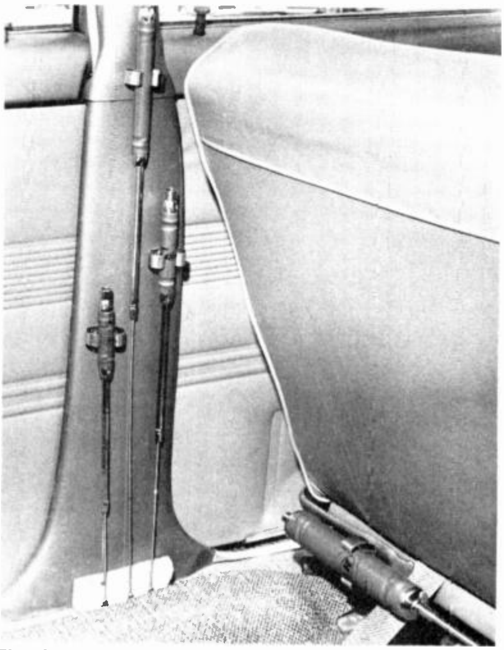


Fig. 9-1—System used by WAØDKQ to store the unused resonators of his Hustler antenna.

FORD MOBILE UNITS

DURING the recent installation of a new HW-32A mobile rig in a 1967 Ford, several problems were encountered and solved. The solutions may be of interest to those planning such installations.

For routing the antenna lead from the dashboard area to the trunk, Ford has conveniently provided a nice wide channel under each door sill. The channel is used as a path for electrical wires that go between the front and rear of the car. By simply removing the aluminum sill covers, the channels were exposed.

Ford ignition noise was found to be a headache. Since the engine, muffler and tail pipes are suspended by rubber insulation to reduce vibration problems, the exhaust system acted like an antenna and sent ignition pulses to the mobile antenna at the rear of the car. To help solve this problem, I used the braid from RG-8/U to ground the muffler and tail pipe at each strap hanger. In addition I also grounded the engine to the frame of the car with a bonding strap of braid. As a result the ignition noise was reduced from an S9 level to S3.

The remaining ignition noise was completely eliminated by replacing the regular spark plugs with Autolite resistor plugs, and installing a 10,000-ohm carbon suppressor between the center distributor lead and the distributor. External suppressors could have been used instead of the resistor plugs, but they aren't completely effective because they can't be installed close enough to the spark gap. It should be mentioned that, in order to use resistor spark plugs, the original resistive ignition wiring had to be replaced with nonresistive wiring. This was necessary to prevent engine malfunction due to excessive series resistance in the plug leads. Each resistive wire has about 10,000 ohms resistance, and each resistor plug has the same. Use of resistive wire or resistor plugs resulted in satisfactory engine performance, but the combination of both presented a total of 20,000 ohms series resistance which seriously affected engine operation. Since this was also true of the wire from the ignition coil to the distributor, it too was replaced with a nonresistive wire when the suppressor was installed. Incidentally, Ford has available a nonresistive ignition wiring kit at a cost of $7.65.

Although the above actions corrected the writer's ignition problems, they may not be completely effective on other vehicles. There are additional noise sources such as generators, alternators and voltage regulators which might cause trouble. The ARRL *Handbook* and *Mobile Manual* are recommended as sources of help in these areas.—*Stanley P. Sears, W2PQG*

MOBILE NOISE HINT

ATTENDING a recent hamfest we had occasion to visit with VE1JG, Jack Price. Jack showed us his mobile installation and what was surprising was the lack of noise, *without* any noise suppression built into the usual places. Jack had reasoned that if there was no noise on the receiver, antenna disconnected, motor running, a good portion of the noise with antenna connected came from the tail pipe carrying the noise to the back of the car near the antenna. By experimenting with metal bonding straps at various points along the muffler system, Jack cleaned up most of the noise.

Just recently, we had occasion to install a Hallicrafters SR-160 in a new Chevrolet Impala. On checking, we found the noise level read S9 or slightly higher on both 80 and 20 meters. The noise disappeared when the antenna was removed from the receiver. Remembering VE1JG's experience, we tried bonding the tail pipe to the car body. On both bands, the noise dropped to S4, which of course was a startling improvement.—*W1ICP*

TRANSCEIVER MOUNTING BRACKETS

My problem has been to find suitable mounting facilities for two transceivers that I use for mobile operation. I own a Swan 350 and I have a Poly-Comm 6-meter transceiver on loan from CD. I wanted some type of mounting brackets that would hold either rig, in spite of the fact that there is a difference of 2½ inches in the widths of the transceivers. In addition, I wanted to answer my wife's complaint that the Swan mounting bracket kept gouging her knee when no rig was in the car.

After a couple of experiments with plumber's pipe strap, I thought about trying hinges. Sure enough, by mounting a pair of 4-inch long triangular door hinges, I solved my problems. I didn't even have to drill extra holes in the hinges, as there were four holes to choose from for installing the rigs. To accommodate the Poly-Comm, the smaller of the two transceivers, I simply bent the hanging portion of the hinges slightly near the bottom, as shown in Fig. 9-2. When not in use, the hinges can be folded up and held against the dash with magnets or strips of tape.—*James Hoffer, WA8OVC*

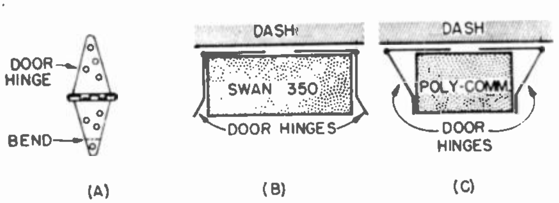


Fig. 9-2—Two triangular hinges are bent as shown in A, and mounted under the dash. B shows the position of the brackets with the Swan 350 in place, and C shows the brackets with the Poly-Comm 6-meter rig installed.

MOBILE ALARM

With varying degrees of merit, many ideas have been offered for the protection from theft of mobile transceivers. Some of the suggestions have proved to be rather expensive for the average mobile operator, and other ideas have been found to be ineffective since in many cases the transceiver could have been removed by the time the alarm sounded. In addition, many amateurs have been reluctant to install systems wherein the horn or alarm continues to sound after once being activated.

Imagine that you and your XYL or YL are enjoying a show or dinner when a break is attempted. A policeman or some other well-intentioned passerby will probably raise the hood and disconnect the horn relay wire if he can find it or start yanking at other wires until the alarm stops. What a mess when you return to the car!

If he has a mind to do so, the policeman could decorate your windshield with a ticket for unnecessary horn-blowing, and this could mean a ten- to fifteen-dollar fine. Meanwhile you have no protection until you return to the car and reconnect the loose wires and reset the alarm.

The ideal protection system is one which is actuated before the sneak thief has the opportunity to remove partially or wholly the equipment he is trying to steal. The following suggestions overcome the disadvantage of the alarm sounding continuously or for long intermittent periods until turned off manually.

Visit your nearest electronic parts distributor and ask for a Tapeswitch ribbon switch type BP. This device is 9⁄16 inch wide by 5⁄32 inch thick and can be purchased in various lengths up to 120 inches. It will close a circuit when a pressure of only eight ounces is applied at any point. Each "press-at-any-point" ribbon switch is supplied with 18-inch leads.

Solder an 18-gauge insulated flexible wire to each lead. Then place the ribbon switch under the width of the seat covers. Next, connect one side of any good toggle switch to one lead of the ribbon switch and connect the other side of the toggle switch to the ground side of the horn relay. Attach the remaining lead from the ribbon switch to the other side of the relay. The toggle switch can now be concealed in any convenient location such as under the dash or hood. When you leave the car, throw the switch on and you are in business.

When the thief sits on the seat, the weight of his body will activate the ribbon switch, and the horn or alarm will sound off loud and clear just as long as he stays in the car. Since a sneak thief needs to work quickly and quietly, he will take off like a bird when the horn sounds.

An alternative system, but one not as sure, uses a "press-at-any-point" switching mat, model CVP 623. The mat measures 6 inches wide by 23 inches long and is 3⁄32 inch thick. It is supplied with 18-inch leads and requires only 5 pounds of pressure to activate. This mat can be placed under your present car mat and the leads run in the same manner as the ribbon switch.

The total cost of a 24-inch ribbon switch should be under $4.00 and the switching mat should not run over $6.00.—*A. J. Peterson, W2MPS*

MOBILE LOGGING

Mobile log keeping at highway speeds can be dangerous. Why not do it the safe and easy way? Buy a small battery-operated tape recorder and tape the time, station, frequency and any other desired information. When you make your next stop, transfer the data to the log. This method of logging is not only safer than writing while driving, but far more accurate than trying to remember the information until the next safe place is found to log it.—*Jim Cason, WB4CCU*

SURGE SUPPRESSOR

Finding it difficult to readily obtain switching transistors, I decided it would be wise to protect the transistors in my mobile supply from surges in the car's d.c. system. Such transients can appear when the starting motor is engaged or when the heater is switched on. Most manufacturers give little thought to surge suppression other than to suggest that transistorized units be left in the "off" position when the starter is engaged.

To protect my Drake TR-3 mobile power supply, I use the circuit shown in Fig. 9-3. Surges are reduced by a 1000-μf. electrolytic capacitor, C_1, connected directly across the battery. C_2 and RFC_1 help to suppress r.f. transients. Such noises can be deadly to transistors. CR_1 clips all large positive-going spikes that exceed the Zener voltage. Negative-going pulses are limited by the low forward-voltage drop, 0.8 volt or so, of the silicon diode. Because it was on hand, a 56-volt Zener diode, Motorola 1N2999, was selected for CR_1; however, a lower voltage Zener should be used if available, since it will start suppressing positive-going spikes at the lower voltage. In any case, the voltage rating of the Zener must be greater than the d.c. voltage supplied to the suppressor. The filter was built inside a small aluminum box as shown in the photograph.

Heavy gauge wire should be used between the battery and the suppressor, and between the suppressor and the power supply. The author employed No. 10 wire between the filter and the minus terminal of the battery, not depending on the car body for a ground return.

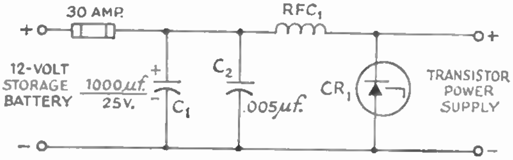


Fig. 9-3—Schematic diagram of surge suppressor.

C_1—Electrolytic.
C_2—Mica.
CR_1—See Text.
RFC_1—12 turns No. 10 enamel, closewound on 10K or higher 25-watt resistor.

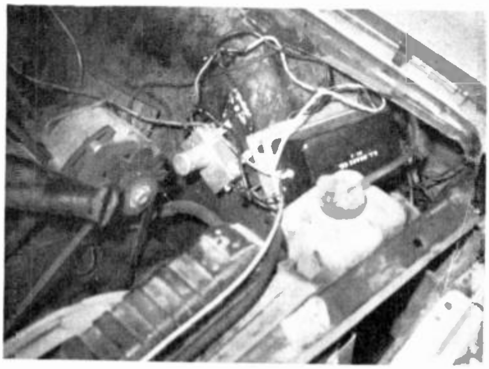


Fig. 9-4—Partial view of the Chevelle's engine compartment, showing the surge suppressor and power supply mounted on one of the side walls.

No. 8 insulated wire was used between the plus side of the battery and the suppressor. Large-conductor cable is available from most electrical supply houses.

The Drake DC-3 power supply is normally furnished for use in cars that have negative ground systems. However, the transistor cases on the bottom of the supply do not operate at ground potential. To prevent contact between ground and the transistor cases and to avert possible damage to the DC-3, I mounted the power supply on a wooden board. As shown in Fig. 9-4, the assembly was installed behind one of the headlights in the author's Chevelle. Since this space is in front of and to one side of the fan, little heat from the engine reaches the DC-3. In addition, a good quantity of air flows through the headlight mounting when the car is in motion, keeping the supply cool.—*Stewart J. Wolfe, W8ZTX*

HW-12 RATTLE

Those whose cars have developed mysterious rattles after the installation of a Heath HW-12, HW-22 or HW-32 might try removing the unit and bending back slightly the bracket that supports the lamp illuminating the meter. It seems that road vibration will cause the lamp to bump against the rear of the plastic meter case in a most annoying manner if the lamp is allowed to rest near the case.—*Robert A. Sullivan, WØYVA/9*

KWM RELAYS

Some KWM owners have had difficulties with their transceivers because of dust and dirt accumulating in the relays. This has been especially true of mobile installations.

Cover the relays with small plastic cups, the type used for food containers. Masking tape will secure the cups to the chassis and keep out the dust.—*Louis A. Gerbert, W8NOH/6*

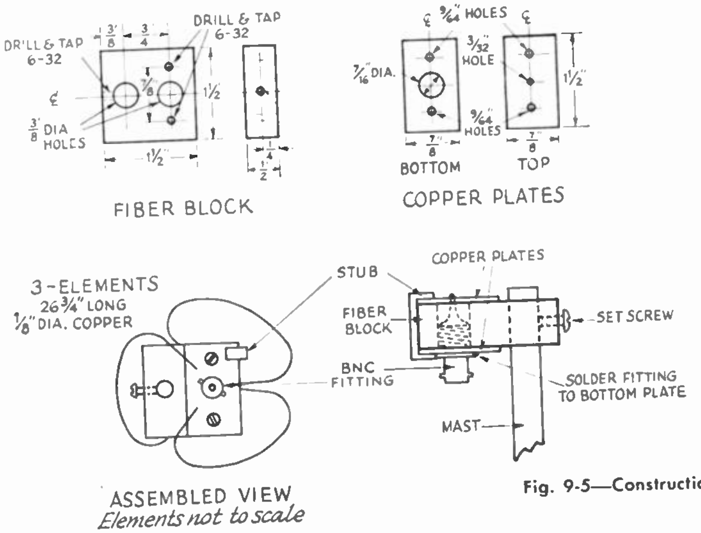


Fig. 9-5—Construction details of the Mini-Wheel 432-MHz. antenna.

"MINI-WHEEL" ANTENNA FOR 432-MHZ. MOBILE

THE "Mini-Wheel" antenna shown in Fig. 9-5 was created for mobile operation on 432.9 MHz. in the Detroit area, where there are about 35 stations active on this band. Since almost all 432-MHz. activity is horizontally polarized, the design was based on ("stolen" from, if you like) the 2-meter Big Wheel,[1] which is both horizontally polarized and omnidirectional. The antenna is only 15 inches in diameter, and can be constructed and tuned up in your workshop. No power gain is claimed for it, and it won't compete with a good beam, but it is a practical mobile antenna and will give an excellent account of itself.

As shown in Fig. 9-5, the three antenna elements are each 26¾ inches long, including ¼ inch for soldering at each end. The material used here was No. 10 bare copper wire. The center mounting block is made of half-inch thick fiber—other insulating materials would do —and is sandwiched between two plates made from 1/32-inch copper. Brass could be used instead. One end of each element is soldered to the top plate, with the element overlapping the plate by ¼ inch. The other ends of the elements are soldered to the bottom plate, as shown in the drawing and photograph. A large soldering gun will handle the soldering job with ease.

It is strongly advised that the elements be preshaped before attempting to mount and solder them. Final shaping can be done after assembly. Each element should fill a 120-degree arc, so that when all three are assembled the rim will be approximately a complete circle. Working in a clockwise direction, the beginning radial portion of each element should be directly over the trailing radial portion of the preceding element.

A matching stub made of ¼-inch copper strap, 1 inch long, is soldered between the top and bottom plates, overlapping the plates ¼ inch at each end. About ½ inch of stub is all that is necessary for matching to a 50-ohm line. A slight adjustment of the length may be needed when making final tuneup.

The BNC fitting (other types can be used) is soldered to the bottom plate by making a fillet of solder around the shoulder on the fitting. The center terminal is connected to the top plate.

In the car installation the feed line can be a short (not over 5 or 6 feet) piece of RG-58/AU. RG-8/U is preferable, and an adapter (UG-255/U) can be used for making the connection to the BNC fitting.

In mobile operation, many contacts have been made from a Detroit suburb to Toledo, Ohio, a distance of over 50 miles, as well as over shorter distances. In fact, several contacts have been made from our basement shack, with the antenna three feet below ground level, over a distance of 17 miles, using about 50 watts output. The transmitter in the car is a modified T44A6A Motorola f.m. unit having about 10-watts output. Rain and snow don't seem to affect the standing-wave ratio.

It should be possible to boost the signal by approximately 3 db. by using two stacked Mini-Wheels. The stacking distance would be about 15 inches.—*George J. Poland, W8FWF*

[1] Mellen and Milner, "The Big Wheel on Two," *QST*, September, 1961.

PROTECTING RELAYS

DUST and dirt will make relay operation intermittent. After cleaning a relay's contacts, cover the unit with Saran Wrap to keep dirt out.—*Richard Mollentine*

AUTO LICENSE PLATES

Amateurs can preserve the appearance of their call-sign automobile license plates by spraying both sides with a coat of Krylon clear plastic. This is especially useful in those states where the original plate(s) must last several years, with only smaller numeral tags being issued yearly. In Florida only one plate is required, on the rear of the vehicle, and the color combinations of the plates are changed annually. However, the same colors are repeated every 3 or 4 years, so I save my old plates and utilize them on the front of the car when that particular matching color combination comes up again. This helps to identify you to other amateur mobiles you may meet on the road.—*Ken Stewart, W4SMK*

QSL HOLDER FOR MOBILE

An envelope glued to the inside back cover of the Minilog makes a convenient location to keep QSLs on long trips.—*Bill Allen, WB2TSA*

IMPROVED VERTICAL ANTENNA FOR 2-METER MOBILE

Observing the excellent results obtained in commercial v.h.f. communications with ⅝-wave vertical antennas, I decided to try an inexpensive adaptation of these antennas in our 2-meter f.m. work. There are several types of these antennas available commercially, but all are quite expensive. The construction shown here costs very little. The antenna is easy to make, and the original has been in use for several months, demonstrating that it is rugged enough for amateur service. Best of all, it has shown an average improvement of 3 db. over the quarter-wave vertical whips formerly used.

As shown in Fig. 9-6, the whip is inserted in the top of a polystyrene rod, which is threaded into the sleeve of a standard coaxial plug (PL-259 or 83-1SP). The whip is ⅛-inch welding rod, 44 inches long. This is not critical, as the tuning capacitance can be varied for different antenna lengths. The impedance of the ⅝-wave whip is quite high, so a matching device must be used. A coil wound on the poly rod is in series with the whip and the sleeve of the plug. The coax line and center pin tap up on the coil about 1 turn from the grounded end. The coil is resonated with a "gimmick" capacitor, or a small trimmer.

The rod is 3 inches long. It is drilled about 1½ inches deep, with a drill somewhat smaller than the whip stock. The end of the whip is then heated and forced into the hole slowly. A hole is drilled up from the other end of the rod, and a similar one into the side, at a point near where the tap will be. A wire may then be run into this to make the tap connection, or a thread may be tapped into the side hole and a screw threaded into it to make contact with the wire that runs down to the coaxial connector center pin. The end of the poly rod can be threaded into the plug if the latter is heated with a torch. An alternative is to turn or file the rod down just enough so that it can be forced into the threaded portion of the plug.

The coil is 4 turns of No. 14 wire, with the top end soldered to the whip. The bottom is soldered to the connector sleeve. The tap is one turn up from the bottom. The gimmick capacitor was made from a twisted pair of hook-up wires, about 8 inches long. This can be cemented alongside the coil after adjustment has been completed.

The system can be resonated by adjusting the length or twist of the gimmick capacitor, checking resonance with a grid-dip meter coupled to the coil. To do the best job, put a 50-ohm resistor across the coaxial line at the point where the antenna is plugged into it, when the resonance check is made. Any variable capacitor could be substituted for the gimmick and replaced with a fixed capacitor of equivalent value when adjustment is completed.

Performance of this antenna was checked by calibrating the receiver's limiter grid current with a signal generator, and then comparing the ⅝ and ¼-wave whips. They were originally installed on a rear fender, where results were consistently better, transmitting and receiving, with the ⅝-wave whip. Still better results were obtained when the ⅝-wave whip was installed in the middle of the car roof.—*Vern Epp, VE7ABK*

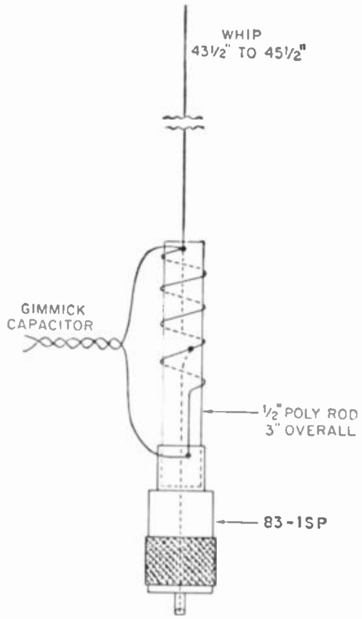


Fig. 9-6—The ⅝-wave 2-meter whip mounts in a poly rod, inserted in the top of a coaxial plug. Impedance matching coil is wound on the rod, and the line to the transmitter is tapped up one turn from the bottom end. The coil is tuned with a "gimmick" capacitor.

MOBILE NOISE

One of the headaches that invariably befalls the mobile operator is automotive noise. After several years of working in the auto radio field, I thought I was acquainted with every type of known noise, but automobile manufacturers continue to add to the symphony of possible noises. Even so, tracing down mobile noise can be less of a chore than most people believe; suppressing the noise is usually even easier.

The first step in solving the problem is to gain an idea of what causes automotive noise. Of the many types of noise generators in a car, the ignition system, of course, is the main noise maker. Other sources include the generator or alternator, regulator, brake lights, gas gauge, air conditioner, heater or blower motor and horn. The battle is half won when you identify the source (see Table 9-I).

If it can be ascertained how the noise is entering the set, your job is less of a hunt-and-peck procedure. This tidbit of knowledge can be gained simply by disconnecting the antenna at the receiver (not at the fender). If the noise disappears, it's a good bet that the noise is entering the set on the antenna lead. If, however, the noise is still present, the power lead should be suspect. The troubleshooting procedure is determined by the path by which the noise enters the set.

If you find that the noise enters via the antenna, check for an open or resistive joint between the coax shield and ground (car body). The coax should be grounded at both ends. Points to check are: (1) connector to coax, (2) coax to antenna base plate, (3) antenna base plate to car body, (4) receiver to car body, and (5) car body parts to car body parts. The time to think about points 3 and 4 is when you make the first installation. The receiver and antenna support are often left floating above ground if the installer fails to scrape paint from around mounting holes. The use of star washers between mounting brackets and mounting surfaces will improve the connection. In case of doubt, run a ground strap between the receiver case and the fire wall; squeak-reducing compounds used between dashboards and fire walls on modern cars often float the dash above ground, so make the installation of a ground wire a normal procedure. Point 5 is often overlooked by amateurs. Be sure that the hood, fenders (around engine compartment and where antenna is installed), and engine have good, strong ground connections. Special spring clamps for grounding the hood are available at car radio shops and car dealers. If your car has a fiberglass hood molded on a screen wire form it behooves you to pick up some of these clamps before the installation is even begun. One car radio manufacturer[1] recommends that a ferrite choke be placed in series with the antenna lead. A suitable choke can be made from a ½-inch o.d. toroid wound with three turns of No. 22 enameled wire. In order for the device to be effective, the lead between the antenna connector and choke must be as short as possible.

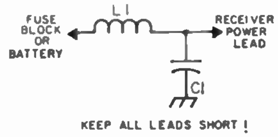


Fig. 9-7—*L*-section filter for receiver power lead.

C_1—0.5 μf. (standard car radio bypass capacitor).

L_1—Three full, close-wound layers of No. 20 enameled wire on 3/16-inch diameter, 1½- to 2-inch long ferrite slug. See text.

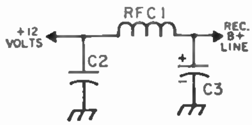


Fig. 9-8—Input filter commonly found in transistor and hybrid mobile receivers. C_2 is a spark plate capacitor. C_3 is usually a 400- to 500-μf., 15-volt electrolytic. Although usually found where shown, C_3 is sometimes located on the other side of RFC_1; it is almost always part of a multisection capacitor. RFC_1, when present, is usually 15 or so turns of No. 12 wire on a ¼-inch form. If C_3 is a multisection electrolytic and the negative lead opens, as it sometimes does, a symphony of oscillations, motor noise and motorboating will occur.

Noise entering the rig via the power lead can usually be filtered out by a simple *L*-section filter. I have made several of the coils for these filters by taking a ferrite slug from an old car radio tuner or from the antenna coil of a Japanese transistor radio and winding several layers of enameled or hookup wire over it (see Fig. 9-7). If you make a filter, be sure (1) the wire can handle the current drawn by your receiver, and (2) the wire isn't so long as to cause a large voltage drop.

A persistent case of mobile noise may indicate receiver trouble. Be sure that the input filter (Fig. 9-8) in your power supply isn't open, especially if your receiver is an all-transistor unit or a hybrid model using tubes such as 12BL6s or 12AD6s. These tubes operate with 12 volts on the plate, directly off the noisy power lead.

The procedures above will not be successful if the proper noise-suppression components are not installed in your car. For this, the procedures discussed in the *Radio Amateur's Handbook* and the *Mobile Manual* are your best bet. Tl majority of the car radio shops

[1] Philco, in a recent bulletin concerning

Table 9-I

General Types of Mobile Noise

Sound Made	*Cause*	*Cure*	*Comments*
Popping static at regular rate, varies with engine speed	Ignition system	Use resistive wiring between coil, distributor and plugs or use special in-line 10,000-ohm resistors. Bypass plus terminal of coil to ground with 0.5 μf.	Check antenna lead (see text).
High-pitched howl, varies with engine speed	Generator	Bypass generator armature terminal to ground with 0.5 μf. Do not bypass field terminal.	If the unit is not marked, the armature wire is the heavy wire.
Whistle, varies with engine speed	Alternator	*L*-section filter at receiver (see text).	May indicate diode trouble in alternator.
Flutter when receiver is set at low volume level	Breaker points	Bypass plus terminal of coil to ground with 1000 μf., 15-volt electrolytic.	Motorola AK-300 made especially for this purpose.
"Frying eggs"	Voltage regulator	Bypass the generator and battery terminals to ground with 0.5 μf. Also see the *Handbook* and the *Mobile Manual*.	Mallory coaxial bypass capacitors have the same thread as most regulator terminals. A proper stud will connect the two.
Popping at regular rate, no change with engine speed	Gas gauge sending unit	Bypass lead-in wire to ground with 0.5 μf. This wire is usually just under floor mat of trunk (above gas tank).	By rocking the car to slosh the gas in the tank, the rate can be varied.
Pop when brake is depressed	Brake light	Use 0.5 μf. across brake light switch.	
Horn noise	Horn	Use 0.5 μf. across horn.	
Electric motor noise	Blower, seat, or convertible top motor	Bypass motor power lead to ground with 0.5 μf.	

use these same techniques; there are few if any hush-hush trade secrets. In general, there are several steps that you should take:

(1) Use resistive ignition wiring (standard on all new U.S. cars). This wire deteriorates after awhile, so check it before the old buggy starts missing.

(2) Keep all leads as short as possible.

(3) If there are regular bypass capacitors already in use, disconnect them before hooking up coaxial bypasses.

(4) Be sure all metallic objects entering the passenger compartment via the fire wall are grounded. I nearly lost my mind once because of an emergency brake cable in a 1961 Ford. A bond strap restored my sanity.

With the aid of Table 9-I, your next trip into the mobile noise field should be a little more pleasant than the last one.—*Joe Carr, K4IPV/4*

Chapter 10

Hints and Kinks . . .

for Test Equipment

DIODE PROTECTION FOR THE HEATH R.F. PROBE

I HAVE been building an s.s.b. rig for 6 meters. In the process of testing the transmitter, I have burned out three or four 1N34 diodes in my Heath 309-C r.f. probe by exceeding the 30-volt r.m.s. rating of the unit.

I solved the problem by connecting a NE-51 neon bulb across the diode as shown in Fig. 10-1. Before the p.i.v. rating of the diode is exceeded, the NE-51 conducts and acts as a protective short across the diode. The particular diode now in use has not been damaged, even though it has been subjected to the same voltage levels that burned out the other diodes, and the accuracy of the probe doesn't seem to have been impaired by the addition of the NE-51.—*C. A. Danforth, K3OKG*

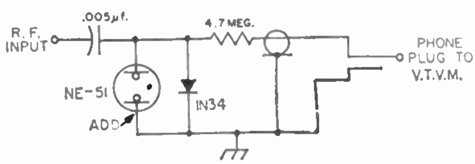
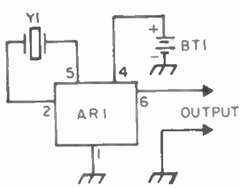


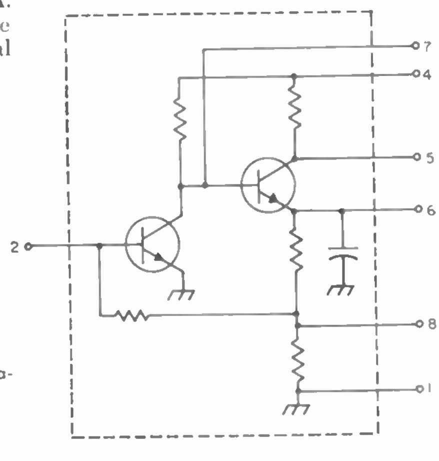
Fig. 10-1—The addition of an NE-51 neon bulb to the Heath r.f. probe protects the unit from overload. Resistor is ½-watt composition.

SIMPLE CRYSTAL CALIBRATOR USING AN INTEGRATED CIRCUIT

A CRYSTAL calibrator circuited used by C. F. Inniss, K6QBF, is shown in Fig. 10-2A. The parts count is three, which is about the smallest number of components that a crystal oscillator can be built with. A Westinghouse WC 1146T integrated circuit is the heart of the unit. The WC 1146T is basically a direct-coupled, two-stage transistor amplifier (Fig. 10-2B) with negative feedback to assure stable operation over a wide temperature range. As shown in Fig. 10-2A, oscillations are caused by feeding back an in-phase signal from lead 5 (collector of the output transistor) to lead 2 (base of the input transistor). A crystal in this feedback path determines the oscillator frequency. If the frequency of the calibrator needs to be adjusted, capacitance can be added across the crystal to lower the frequency, or inductance may be added in series with the crystal to raise the frequency.—*W1YDS*



(A)



(B)

Fig. 10-2—Schematic diagram of the crystal calibrator (A) and the WC 1146T integrated circuit (B).

AR_1—Westinghouse WC 1146T integrated circuit.

BT_1—Small battery, 5- to 12-volt range.

Y_1—Fundamental crystal.

DETERMINING TRANSISTOR BETA

AN ohmmeter can be used to determine a transistor's amplification factor, beta, replacing methods for this purpose in which a microammeter is normally used. As shown in Fig. 10-3, the voltage is taken from the battery in the ohmmeter. The measurement is done as follows. After the ohmmeter is zeroed, its positive lead is connected to the emitter and its negative lead to the collector of the transistor being tested. One at a time, resistors R_1 and R_2 are switched in series with the base and the collector. As the resistance in series with the base changes, the resistance of the collector-to-emitter path also changes. The value of the collector-to-emitter resistance is read on the ohmmeter for each position of switch S_1. The

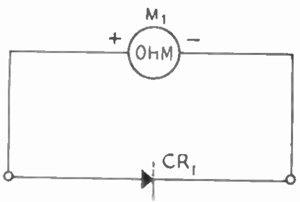


Fig. 10-3—Circuit for determining the polarity of ohmmeter leads. If the ohmmeter, M_1, reads 2000 ohms or less, the polarity of the leads is as shown. CR_1 is any diode whose cathode end is known.

amplification factor of the transistor is then found from the formula:

$$B = \frac{\Delta R_b}{\Delta R_c} \approx \frac{R_2 - R_1}{R_{ce2} - R_{ce1}}$$

where B is the amplification factor of the transistor, and R_{ce1} and R_{ce2} are the resistances of the collector-to-emitter path when, respectively, R_1 and R_2 are switched in series with the base and collector. Resistance of the transistor's base-to-emitter junction is not accounted for since its influence is negligible for practical purposes.

The circuit shown in Fig. 10-4 is for p-n-p transistors. For determining the beta of n-p-n types, you must shift the polarity of the ohmmeter. The polarity of the test leads can be found if you connect them to any diode as shown in Fig. 10-3. If the instrument indicates a resistance of less than 2000 ohms, the polarity of the test leads is the same as in Fig. 10-3.

To find the beta of transistors, the method described has been used with ohmmeters switched to the "X 100" and "X 1000" ranges. Other measuring ranges give different variations in collector current, and the beta is changed accordingly. On lower measuring ranges, I_c and beta tend to grow bigger. Therefore, depending on whether the collector current in the intended circuit will be large or small, you can choose the most suitable measuring range of the ohmmeter.

When the beta of a low-power transistor is measured, the ohmmeter should not be switched to the very lowest ranges, since in this case the collector current can grow very quickly and destroy the transistor.

Also it should be mentioned that, if nothing happens to the ohmmeter when you switch the resistors, R_1 and R_2, in series with the base and collector, the transistor is defective.—*From a translation by Gunnar Lind, SM7DZW, of an article by V. Babaev that appeared in the June 1966 issue of the U.S.S.R. publication* Radio.

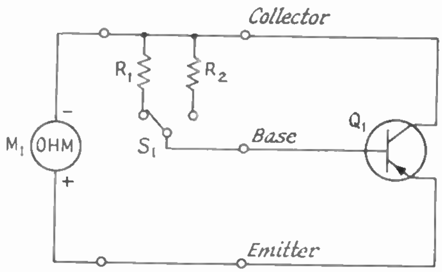


Fig. 10-4—Beta checker for p-n-p transistors. N-p-n types can be tested by reversing the polarity of the ohmmeter.

M_1—Ohmmeter.

Q_1—P-n-p transistor. Reverse ohmmeter polarity for n-p-n types.

R_1—10,000 ohms, ½-watt composition.

R_2—110,000 ohms, ½-watt composition.

S_1—S.p.d.t. toggle or slide switch.

CALIBRATING INEXPENSIVE SIGNAL GENERATORS

INEXPENSIVE wide-range signal generators that use air-core coils can be calibrated exactly, even though they don't have an individual calibration adjustment for each band. Stuff a length of spaghetti tubing with aluminum foil and insert it into the coil to be adjusted. Slide the tubing in and out of the coil until zero beat is achieved on a calibrated receiver. For best mechanical stability, the tubing should fit snugly in the coil.—*Lou Fuentes, WB2MYN*

(Since an aluminum core lowers the inductance of a coil, the above method of alignment will not work on those bands where the coils employed have too little inductance. This situation can be corrected by the following technique: Switch the generator to the band which is in error on the high-frequency side by the greatest percentage and fix the position of the tuning capacitor at some convenient frequency. Unloosen the pointer and reattach it at the correct calibration mark. Proceed to calibrate the other bands as suggested by WB2MYN. Observe, however, that the calibration points may or may not be true across the entire scale. Also note that inserting aluminum foil in an air-core coil will lower the Q of the inductor; in some cases, the reduction in Q of an oscillator might cause the circuit to cease functioning.—*Editor.*)

CHECKING RESONANT FREQUENCIES

TO check a coil and capacitor combination to see if it will resonate at a desired frequency, set up a variation of the old wave trap. Connect the coil and capacitor in parallel, and put them in series with the antenna lead to your station receiver. Find a signal close to the desired frequency and tune either the coil or capacitor, whichever is variable. At resonance, the signal in the receiver will be attenuated. When you use the tuned circuit, remember that tube and wiring capacitance in a circuit will add a few picofarads that were not there when you checked it, so a little retuning will be required. —*Julian N. Jablin, W9IWI*

HEATH HW-32 ALIGNMENT

The instruction book for the HW-32 Heathkit states that a v.t.v.m. r.f. probe and dummy load are needed for aligning the transmitter r.f. amplifier. However, if you have an s.w.r. bridge (such as the Heath HM-11), an r.f. probe is not needed. Just insert the s.w.r. bridge between the HW-32 and the dummy load. The s.w.r. bridge makes a sensitive indicator in its forward position.—*Conrad E. Bluhm, K3SWW/KG6.*

V.H.F.-U.H.F. SIGNAL SOURCE

While checking a 432-MHz. converter, I discovered that the simple one-transistor crystal test oscillator described by W3GKP in the "Hints & Kinks" column of *QST* for February 1965 makes a very potent v.h.f.-u.h.f. signal generator if a reasonably good v.h.f. transistor is employed. Using a 2N706 and an 8-MHz. crystal, strong harmonics in the 420-MHz. band were obtained. (Since the 2N706 is an n-p-n transistor, the battery polarity of the original circuit must be reversed as the test oscillator was designed for p-n-p types.) Harmonics in the desired range may be enhanced by connecting the oscillator output to an antenna which is resonant at the desired frequency. With quarter-wave whips on both the oscillator and a 432-MHz. low-noise converter, the signal was easily detected when the antennas were twenty feet apart and was considerably over S9 with an antenna separation of a couple of feet. This simple oscillator compares favorably in signal strength and stability to a complicated signal generator using a 72-MHz. crystal, two good u.h.f. transistors and a diode multiplier.—*Gerald R. Lappin, W4WQZ*

FINDING THE VALUE OF AN UNKNOWN INDUCTANCE WITH AN AUDIO OSCILLATOR

It's no chore to determine the value of an unknown inductance below 0.5 henry with a grid-dip meter and a known capacitance. Higher values of inductance require the use of a known capacitor so small in value as to make this method of measurement highly inaccurate. The circuit shown in Fig. 10-5 illustrates one method of measuring inductors of 0.1 henry to 100 henrys with good accuracy. A v.t.v.m. and an audio oscillator are used in place of the grid-dip meter. The v.t.v.m. is switched to a low a.c. scale, the oscillator adjusted for full-scale deflection of the voltmeter and the oscillator frequency varied for a dip in this reading. After noting the frequency at which the dip occurs, the value of the unknown inductance may be found by solving the formula listed below.

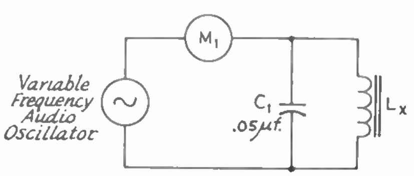


Fig. 10-5—Circuit for determining the value of an unknown inductance.

L_x—Unknown inductance.
M_1—V.t.v.m., low a.c. scale.

Lower and higher values of inductance can also be measured by this method, but C_1 will have to be changed accordingly to produce a resonant frequency within the range of the audio oscillator.

$$L = \frac{1}{4\pi^2 C F_r^2}$$

where L = Unknown inductance in henrys.
π = 3.14.
C = Capacitance of C_1 in farads.
F_r = Frequency of dip in Hertz.

—*Noel B. Sargent, K8QOQ*

(If the inductor is to be used in an application where no d.c. passes through the inductor, as in an audio filter, this method of measurement will be satisfactory. Another technique is necessary if the circuit requires direct current to flow through the inductance. See Ellison, "Measuring Inductance of D.C. Loaded Chokes," *QST*, February, 1963.—*Editor.*)

PAD CONSTRUCTION

Resistive pads are handy devices, having more applications than the average amateur realizes. Besides the obvious one of offering a known amount of attenuation in a line, pads can be used for isolation, impedance matching, or all three in combination. However, to realize the theoretical possibilities, the pads must be as purely resistive as possible and must be so constructed that stray coupling between sections is negligible.

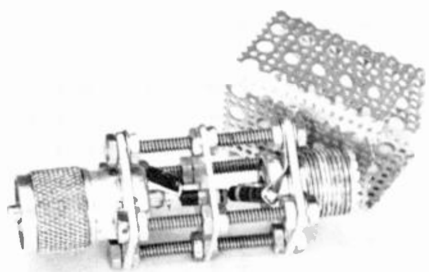


Fig. 10-6—Using coax connectors as the chassis for constructing a resistive attenuator pad. The cover, which slides on the connector assembly making a close fit, completes the shielding between sections. Thin perforated aluminum was used for the one shown because it happened to be on hand; the shielding would be a little better with solid metal.

An SO-239 socket can be substituted for the special male connector at the left end (this connector is no longer available) for ordinary "in-line" insertion, and a Dow-Key DKF-2 double male connector can be used for direct mounting to a receiver antenna-input terminal.

Small composition resistors, in the values commonly required for use in pads suitable for coaxial line, are nearly-enough purely resistive to work very well through at least the lower v.h.f. region, provided they are installed with negligible lead length. The matter of stray coupling can be handled by suitable layout and shielding.

Fig. 10-6 shows a simple, but satisfactory, method of construction. The basic assembly is a pair of chassis-mounting-type coaxial connectors, rigidly supported 1½ inches apart by four lengths of brass rod with a 6-32 thread. This distance is just sufficient for mounting a ½-watt resistor between the two center terminals of the connectors, allowing enough lead length at the ends for soldering on the two leads from the shunt resistors of the pi-section circuit. At the center is a flat piece of aluminum cut to the same size as the connector mounting plates, with a ¼-inch hole in its center through which the pi series resistor projects. The shunt resistors are soldered to lugs at their other ends, with substantially no lead length; the lugs have considerably less inductance than the resistor leads. A cover formed from thin aluminum is folded around the assembly to make a close fit, completing the shielding between sections.

The pad shown in the photograph is a 6-db. 50-ohm matching pad used for isolation and for terminating lines in a load whose impedance is not known exactly, such as the input impedance of a receiver. The series arm is nominally 39 ohms and the shunt arms are 155 ohms, selected by resistance measurement to be as close as possible to the theoretically-correct values of 37.5 and 150 ohms, respectively. Design data for pads in general can be found in *Reference Data for Radio Engineers*, published by the International Telephone and Telegraph Corp., New York.—*W1DF.*

SIMPLE LINEAR SWEEP FOR OSCILLOSCOPE

When one changes from a.m. to single sideband, he can no longer use the familiar trapezoid oscilloscope pattern for monitoring his transmissions. If the scope includes a sawtooth horizontal sweep oscillator there is no problem, of course, but there is an easy conversion for a scope with no oscillator.

A 60-Hertz transformer with a center-tapped winding is required. An old 250- to 350-v.c.t. transformer will do. The exact value can't be specified because the horizontal deflection sensitivity varies with different types of tubes. The voltage should merely be sufficient to deflect the spot well off the screen on either side. You now have a substantially linear sweep but it is as bright on retrace as on left to right. To blank it in one direction, it is only necessary to couple the a.c. to the No. 1 grid of the scope. The circuit is shown in Fig. 10-7.

It will be found that the spot cannot be focused as sharply as before, and you will have to settle for a wider trace. However, it is still quite adequate for monitoring a linear amplifier's output.—*W1DX*

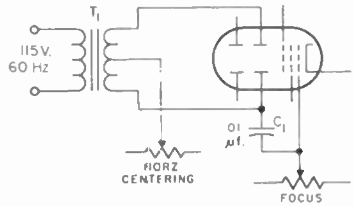


Fig. 10-7—A linear time base for an oscilloscope can be obtained from the "center" portion of a sine wave. Coupling the a.c. to the grid gives "intensity modulation" that blanks the retrace.

C_1—Ceramic capacitor of adequate voltage rating.

T_1—250- to 350-volt center-tapped secondary. If voltage is too high, use dropping resistor in primary side.

USING THE *QST RX* BRIDGE

The simple *RX* bridge described by W8CGD (*QST* for June 1965) is an excellent unit for amateurs. Measurements on 1 percent resistors and series resistor-capacitor combinations indicate that the accuracy is very nearly as good as some instruments costing over a thousand dollars.

The article seems to imply that a Smith Chart is required in interpreting the results. Unless impedance measurements made at the transmitter end of the feeders are to be converted to antenna impedance, the Smith Chart does not seem to be necessary. At my station an electrical half wave of coax at the lowest frequency to be used was connected between the antenna and shack and measurements were taken at the input end that are within 5 percent of those taken at the antenna. A pad of quadrille-ruled paper simplifies layout of the vectors. If a 1 percent 50-ohm resistor is used for the series *R*, one can immediately lay off the E_r line of five divisions (assuming the voltmeter reads 5 volts for E_r). This method does not even require a ruler—just a pair of compasses.

If a separate v.f.o. is available, the output will usually be sufficient to provide the few volts required for the bridge. A word of caution is in order here: If the v.f.o. is of the oscillator-multiplier breed, the harmonic energy may be high enough to upset measurements made with the bridge. In this case a bandpass filter or high-*Q* tank connected in the v.f.o. output is required. Fortunately, my v.f.o. utilizes a roller coil as the band-setting device, so it was possible to put the oscillator on the frequency of measurement without multiplying. If attenuated transmitter output is used as in the article, harmonics should not be a problem.

The *RX* meter has paid for itself at my station. The feed line for my quarter-wave vertical antenna had an s.w.r. of about 2:1, which was considered about normal with a 52-ohm line, since the books say the impedance of this antenna should be about 32 ohms. However, the tuning of my transmitter seemed to indicate a higher impedance. This was found to be the case, as the *RX* meter indicated 85 ohms resistive. The difference with theory was attributed to ground resistance, since only one ground rod was in use. No time was lost in rushing down to buy a couple of ground rods. The first additional rod dropped the impedance to 55 ohms, and a second provided an additional 5-ohm drop.—*W. S. Skeen, K6YRQ*

THE TELEMATCH REVISITED

The end result of my construction of the Telematch from *QST* for February 1965 seems to be a logical development of the original, and may be of interest to others. Figs. 10-8 and 10-9 show almost everything but the work involved. An extra switch was added to connect the meter to either the Telematch circuit, or, through an appropriate series resistor, to the diode circuit of a Heath Cantenna.

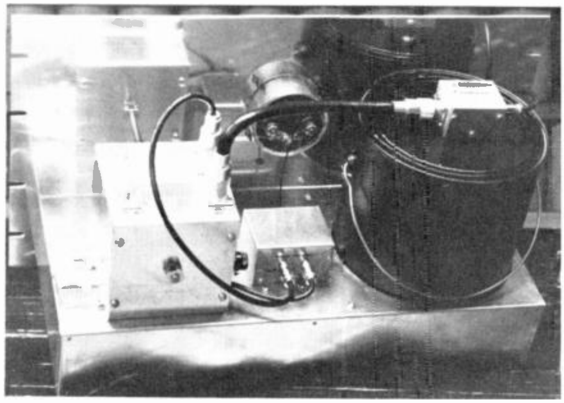


Fig. 10-9—The Cantenna is mounted by bolting a piece of plywood across the bottom of the chassis, and then bolting the Cantenna to the board. The mounting bolts are soldered to the inside of the can to prevent oil leaks.

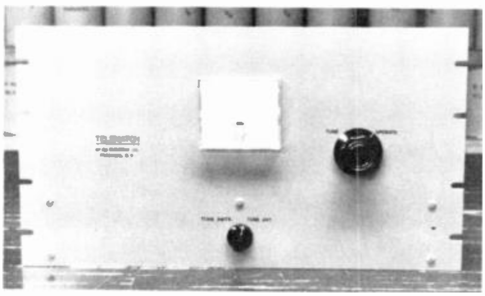


Fig. 10-8—Front view of the completed Telematch for mounting in a standard 19-inch rack. The switch below the meter selects either the s.w.r. reading from the Telematch bridge or relative power at the Cantenna.

Although my unit is not complex, some care is required in assembly. One of the problems is in mounting the Cantenna; the mounting bolts go through the bottom of the can and should be carefully soldered after assembly. This soldering inside the Cantenna pail is a bit hard to do but worth some care because of the mess you will have if the job isn't successful. The other problem is the sheet-metal and four-bearings-in-line structure of the big r.f. switch. This can be worked out with some careful marks scratched in the back of the panel and in the chassis. The switch assembly is mounted by four 8-32 bolts threaded into the aluminum, put down through holes in the chassis, and fastened on the bottom with nuts and lock-washers.

By installing them in proper order, the bearings can be placed well enough to avoid trouble with binding. The order is this: The panel bearing is installed, and the switch assembly without
end plates. With the switch bolted in place, the

shaft is put in. The rear end plate is slipped over it and screwed down tight, located by the shaft. Then the switch assembly is removed and the front plate installed, again fitting it over the shaft. Finally, the whole thing is put together again. Don't forget to grease the bearings!

It may be desirable to put some good epoxy at the base of each of the coax connectors. The ones I used—new, and good quality—were not stable enough to guarantee the location of the clips soldered on them. The epoxy cured that and now they stay put whether or not there's a connector on them. They will stay where they are put for sure when the epoxy hardens!

If you have trouble finding the clips, try Arrow Electronics or Harrison Radio, as they both carry Grayhill.—*James Ashe, W2DXH*

AUDIO LIGHT METER

A cadmium sulphide photocell plus an oscillator module shown in Figs. 10-10 and 10-11 will enable a sightless operator to test and tune his transmitter. The light-sensitive probe can be

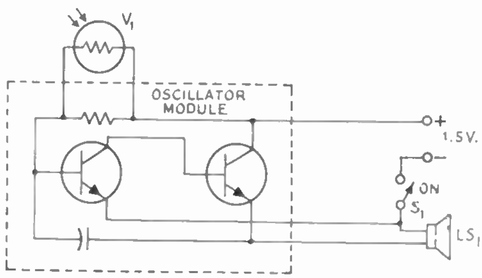


Fig. 10-10—Diagram of K2HTG's audio light meter. The oscillator module is Lafayette 19 R 1513.

LS_1—1½-inch speaker (Lafayette 99 R 6035).
V_1—Photocell (Lafayette 19 R 2101).

used to watch a light-bulb dummy load, a twin-lamp indicator, or a neon-bulb tester. K2SEQ has found many non-radio uses for this tester, including determining if the lights are on in his apartment and picking out light or dark shirts and socks.

The oscillator is a commercial item constructed on a 1¾ × 2-inch circuit load. One resistor in the circuit determines the frequency of the oscillator. The photocell, a unit which has 10 megohms resistance in the dark, dropping to about 75 ohms in bright light, is wired in parallel with the frequency-determining resistor in the module. The meter is constructed in a small plastic box. A 1-inch hole is cut in the box for the speaker. A short length of lamp cord is used to connect the oscillator to the photocell which is housed in the outer shell of a phone plug. A cardboard diaphragm with a 1/16-inch hole in the end is slipped over the end of the probe when the meter is used in very bright light; otherwise, the oscillator will be above the audible range.

The meter is used in a manner similar to a Geiger counter. As the probe is turned toward a source of light the tone from the speaker will rise in pitch. Perhaps you have a blind friend who could use such a device.—*Julian B. Anderson, K2HTG*

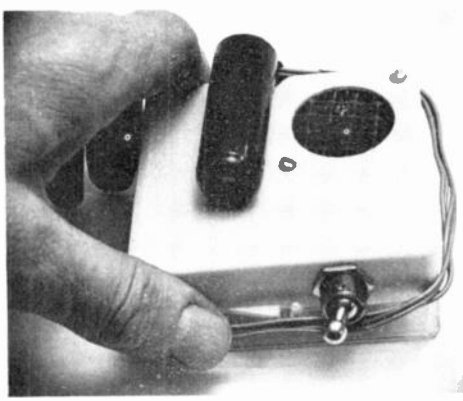


Fig. 10-11—The completed light-level meter. The phone-jack cover houses the photocell.

V.H.F. SCOPE CONNECTIONS

When you wish to check modulation patterns, obtaining vertical deflection voltage for the plates of an oscilloscope can be quite a problem above 50 MHz. A simple solution is shown in Fig. 10-12. For low-power transmitters a "tee" connector may be used to sample the output of the transmitter which is fed to the scope via a ½-wavelength balun to provide a push-pull vertical deflection voltage. High power will require a small coupling capacitor—the exact value will depend on the power of the transmitter and the frequency used. Any type of coax may be used, and the length of line between the transmitter and scope can be made ½ wavelength, or odd multiples thereof, for maximum deflection voltage. The shield of the connecting coax should be grounded to the scope. This system has been used from 50 to 432 MHz. at powers up to 1 kw., and it works very well.—*Jon O'Brien, W6GDO*

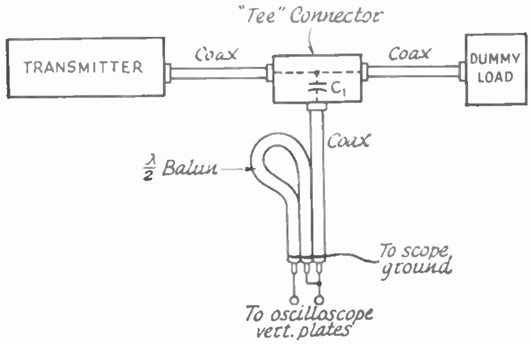


Fig. 10-12—Test setup to check the modulation patterns of v.h.f. transmitters. Low-power transmitters may be directly connected to the scope with a "tee" connector. Medium- and high-power transmitters will require C_1, which the author mounted in a modified "tee" connector.

C_1—1–20-pf. disk ceramic (the value will depend on frequency and power level used).

OSCILLOSCOPE TUBE STRETCHER

The distance from my eyes to the oscilloscope tubes of my Heath Monitorscope and Ham-Scan is neatly mismatched to the focusing ranges of my bifocals. Becoming tired of either having to bend forward and getting a "crick" in my neck, or having to lean back and then being hardly able to see the patterns, I decided something must be done.

The solution was quite simple, as Fig. 10-13 shows. The stamp collectors' counter of a nearby store furnished two very fine 3½-inch-diameter magnifying glasses at two dollars apiece. The handles were unscrewed and the lenses installed

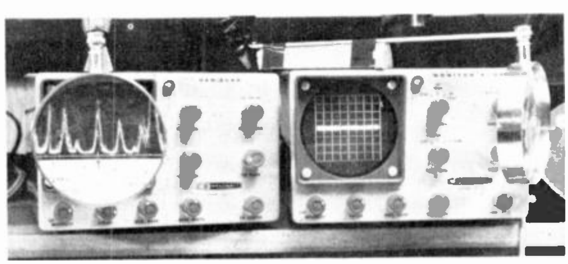


Fig. 10-13—K1MRL's tube stretcher is constructed from a stamp collector's magnifying glass, a piece of bar stock, and a counter weight. The distance between the scope and the glass is adjusted for best focus from the operating chair.

at the ends of thin metal bars. The bar stock should be flexible enough to position the lens, yet strong enough to support its weight. Pieces of scrap lead were used as anchor weights. Almost any gimmick will do to support the lens, even to screwing the brackets to the scope case. However, for the sake of convenience, I would suggest the support be flexible as to position, and not be fastened to the case.—*Thomas M. Lees, K1MRL*

GATE-DIP OSCILLATOR

NEXT to a v.t.v.m., probably the most useful test instrument for the amateur experimenter is the grid-dip oscillator, or one of its variations. In the past few years, several solid-state versions of the g.d.o. have appeared in the literature and commercially. Although the convenience of battery operation is an advantage of the transistor units, their performance has not been comparable with the more classic tube circuits. This is because the transistor oscillator must be forward biased for its operation, while the tube units run at a bias level which is dependent upon the amplitude of the oscillation. The tube oscillators take advantage of the d.c. characteristics of the active device, as well as the properties of a marginal oscillator.

The performance of a tube unit along with the convenience of the transistor oscillator may be realized simultaneously in a solid-state circuit utilizing a junction field-effect transistor. The "gate-dip oscillator" used by the writer is shown in Fig. 10-14. The dual variable capacitor is a typical transistor radio type with the larger capacitance section (130 pf.) used on the gate side of the tuned circuit. A dual-section 365-pf. variable has also been used in a breadboard circuit. Plug-in coils are used to cover the range of 3 to 200 MHz. A sensitivity control has been found to be unnecessary. In the author's unit, a remote v.t.v.m. is used in preference to a built-in meter. However, a 200-μa. meter in series with the 47K gate-leak resistor would provide similar results.

The extreme simplicity and overall good performance make this circuit very attractive for the experimenter. Further, it may be feasible to convert an old-fashioned tube unit to a more desirable solid-state circuit with a minimum of effort.—*Wes Hayward, W7ZOI*

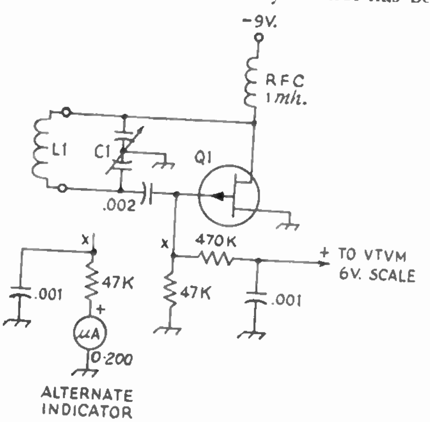


Fig. 10-14—"Gate-dipper" circuit. Resistances are in ohms (K = 1000); capacitances are in μf.

C_1—Dual-section variable; see text.

L_1—Plug-in coils for required ranges.

Q_1—P-channel junction FET (Fairchild 2N4342, 2N4360 etc.).

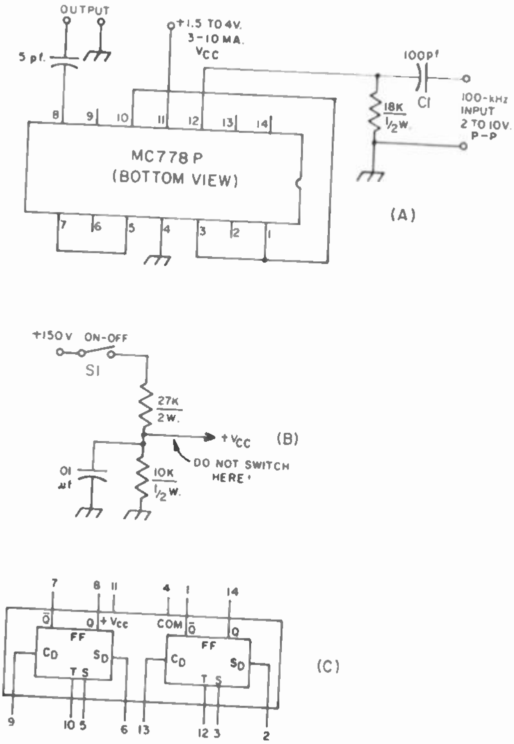


Fig. 10-15—(A) Divide-by-four circuit using a Motorola MC778P dual flip-flop integrated circuit. (B) Using the regulated 150-volt receiver supply to obtain operating voltage for the IC. (C) Functional drawing of the MC778P.

25-KHZ. MARKERS

WITH the new band subdivisions there are going to be many people wanting to know how to build or modify their calibrators to mark the edges. The circuit of Fig. 10-15 uses one $2.35 integrated circuit (two interconnected flip-flops) and your receiver's old 100-kHz. oscillator to give 25-kHz. markers simpl, cheaply and compactly without special adjustment or possible error such as might occur when you use a synchronized astable multivibrator.

The Motorola MC778P flip-flop is two type D flip-flops; in order for a type D to toggle (divide by two) when a pulse is applied to the T input the Q output must be connected to the S terminal; other than that, the circuit is straightforward. Flip-flops such as the Fairchild 923 or Motorola dual 790P unit are not recommended because their slight advantage in cost (35 cents) is offset by more severe power requirements; also, they require a faster pulse on the toggle terminal (about 0.1 µsec fall time) than an ordinary 100-kHz. oscillator might supply. The MC778P gave easily-distinguished 25-kHz. markers through 28 MHz. with 1.5 volts, although they were not loud. Using 3 volts gave even better results. The IC is made to work with 3.6 volts nominal.

A voltage divider can be used from a higher voltage power supply (B) to get the necessary 6 ma. or so to drive the IC; switch only at the high side of the supply in this case and put a transient suppression capacitor across the IC. Since there will be no output when there is no 100- kHz. input you can just keep the old 100-kHz. oscillator switching arrangement and let the IC run continuously. By the way, the divider will work well to several megahertz if you want to divide some other frequency by four.—*John K. Green, WØKPZ*

R.F. ATTENUATOR

The "Simple Step Attenuator," page 24, August 1967 *QST*, is a very helpful device. The rag chewer can give his fellow hams exact signal reports, as well as tell how strong one signal is compared with another.

The procedure is simple: Have one ham transmit a c.w. tone and switch in db.s until your S meter reads, say, S9. Now have another ham transmit, and then switch db.s in or out until S9 is achieved again. The change in attenuation gives the db. difference between the two signals.

Many other things can be checked—antenna adjustments, linear-amplifier gain, carrier suppression, S-meter calibration, to name a few.

While charts and tables giving data for attenuators are available, most hams I know want someone else to figure it out in advance. Table 10-I lists the factors needed for determining the values of attenuator resistors when the source and load impedances are identical and known.—*Joe Poston, K9GCE*

C AND L MEASURING GIMMICK

The box to be described will measure capacitance from 800 pf. to 0.8 µf. and inductance from 80 mh. to 80 h. when used with a calibrated audio oscillator and either an a.c. v.t.v.m. or an oscilloscope, hereafter referred to as the "detector." The device has no variable controls and is very easy to build and use.

The idea is to find the frequency at which the reactance of an unknown coil or capacitor is 10,000 ohms. Referring to the circuit, Fig. 10-17, the input from the oscillator, E_1, feeds a 10K resistor, R_1, in series with the unknown coil or capacitor. The oscillator frequency is varied to find the value at which the output voltage is 0.707 E_1 corresponding to a reactance of 10K. Since the output voltage of inexpensive oscillators will vary with the load, and since the load always has a reactive component and hence varies with frequency, the oscillator output can be expected to vary with frequency. To facilitate matters, the voltage divider made up of R_2, R_3, and R_4 always produces an output of 0.707 E_1 regardless of variations in E_1. With the switch in the "set" position, the operator

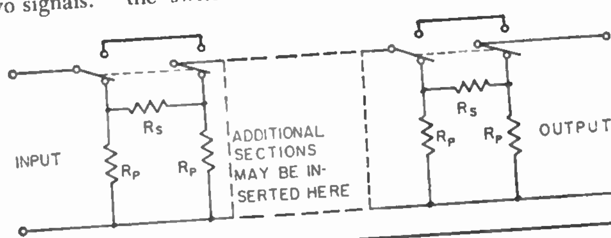


Fig. 10-16—Sectionalized symmetrical π attenuator. Additional sections may be inserted as desired. Combinations of the six sections listed in Table 10-I will give attenuation in 1-db. steps to 60 db.

Table 10-I

To determine resistance, values for R_s and R_p, Fig. 10-16, multiply the chosen design impedance value, Z, by the factors given below in the second and fourth columns.

Attenuation, db.	Series Factor	R_s for Z = 50	Parallel Factor	R_p for Z = 50
1	0.115	5.77 (5.6)	17.4	870 (910)
2	0.232	11.6 (12)	8.72	436 (430)
4	0.478	23.9 (24)	4.42	221 (220)
8	1.057	52.8 (51)	2.32	116 (120)
15	2.74	137 (130 + 6.2)	1.44	71.9 (75)
30	15.8	790 (750 + 43)	1.67	53.3 (51)

Values in parentheses in R_s and R_p columns are nearest standard values in 5 percent tolerance series.

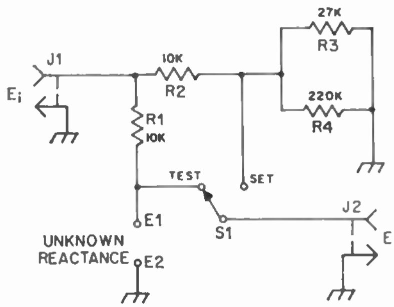


Fig. 10-17—Electrical schematic. All resistors are non-inductive—i.e. not wire-wound.

E_1, E_2—Binding posts.
J_1, J_2—Phono jacks.
R_1, R_2, R_3—1% tolerance, ½ watt.
R_4—5% tolerance, ½ watt.
S_1—S.p.d.t. rotary or toggle.

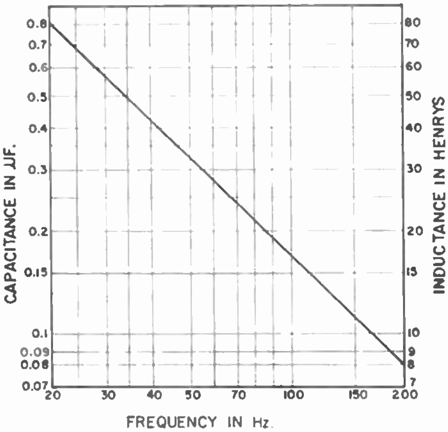


Fig. 10-18—Graph of unknown C or L vs. balance frequency. For decimal point, refer to Table 10-II. E.g., if the balance frequency is 350 Hz. the frequency is between 200 and 2000 Hz., so the capacitance is between 0.0795 and 0.00795 µf., or the inductance is between 7.95 and 0.795 henrys. The values at 350 Hz. therefore would be 0.045 µf. or 4.5 henrys.

f, Hertz	*C, µf.*	*L, henrys*
20	0.795	79.5
200	0.0795	7.95
2,000	0.00795	0.795
20,000	0.000795	0.0795

Table 10-II—Unknown Capacitance and Inductance over the usual frequency ranges of audio oscillators.

adjusts the oscillator amplitude and detector gain to a convenient reading. The switch is then thrown to the "test" position and the oscillator frequency is varied to obtain the same reading. As the reading is approached, the switch is thrown back and forth as small changes are made in the frequency until the point is reached where the detector reads the same with the switch in either position. The oscillator frequency is then read and substituted into the appropriate equation:

$$C = \frac{15.9}{f}\ \mu f. \qquad (1)$$

$$L = \frac{1590}{f}\ \text{henrys} \qquad (2)$$

where f is the balance frequency in Hertz.

Alternatively, the unknown value may be obtained from the graph, Fig. 10-18. The location of the decimal point is facilitated by reference to Table 10-II.

If non-inductive (i.e. not wire-wound) resistors of the specified tolerances are used, the accuracy will be limited primarily by the accuracy of the oscillator frequency calibration.—*Frank W. Noble, W3QLV*

ECONOMATCH REFLECTOMETER

The usefulness of the Monimatch-type reflectometer has been proven over and over again. The main advantage of the unit shown here is its one-piece construction, combining the bridge and indicator in one relatively-compact box. In addition it can be built, using all new parts, for less than five dollars and should take even the most inexperienced builder only a couple of evenings to complete. The pick-up element used in the "Economatch" is the same as the one described by McCoy in an earlier issue of *QST*.[1]

The "Economatch" (Fig. 10-19) is built in a 5 × 2¼ × 2¼-inch Minibox. We centered our level control and flanked it by the meter and the switch as shown. The coax connectors are mounted 1½ inches back from the front panel. Rubber feet were added to the box to prevent scratching the operating table. The rectangular holes for the switch and meter can be easily filed out. The meter is mounted by using a U-shaped bracket which is in turn fastened to the front panel with two screws. The U cut-out in the bracket was made with a half-round file. Each coax connector is mounted on the inside of the box, using four screws and lock-type solder lugs.

The pickup unit is made from a 6-inch length of RG-8/U coaxial cable. First the outer jacket is removed and then the copper braid is carefully slid clear. The remaining cable is cut to 4¼ inches total length, and then a 3/16-inch section of the insulating material is removed from each end. The pick-up wires are 4¼-inch lengths

[1] McCoy, "A Versatile Transmatch," *QST*, July, 1965.

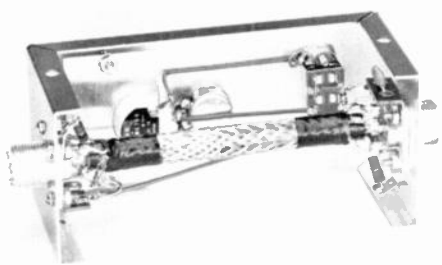


Fig. 10-19—Interior view of the "Economatch." The meter is partly visible at the left, under its flat U-shaped mounting bracket. Method of grounding the braided sections of the outer conductor of the cable section is shown at each coaxial connector.

of No. 16 enamel-coated wire. It's best to scrape off the enamel about ⅜-inch from each end and tin the leads before assembling the pickup. The pickup wires are then taped to the 4⅛-inch length of conductor, each pickup wire on opposite sides of a given diameter. Taping the entire length of the pickup wires will help prevent slipping.

Next, the copper braid is slipped over the entire pickup assembly. Pull the braid at each end until it fits snugly over the conductor. Now tightly wrap a length of electrical tape around the braid and conductor ¾-inch from each end. Next, twist four braids at each end of the large copper braid until the newly-twisted braids reach the tape. All eight braids should now be tinned. Each of these braids connects to a solder lug mounted on the coax connector. The termination resistors, R_1 and R_2, go directly from the pickup wires to a solder lug. The diodes

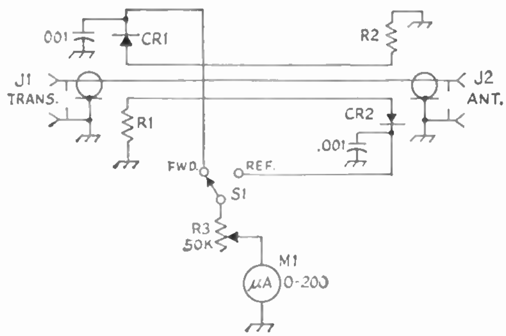


Fig. 10-20—The "Economatch" circuit. Capacitances are in μf.; fixed capacitors are disk ceramic.

CR_1, CR_2—Germanium diode, 1N34A or equivalent.
J_1, J_2—Coaxial receptacle, chassis-mounting (SO-239).
M_1—Miniature 0-200 microammeter.
R_1, R_2—For 52-ohm load, 68 ohms; for 70-ohm load, 47 ohms; ½-watt composition.
R_3—Miniature linear control, 50,000 ohms.
S_1—S.p.d.t. slide switch.

are connected between the pickup and a terminal strip. Care should be taken when installing the diodes to avoid heat damage, and also to use the proper polarity.

When construction is completed the unit may be calibrated, if desired. The values given for R_1 and R_2 (Fig. 10-20), although nominal, are fine for all but the perfectionist. Remember that the sensitivity control should be set at maximum resistance to start with, to avoid meter burnout.

Should you desire to calibrate the Economatch, a dummy load of known impedance should be used. Observe both reflected and forward readings on the highest band to be used (up to 30 MHz.). If the reflected reading is greater than one division for a full-scale forward reading, the termination resistance in the reflected circuit should be slightly altered—say two or three ohms plus or minus. The symmetry of the Economatch can be checked by reversing the input and output connections. Once you're satisfied with the null the unit is ready to go. Remember, though, the Economatch is only a relative indicator and should be treated as such.—*Robert E. Anderson, K1TVF*

SINE-TO-SQUARE WAVE ACCESSORY FOR AUDIO GENERATORS

Square waves are useful for testing audio and radio equipment, digital and pulse circuits, plus microphones and relays. A good book says so! But after examining the prices on square-wave generators, the writer decided to try and adapt the old shack audio oscillator to produce "economical" square pulses.

The gadget shown in schematic form in Fig. 10-21 is the result of a little reading and a lot of tinkering. When driven by an audio generator, it will produce square-wave pulses of excellent symmetry (on and off times equal) and rise time.

The basic circuit, which evolved from an idea suggested by Jack Shagena and Aaron Mall of Bendix, uses a Schmitt trigger. This configuration produces a positive output pulse for each positive swing of the input signal. The pulse length is determined by the input voltage. Thus, symmetry can be adjusted with the output control of the audio generator. Although normally set for 50 percent "on" time, the duty cycle can be reduced to 20 percent or so by reducing the generator's output.

An emitter follower is used to isolate the trigger circuit from the load. The emitter resistor, R_1, is the output control. The popular 2N404 transistors are used, although any of the 50-odd other similar switching types will work as well.

The unit was constructed on a homemade 2 × 3 × 5-inch open-end chassis. "Nonmetal-benders" can use a Bud C-1788 or a Minibox of appropriate size. The circuit is built on Vectorbord, with the parts mounted on top and the interconnections made below. As there was

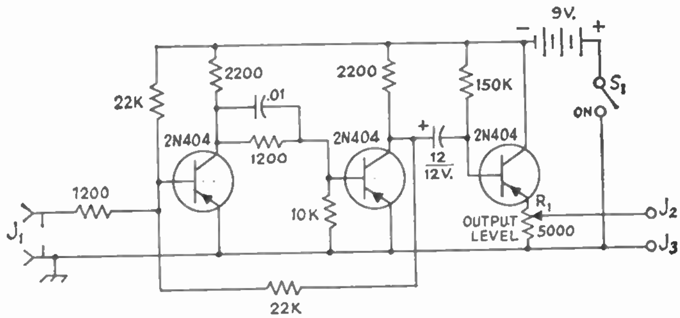


Fig. 10-21—The circuit of the sine-to-square wave accessory. Resistances are in ohms (K = 1000); resistors are ½-watt composition. Capacitances are in μf.; the 0.01 capacitor is a ceramic disk; capacitor with polarity marked is electrolytic.

J_1—Phono jack.
J_2, J_3—Banana-jack-top binding posts.
R_1—Linear-taper control.
S_1—S.p.s.t. slide switch.

no battery clip in the junk box, the battery was simply tied to the board with lacing twine.

Each side of the chassis bottom was covered with a strip of "Flan," a sticky-back flannel material (sold in discount stores) that makes excellent scratch-proof feet.

The gadget requires an input of approximately 6 volts peak to peak for 50-percent duty cycle, producing an output of 8 volts peak to peak. The rise time at 1000 Hz. is 2 microseconds.—*Douglas A. Blakeslee, W1KLK*

CAPACITANCE CHECKER

Most experimenters have an accumulation of mica, ceramic and variable capacitors whose values are unknown as a result of faded markings, strange color codes, or no markings at all. These capacitors can be measured with the aid of the Picofarad Picker—"P Picker," for short.

The P Picker is an inexpensive grid-dip-meter accessory that makes it possible to measure small values of capacitance with ease and accuracy. It is true that an accessory to the grid-dip meter is not required to measure capacitance, but the use of the P Picker can result in better accuracy and is a great deal more convenient than interpreting the capacitance-*vs.*-frequency chart of a coil of known inductance.

The principle of operation is simple. Consider the resonant circuit shown in Fig. 10-23. The resonant frequency is measured with the variable capacitor set at maximum. This is done once when the instrument is built, and the information is recorded for future use. If an unknown capacitor is connected across the output terminals, the variable capacitor will have to be reduced in capacitance in order to restore resonance as indicated by the g.d.o.; the value of the unknown can be read from the variable-capacitor dial assuming it has been calibrated ahead of time.

Any coil and capacitor can be used as long as the combination resonates within one of the lower frequency ranges of the g.d.o. The components employed by the author resonate at an easy-to-remember figure of 5 MHz. A slug-tuned coil has been used so that the basic resonant frequency can be set to exactly this value. The variable capacitor should have semi-circular plates if linear calibration is desired. The capacitor specified makes it possible to measure from 0 to 150 pf. A second unit containing a larger variable capacitor can be built if it is desired to measure higher values of capacitance. The low cost of these units makes this feasible. A metal box should be used to minimize hand-capacitance effects. The box shown in Fig. 10-22 measures four inches cubed; it is large enough for a good-sized dial but yet not too bulky. The coil is mounted in a plastic pill-bottle cover on the outside of the box so that it lines up with the g.d.o. coil when both instruments are on a flat surface. The coil cover is the pill bottle itself.

Six capacitors are required for calibration: three 20 pf. and one each of 10, 33 and 47 pf. They should be either mica or silver mica with a tolerance of ±5 per cent or better. Ceramic capacitors are not satisfactory due to their loose tolerance. Before calibrating the P Picker, combine two 20-pf. capacitors in parallel to form a 40-pf. unit and connect the 33- and 47-pf. capacitors in parallel to make an 80-pf. unit. Then set the capacitor in the P Picker to maximum. Mark this point 0 on the dial. Measure the resonant frequency and adjust the coil slug until the circuit resonates at 5 MHz. Secure the slug in place with a lock nut or dab of glue. Now, without changing the frequency of the g.d.o., connect the 10-pf. capacitor to the output terminals and rotate the P Picker dial until the g.d.o. again indicates resonance. Mark this point 10 on the dial. Disconnect the 10-pf. capacitor and connect the 20-pf. unit.

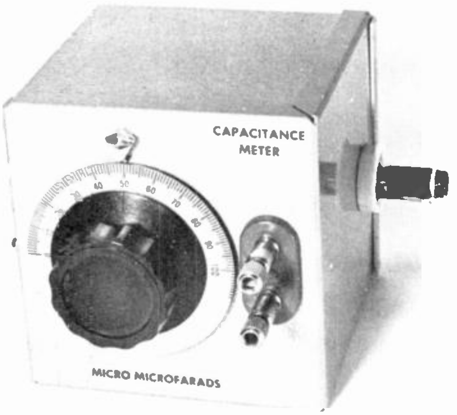


Fig. 10-22—An LMB type 444EL Flanglock box is used to house the P Picker. The coil on the right side of the box is mounted in a plastic pill-bottle cover. By inserting the bottle in its cover, the coil is protected from possible damage.

Rotate the dial until an indication of resonance is obtained and mark this point 20. In a like manner use the other capacitors to obtain calibration points. Calibration marks every 10 pf. from 10 to 150 pf. can be obtained by using the calibrating capacitors either singly or in parallel. For example, 70 pf. would require the use of the 10-, 20-, and 40-pf. capacitors in parallel. 150 pf. requires the use of all capacitors in parallel. Following calibration the instrument is complete and ready for use.

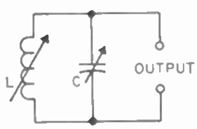


Fig. 10-23—Schematic of the P Picker.

C—140 pf. variable (Johnson 149-6).
L—5.0–9.0-μh. adjustable (Miller 4505).

Employ the lightest possible coupling between the P Picker and the g.d.o. that will give an indication on the meter. Set the P Picker dial to zero and resonate the g.d.o. to the P Picker frequency when starting a test. Do not change the frequency thereafter. Try to maintain the same degree of coupling throughout the tests. The P Picker will prove surprisingly accurate if these precautions are observed and will soon repay its modest cost in salvaged capacitors.—*Melvin Leibowitz, W3KET*

IMAGE DIPPER

While listening for intruders in the amateur bands, I began to wonder if I was actually hearing intruders or some combination of beats and signals cooked up by my receiver. An idea came to mind for a gadget that would indicate if a signal was in an amateur band or elsewhere. Over a period of years, I had used series-tuned traps to get rid of a lot of things I didn't want to hear. Now a calibrated series-tuned circuit would help me to identify the frequency of an interfering signal.

The gadget is pictured in Fig. 10-25 and its circuit in Fig. 10-24. All of the parts came from my junk box. By using plug-in coils, I was able to cover the two ranges I was most interested in, 6.2 to 14 MHz. and 13.8 to 23 MHz. Old octal tube bases made good no-cost coil forms.

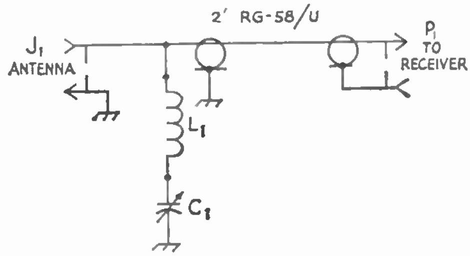


Fig. 10-24—Circuit diagram of the image dipper. J_1 is a phono jack and P_1 is a phono plug. The component values given below may have to be changed to obtain the designated ranges, depending upon the receiver input circuit.

C_1—140-pf. variable.
L_1—6.2–14 MHz.: 8 turns No. 22 enameled, 1¼-inch diam., closewound on octal tube base.
13.8–23 MHz.: 5 turns No. 22 enameled, 1¼-inch diam. closewound on octal tube base.

Fig. 10-25—W8ZCQ's image dipper. The cable at the right is part of a two foot length of RG-58/U that terminates in a phono plug.

Phono connectors were used to mate with existing fittings on my receiving equipment. The tuning capacitor was from an old f.m. tuner and the scale was just a sheet of heavy white paper pasted on the front of an old utility box. The words "image dipper" on the face of the unit point out the fact that many of the signals that I thought were intruders turned out to be images.

Calibration of the image dipper is simple if a grid-dip oscillator is available. Connect the series wave trap to the antenna-input terminals of the receiver and attach the receiving antenna to the image dipper. With the g.d.o. loosely coupled to the trap, mark as many calibration points as desired on the dial scale. Note, however, that switching the receiver to another band or varying the input circuit may effect the accuracy of the calibration. To use the image dipper, simply tune the gadget through its range while listening to a suspected intruder. If the signal doesn't disappear or become greatly reduced in strength when the dipper and the receiver are tuned to the same frequency, the "intruder" is not an intruder at all, but is some sort of receiver product.—*Dan Umberger, W8ZCQ*

A 300-OHM STANDARD FOR THE TRANSMATCH

Many radio amateurs use balanced feeders, and 300-ohm twin lead is a common choice among these operators. Effecting an impedance match between the balanced transmission line and the antenna is difficult to do when one does not have a balanced-line type s.w.r. bridge. Admittedly, a coaxial balun can be inserted between the 300-ohm antenna and the feed line so that a 75-ohm unbalanced s.w.r. bridge can be used, but at the lower frequencies a coaxial balun becomes unwieldy. A coil-type balun transformer can be used, but what if one isn't readily available when needed?

A simple solution lies in the use of a transmatch and a 300-ohm noninductive load. The 300-ohm standard is attached to the transmatch in place of the antenna feed line, an s.w.r. bridge is connected between the transmitter and the transmatch, and the transmatch is adjusted for a 1:1 s.w.r. The dial readings on the transmatch are noted and when the feed line is again connected to the transmatch, the matching network at the antenna is adjusted for a 1:1 s.w.r. with the transmatch dials set at the same position as for the 1:1 condition when the 300-ohm load was attached.

Simple? Yes, but let's talk about the standard and how it's built.

The dummy load shown in Fig. 10-26 will handle 20 watts of r.f. power (sustained) and up to 50 watts for periods of 10 seconds or less. Generally, the station exciter can be used for the antenna tests, keeping the power output within the limits specified for the 300-ohm standard. The standard will present a 300-ohm impedance (non-reactive) from 1.8 to 30 MHz. A deterioration in performance was noted at 50 MHz., resulting in an impedance reading of 220 ohms when the unit was tested on a Boonton 250-A *RX* meter. Hence, it is not recommended that the load be used as a standard above 30 MHz.

The unit is made up from six 1-watt, 1800-ohm resistors. When parallel connected, the resistance becomes 300 ohms. For best accuracy, 5-percent resistors should be used, but by hand-selecting 10-percent resistors, it should be possible to obtain the 300-ohm figure.

The resistors are mounted between a pair of 1-inch diameter copper or brass disks, and are spaced around the perimeters of the disks as shown in Fig. 10-26B. Make certain that the body of each resistor is flush against the disk before soldering the pigtail to the disk. When soldering, do not overheat the assembly because this can change the value of the resistors.

Two E. F. Johnson binding posts are mounted on the lid of a small paint can (mine measures 2½ inches in diameter by 2¾ inches high), using rubber gaskets between the bases of the posts and the lid. The resistive load is soldered to the tips of the binding posts. A relief valve, made from a 4-40 bolt and nut, 2 washers, and a small spring, is installed on the lid to provide a safety outlet in case the load becomes too hot.

The completed assembly is pressed into place on the main body of the can after the container has been filled with transformer oil. Mineral oil was found to be a good substitute. Use only enough oil to completely cover the resistors and the copper disks.

Other values of resistance can be made up for working with different antenna impedances. By using 6 resistors in the configuration shown, the reactance should remain low.—*W1CER*

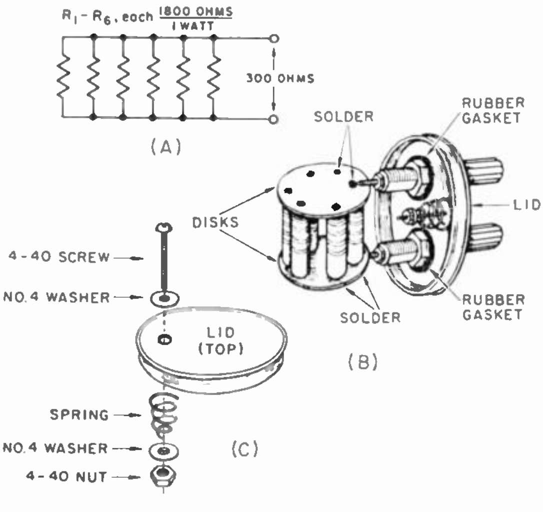


Fig. 10-26—Schematic and sketch of the dummy load.

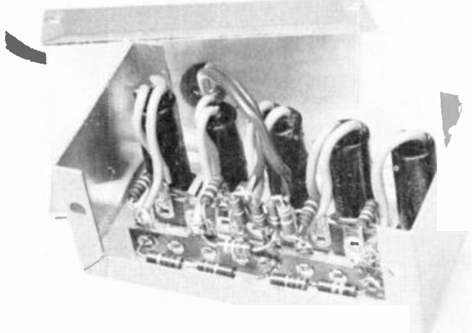


Fig. 10-27—View inside the Minibox shows the terminal-strip mounting of the resistors. The neon-lamp indicator assembly is a one-piece molding.

READOUT A.C.-LINE VOLTMETER

THE inexpensive gadget shown in Fig. 10-27 can be built in a few hours and will relieve your regular workbench voltmeter for other jobs. Simply plug it in the a.c. line and observe the neon-lamp indicators on the panel. If the 105-volt and 110-volt lamps are lit while the 115-, 120-, and 125-volt lamps are not, then the line voltage is 112 volts, plus or minus 2 volts. Of course, the device can be designed for finer or coarser voltage resolution.

Built in a 4 × 2 × 1¾-inch Minibox (Bud CU-2102A), the readout voltmeter consists of neon lamps and resistors. Almost any neon lamp can be used; the ones shown in Fig. 10-27 were found in a "bargain barrel" at a local radio and TV parts supplier. The lamps are part of a complete molded neon-indicator assembly which snaps into the panel holes. The voltage-dividing resistors are all ½ watt and are mounted on two lug-type terminal strips (H. H. Smith type 870).

Because of variations in the neon lamps and because of resistor tolerances, resistor values must be arrived at empirically, although simple Ohm's Law calculations will get the values in the ball park. Since the neon lamps will fire somewhere around 65 volts or so, the lamps are connected across resistors that will have a drop of 65 volts when the line voltage reaches the desired value. In the case of a 1/25-watt lamp (such as the NE-51), a line voltage of 130, and a total resistance across the line of 30,000 ohms, the lamp will fire when connected across 15,000 ohms.

Because of capacitance and unbalances in the a.c. line, it is necessary to maintain electrical and mechanical symmetry in the resistor network. This is the reason, as shown in Fig. 10-28, for splitting the resistance into equal segments on either side of the lamp and its parallel resistor. For example, in Fig. 10-28, I_4, (120-volt indication) is across 15,000 ohms, R_4. R_{14} and R_9 should add up to 12,800 ohms, or 6400 ohms each.

For an NE-51 and a shunt resistor of 15,000 ohms, the total calculated dropping resistance (R_6 + R_{11}, etc.) for various line voltages is: 105 volts–9300 ohms, 110 volts–10,500 ohms, 115 volts–11,600 ohms, 120 volts–12,800 ohms, 125 volts–14,000 ohms, and 130 volts–15,000 ohms.

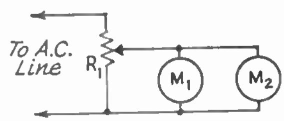


Fig. 10-29—Circuit for calibrating the readout meter.

R_1—50,000 ohm potentiometer (see text).

M_1—Readout a.c. voltmeter.

M_2—Calibrating meter (v.o.m., v.t.v.m., etc.).

Calibrating the readout voltmeter can be done with a Variac and the shack voltmeter. Place the calibrating voltmeter and the readout voltmeter across the line from the Variac. As the Variac is advanced, note and record the voltage at which the various neon lamps fire. If a specific voltage indication is desired, it will require some filing of "V" notches in the

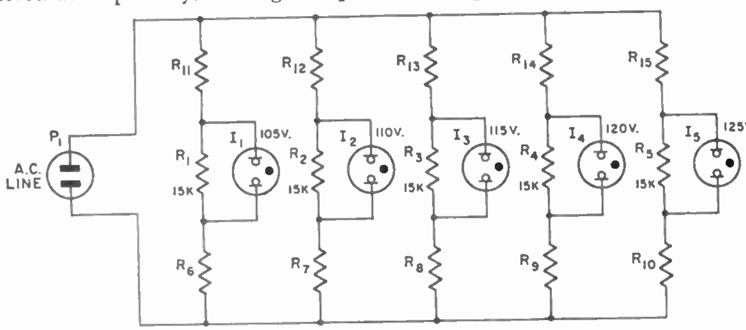


Fig. 10-28—Diagram of the readout voltmeter.

I_1–I_5 inc.—Neon lamps (NE-51, etc.).

R_1–R_5 inc.—15,000 ohm ½-watt resistors.

R_6–R_{15} inc.—Values depend on neon lamps used. See text.

resistors to change their values to give the required resistance. This filing technique works only with composition resistors and always *increases* the resistance.

If a Variac isn't handy for the calibration procedure, a potentiometer of 50,000 ohms or so will do just as well. Connect the pot as shown in Fig. 10-29 and carry out the calibration as described above. *Caution—high voltage:* use an insulated knob on the control and be careful of your "grounds."—*W1CUT*

KIT CHECKER

There is always a need for checking out a piece of equipment after it has been assembled from a commercial kit. Homemade equipment is deserving of the same treatment. One way to be sure that the gear won't go up in smoke when it is first turned on is to go over all of the wiring, completely and carefully, checking resistance readings from B plus to ground, across the transformer windings, and in other parts of the circuit where resistance readings can be compared against those given in the instruction manual.

A more certain way to avoid smoking components when you first turn the switch to ON, is to install the simple tester described in this article, between the equipment and the 115-volt line. The kit checker protects the gear being tested, even if a dead short is present in the circuit. The checker places an ordinary 115-volt incandescent lamp in series with the a.c. input to the pieces being tested, thus causing the bulb to consume power from the line when a shorted, or partially shorted circuit exists. The checker also includes a means for measuring the a.c. current being drawn by the equipment.

Ordinary household electrical hardware can be used to build the checker of Fig. 10-30. The layout used should insure against accidental contact with the 115-volt line. A wooden box can be used to house the unit, or a metal utility cabinet will work nicely. The lamp socket, X_1, can be the porcelain variety used for surface-type house wiring. All components can be purchased for less than two dollars.

As mentioned earlier, the equipment should be given a careful inspection, visually, then checked for proper resistance readings as specified in the instruction book. Once this has been done, the line cord from the equipment can be plugged into J_1 of the tester. Next, plug a 25-watt, 115-volt lamp into socket X_1. Place S_1 in the ON position. When the equipment under test is turned on, the bulb should light to approximately half of normal brilliance if no serious shorts exist. If the bulb becomes *very* bright, this indicates that an abnormally heavy load is being drawn by the equipment and that a short or partial short is present. The larger the lamp used, the greater will be the amount of current that can flow to the load. A 25-watt bulb will allow up to 0.25 ampere to flow. A 50-watt bulb will permit a flow of up to roughly 0.5 ampere. A voltage reading can be taken across the lamp at any time and if this reading approaches that of the line voltage itself, there is trouble in the equipment under test.

If the equipment is working normally, its voltages (bias, B plus, and filament) will be lower than specified by the manufacturer when the tester is in series with the line. The larger the bulb used at X_1, the higher the circuit voltages will be.

Once it is determined that the equipment is working properly, the light bulb can be replaced by a fuse of appropriate value for the equipment being tested. Generally, a 5-ampere fuse will suffice for all but the largest of equipment. Next, the voltage across R_1 can be measured, with S_1 open, to determine how much current is being drawn by the equipment. A voltmeter is connected between E_1 and E_2. A reading of one volt, for example, equals one ampere of current. Five volts equals five amperes, and so on. CAUTION: Resistor R_1 will handle a maximum of five amperes, only, so make the tests short in duration. Combinations of paralleled 25-watt resistors can be used to permit measurements on larger equipment, if desired.[1] Although R_1 will not be a precision unit, the results of the tests will be accurate enough to permit a comparison between the manufacturer's stated current figures and those that are calculated from the voltage drop across R_1.

The checker can be used to trouble shoot appliances, also, such as toasters, electric irons, motors, and the like. It is useful for working on all types of electrical equipment.—*Boleslaw A. Skurnowicz, W3OSJ*

[1] If size and cost are not of great importance to the builder, larger resistors can be used at R_1. One-ohm resistors are available in 100-, 175-, and 225-watt ratings. —*Editor*

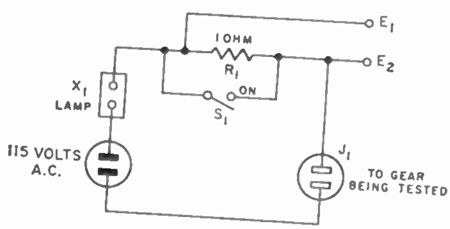


Fig. 10-30—Schematic diagram of the kit checker. X_1 is an incandescent lamp socket, test points E_1 and E_2 can be insulated pin jacks, and S_1 can be any s.p.s.t. switch that will handle the current being drawn through the circuit. R_1 is discussed in the text. J_1 is a female a.c. receptacle.

Hints and Kinks . . .

for Equipment Construction

EQUIPMENT LABELING

I use india ink for equipment labeling and get results at least comparable to press-on letters. Employed are a special lettering pen ($2.50 three years ago) and special lettering guides ($3 to $5 each). They are made by WRICO (Wood-Regan Instrument Company), Nutley, New Jersey, and can be ordered through or obtained directly from most office supply or stationery stores. Lettering guides come in a wide variety of letter sizes and styles, with the recommended size of pen tip increasing with the size of the letter. I find the VCN 120 lettering guide and the No. 7 lettering pen excellent for normal panel labeling. A larger guide, the VCN 200, works fairly well with the No. 7 pen, although it was intended to be used with a pen having a thicker tip.

An almost unlimited variety of markings can be made with any one lettering guide. Added flexibility lies in the fact that india ink is available in a number of colors. If one makes a mistake, he can easily remove the ink from bare or painted metal surfaces by licking a finger and rubbing the mark away. After the lettering is completed it should be covered with a transparent coating. I have successfully used both Krylon crystal clear spray lacquer and finger nail polish, the latter being a little tricky to apply to some types of painted surfaces. To be sure the coating will cause no harmful effects, one should experiment first on a hidden corner of the surface to be covered.

A little practice with this lettering method can lead to some really good-looking results. A disadvantage is the initial cost. Once a pen and lettering guide are purchased, the expense is negligible since a bottle of india ink is both inexpensive and hard to use up. For best results I recommend that the pen be cleaned with a cloth and warm water after each use.—*Tim Walling, K9APS*

IMPROVED METHODS FOR WIRING 83-1SP (PL-259) PLUGS

Wiring 83-1SP plugs can be annoyingly difficult. Many amateurs do not follow the manufacturers' instructions to tin the braid before inserting the coax into the plug, because they find it impossible to fit cable with tinned braid into the body of the 83-1SP. This is due to the fact that the diameter of the shield increases when the braid is trimmed, since it is impossible to cut the shielding without disturbing it. However, if the method to be described

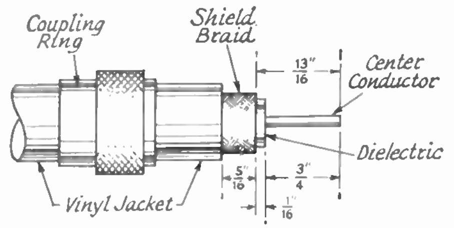


Fig. 11-1—Coaxial cable as prepared for insertion into an 83-1SP plug. See the text for details.

is used, the shielding is not upset, the trimmed braid does not become overly large, and the plug can be screwed onto the cable without difficulty. Here is the procedure:

1) Referring to Fig. 11-1 remove 13⁄16 inch of the vinyl jacket.

2) Remove 13⁄16 inch of the braided copper shielding. This is easy to accomplish with a small fine-ridged file. First cut the braid with a corner of the file. Then remove all the stray ends of the wire shield, by rubbing the flat side of the file against the edge of the vinyl jacket.

3) Bare ¾ inch of the center conductor and tin the wire.

4) Remove 5⁄16 of the vinyl jacket and tin the exposed braid.

5) Screw the plug on the cable. At the four body holes, solder the braid to the connector, and solder the center conductor to the tip of the plug.

6) Screw the coupling ring on the assembly. —*Samuel Ansel, WB2MOI*

Some hams do not tin the braid of RG-8/U when wiring 83-1SP (PL-259) plugs to the coax, because they find it hard to insert a tinned cable into the connector. The result can be poor shield-to-connector contact or a possible short circuit between the center conductor and stray wires of the braid. However, these problems don't need to occur, since there is a satisfactory way of preparing tinned braid. Referring to Fig. 11-2A, remove 1⅛ inches of the vinyl jacket, and tin the braid as shown. Then using a tube cutter, such as the type used to cut copper pipes, remove 13⁄16 inch of the braid (Fig. 11-2B). Next move the cutter toward the end of the coax and remove ¾ inch of the dielectric. With this method, you can cut as deeply as you wish, and the work can be inspected as you go along. To complete the installation, slide the coupling

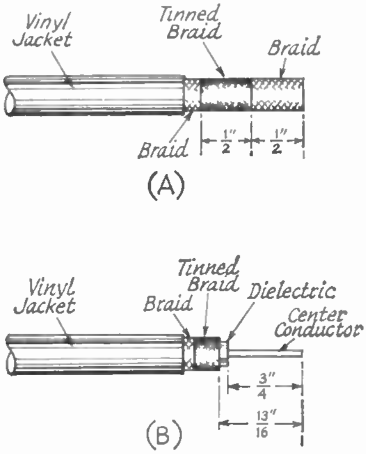


Fig. 11-2—Steps for preparing RG-8/U for installation in 83-1SP connectors.

ring on the coax, insert the cable into the plug, solder the shield to the body, and solder the center conductor to the tip of the connector.—*Epps Griffin, W5IIBD*

For about fifteen years I have been using the following method to install 83-1SP connectors on coaxial cable. Although over a kilowatt has been run through the connectors, there have never been any breakdowns. The prepared cables look professional, and the continuity of the outside conductor is about as good as it can be.

Remove about two inches of the vinyl cover. With a 100-watt soldering iron, tin the braid from about ⅜ inch from the vinyl to near the end. After the shield has cooled, cut the braid and polyethlene dielectric ⅝ inch from the vinyl. In order not to nick the center conductor, cut only part way through the dielectric. Flex the polyethelene at the cut and it will break free. Place the couplıng shell on the cable and then attach the connector. Thread the end of the vinyl into the plug until the braid bottoms. Put a dab of solder in one hole of the body, being sure that the heat transfer is from iron to body to braid to solder. For good continuity between the braid and the connector, it is very important that the heat from the braid melts the solder. It is not necessary that the hole be filled with solder; the solder should run inside the body and help complete the connection. Finish the job by soldering the center conductor to the tip of the plug.—*Frank A. Eberhardt, W6VLR*

NEW FACES FOR OLD METERS

Recently I built a regulated d.c. power supply using transistors. Not having a well-stocked junk box, the only devices I could find for monitoring the output voltage and current were two surplus VU meters. The meters were the right size and they worked well when properly shunted. However, the meter faces were horrible. They had uneven orange graduations on a black background.

The faces were too small to be redrawn by hand, since they measured only 1 by 1½ inches. In addition, my fingers are not very small and my drafting capabilities are extremely limited. These factors caused me to use the photographic method to be described.

A Poloroid Land camera with a close-up lens attachment is used to photograph a hand-drawn template of the desired scale. At a focusing distance of 9⅞ inches, any object on the finished print will be half its original size. By drawing the scale twice its original size—a rather simple undertaking—you can easily produce the exact meter face needed.

A compass, ruler and scissors are the only tools required to make the template. Draw the meter face on bright white drafting paper. A lettering set for the numbers will add to their appearance, but it isn't a must if a little patience is used.

Two 75-watt lamps near the template will provide sufficient light for the photograph. Once the picture it taken, cut a hole for the meter pointer and two mounting screws, and then trim the print as required.

Remember that since the finished picture from a Poloroid is 3¼ by 4¼ inches, any meter face below this size can be made. Each black and white photograph costs only 25 cents. As can be seen from Fig. 11-3, the results are professional looking.—*John Michael Shaw, K2LRE/KL7*

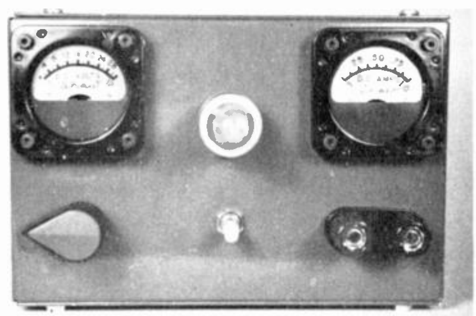


Fig. 11-3—The two meters shown on this d.c. supply have homemade faces. See the text for details.

COMPONENT SOURCE

One source of parts for the beginner or those with limited finances is a junk yard. Many of the components I have used in my rig have been purchased at the low price of ten cents per pound from an iron and metal company. The parts, of course, are not new, but work well if cleaned and fixed up a bit. For a few cents there are many excellent power transformers just waiting to be bought and used.—*Mark Bauer, WA9MJT*

SEPARATING KIT PARTS

While putting together electronic kits, I have often found it to be quite a problem to store resistors, capacitors and other small parts, so that any particular component could be located without difficulty. I recently solved this situation during the construction of my HW-32A. As shown in Fig. 11-4, I placed vertical strips of masking tape (sticky side up) about two inches apart on a piece of cardboard. This permitted all the small components to be stuck to the tape until they were needed.—*Jack C. Andrews, W9YWE*

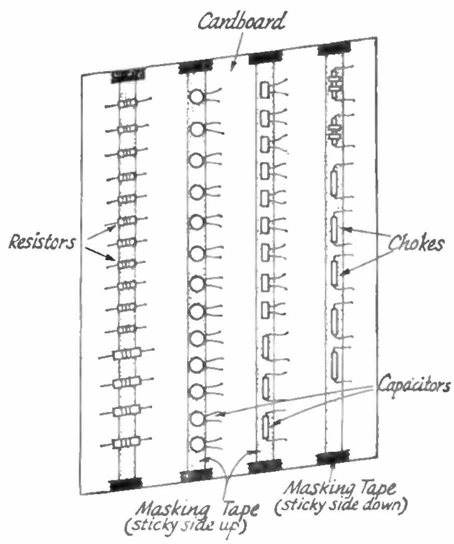


Fig. 11-4—W9YWE's method of separating kit parts.

EQUIPMENT CABINET

The next time you need a small cabinet for a portable or mobile rig, try a child's lunch box. To protect the components that protrude from the front of the container, handles can be installed as shown in Fig. 11-5. In order to service the unit, it is only necessary to unsnap the fasteners on top of the box.—*Mike Bailey, WB4DCW*

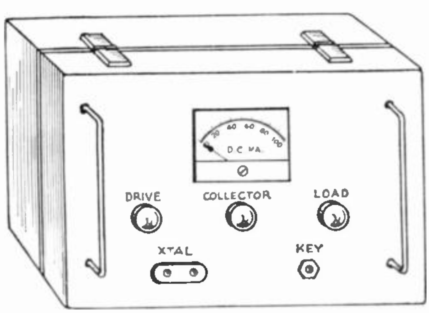


Fig. 11-5—A child's lunch box used as a transmitter cabinet.

COAXIAL SWITCH

When constructing a coaxial switch like the one described in the article "A Really Rugged Coaxial Switch" in *QST*, January 1967, do not use only one type of connector. Invariably you will want to use a different type of fitting later. I constructed a similar switch sometime ago, made three connectors alike, and then added one type N and one type BNC fitting. It is surprising how handy it has been to have various types of connectors available on the switch.—*Lester Harlow, W4CVO/6*

INSULATED SHAFT EXTENSIONS FOR PRINTED-CIRCUIT CONTROLS

Insulated shaft extensions for printed-circuit potentiometers with ⅛-inch shafts can be made easily from the dielectric of large-diameter coaxial cable. Simply cut a section of the cable to the desired length, remove the braid and center conductor, and drill a ⅜-inch deep, 7/64-inch diameter hole in one end of the dielectric. Then jam-fit the piece onto the control as shown in Fig. 11-6. To prevent damaging the circuit board while installing the extension shaft, it is wise to support the control from below the board.

I find this kink very useful for the VOX controls in my Heath SB-400 transmitter, where occasional adjustment is desirable but somewhat difficult if a screwdriver must be used.—*Father Ray Backes, KØTYY*

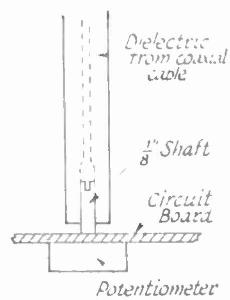


Fig. 11-6—An extension shaft for hard-to-reach controls.

COIL-WINDING TIP

It can be difficult to remove a homemade self-supporting close-wound coil from a winding form without distorting the coil. However, by using the following method, this need not be the case. First close-wind the form with a layer of plastic fishing line. Then add a few layers of wax paper, using tape to hold the paper in place. Next wind the coil, and dope it thoroughly. After the coil has dried, pull out the fishing line from both ends. The coil should be loose enough to remove intact.—*Charles W. Kram, Jr., W5TFZ*

WINDING SMALL TOROIDS

The winding of small toroid coils is eased if the wire is threaded in a common sewing needle.—*M. E. Deck, WA6JVF*

SIMPLE BANDSPREADING SYSTEM

The bandspreading scheme shown in Fig. 11-7 has been used in several applications at my station. It permits the remote tuning of resonant circuits. For example, I use the original dial mechanism and 350-pf. tuning capacitor from a standard broadcast receiver to tune the high-frequency oscillator in my 6-meter receiver. In this case, a two-turn link gives a tuning range of 2 MHz.

Increasing the number of turns on the link, positioning the link closer to the coil, and increasing the value of the remote-tuning capacitor contribute to greater coverage. Low-capacitance line also helps to achieve this end.—*William L. North, W4GEB*

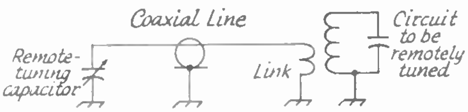


Fig. 11-7—W4GEB's bandspreading system. Component values are discussed in the text.

PEBBLE-GRAIN FINISH

After several experiences with wrinkle-finish spray paint that failed to wrinkle uniformly over the surface to which it was applied, a pebble-grain finish was developed that is economical and foolproof. This attractive finish can be applied in the following manner.

Give the surface a coat of the paint to be used. (Surfaces that have been finished previously in the desired color need not receive this first coat.) For the usual black finish, ordinary sash-and-door paint is satisfactory. Once the first coat is dry, apply a thicker second coat. Immediately sprinkle an excess of builders' sand (a fine grade of sand used to give plaster a textured finish) on the painted surface. The sand will take up the paint by capillarity. After a minute or more, tip the painted surface and let the excess sand roll off. Once the second coat has dried in the imbedded sand, apply a very thin final coat. Completely cover the exposed surface of the sand grains, using a brush having short, stiff bristles. The result should be a dull, pebble-grain finish with an occasional sparkle from the surface of a few of the sand grains. The thicker the final coat is painted, the smoother and more glossy will be the surface. Areas that may not have had enough of the second coat of paint to cause adherance of the desired amount of sand can be touched up before or after application of the final coat.—*Charles A. Black, KØRH*

MAKESHIFT RUBBER FEET

Temporary feet for a piece of home-built equipment can be made from Dr. Scholl's Adhesive Foam. This material is made of foam rubber with adhesive on one side and comes in 6 by 6-inch sheets. It is available from most drugstores and can be cut to any desired shape. I have used it on the underside of my transmitter chassis and on the bottom of my key-mounting board to keep it stationary during use. —*Jeff Bauman, WB2WRH*

WINDING COILS

When winding coils of small gauge wire, it often becomes difficult to maintain the desired spacing and still have a neat coil. To avoid this problem, I first wrap the coil form with cellophane tape that has adhesive on both sides. Then when winding the coil, the wire may be placed exactly where it is intended to be located and it will stay put. The completed coil may be protected by covering it with a heavy coat of lacquer or varnish.—*Robert A. Pautsch, WA8KIE*

SALVAGING COMPONENTS FROM SURPLUS PRINTED-CIRCUIT BOARDS

Surplus component boards, currently available at very reasonable prices, are a good source of diodes and transistors. However, it's easy to damage the parts during their removal. If the components are unsoldered, they can be damaged by excessive heat; if the parts are cut loose, they may be of no value because their leads are too short. On the other hand, if the circuit board is literally cut from around them, all the parts can be salvaged.

Cut the board between the components with a pair of diagonal side-cutting pliers or small tin snips. Although the circuit board will be completely destroyed, this is of no consequence since we are interested only in salvaging components. As the board is successively cut into smaller and smaller fragments, each with a single mounted component, it will become easy to completely free the desired item. As a final step, cut through the hole where the lead was inserted and soldered (on the reverse side of the board). This will free the item, with only a blob of solder remaining on each lead tip. Remove the blob by simply crushing it with a pair of long-nose pliers.

As described above, I have salvaged components without heating them or further shortening leads that were already short. I have removed without damage 1/10-watt resistors with 5/16-inch leads and transistors with leads sufficient in length to allow their insertion into transistor sockets.

One word of caution: Some circuit boards shatter violently when cut with diagonal cutters, so the use of safety glasses is strongly recommended.—*John J. Risch, WØFEV*

MOUNTING AIR-WOUND COILS

Mounting commercial air-wound coil stock can often times be a difficult task, especially if rigidity of the assembly is important. Fig. 11-8 shows how a piece of insulating board or unclad circuit board can be snug-fit into the inside of a piece of coil stock. The board is installed just above or below opposite pairs of polystyrene ribs. A sufficient amount of the board is allowed to protrude from each end of the coil to permit steatite insulators to be used as mounting feet for the entire assembly. Epoxy cement can be used to secure the board in place. In the model shown, a link was made from larger-diameter coil stock than the main coil and cemented in place over one end of the inductor.—*W1CER*

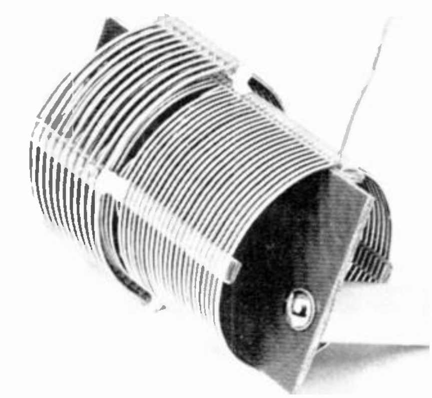


Fig. 11-8—W1CER's method of mounting air-wound coils.

MORE TIE TABS

In reference to K1YSD's hint in *QST* for April 1967 on using tie tabs from bread wrappers, you'd have to eat an awful lot of bread to collect many of these ties. You can buy exactly similar stuff at any garden center. They're called "Tyems" and come in 6- to 12-inch lengths which can be cut up into shorter lengths with shears. They're used to tie plants to stakes and are very cheap.—*W1TS*

BATTERY CONNECTORS

A ready supply of battery connectors for the rectangular 9-volt batteries in common use can be had by removing the terminal end of discarded batteries of this type and wiring the connectors appropriately. Don't forget that the formerly positive terminal now goes to the negative contact of the battery, and vice versa. —*J. Paul Alexander, K5LZT*

MICA WASHERS

Have you ever started a new project using large power transistors or rectifiers and found that you had forgotten to get the mounting kits which include the all-important mica insulating washers? Or did you misplace or damage the washers that came in the mounting kits? Here is a hint that will solve the problem.

Check your junk-box for an old, high-voltage, mica-type transmitting capacitor. Carefully break off the hard protective coating on the capacitor. A block of mica and aluminum sheets will be revealed. Remove any clamps or connectors on the block. Notice that there is a 1/32- to 1/16-inch thick sheet of mica at each end of the block. Pry off one of the end sheets with a razor blade. Make sure that there are no aluminum plates in the end sheet. If there is a film of varnish or similar material on the surface of the sheet, clean it off with a small rag dipped in lighter fluid. Now use the razor blade to gently pry off thin wafers of any desired thickness. Typical wafers included in mounting kits are so thin that you can clearly see through them. However, most experimenters will have trouble working with a wafer this thin, so try to cut off wafers that are about as thin as, or thinner than, the thickness of a sheet of newspaper. This extra thickness won't significantly affect the transfer of heat from the transistor to the heat sink.

Drill the wafer to match the mounting holes and terminals of the transistor or rectifier to be used. Do the drilling at low speed with very little pressure. To realize the most benefit from the heat sink, be sure to apply silicone grease between the semiconductor and the washer and between the washer and the heat sink.—*"Tank" Miller, WA4UBQ*

CABINETS BY THE GALLON

Rectangular cans of the one-gallon size used to contain antifreeze or turpentine make fine modular cabinets when modified as shown in Fig. 11-9. The end of the can with the spout is cut free with a can opener in order to leave a smooth edge. By tack soldering the cans at the points shown, they are held together. Spray paint and decals complete the job.—*Morton Fromer, W2RKF*

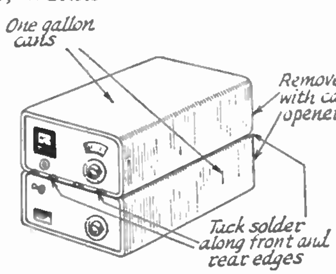


Fig. 11-9—Sketch of how antifreeze cans can be converted into equipment cabinets.

SOME USES FOR PLASTIC DRINKING STRAWS

PLASTIC straws are available at most grocery stores and are found in a variety of colors. Some have heavy walls and are able to maintain their circular shapes even though subjected to considerable stress. The straws used in the applications described here cost only 25 cents for 25 straws. Results were most gratifying.

V.h.f. r.f. chokes can be hand-made at a considerable savings by slicing off sections of the straws and winding enameled wire on them. Although there are optimum values for choke inductance in the various parts of the v.h.f. spectrum, this writer has successfully used a rule-of-thumb method when winding chokes for 50 through 420 MHz. A one quarter-wave length of enameled wire, close-wound on a ⅛- to ¼-inch form, always seemed to do the job nicely. As shown in Fig. 11-10, plastic straws make good coil forms for this purpose. An ice pick, or similar sharp instrument, can be used to poke tiny holes at each end of the coil form for securing the ends of the windings. A coating of Q dope can be added to the completed coil if the user wants to protect the coil against moisture. The diameter of the wire used should be sufficient to handle the current that will flow through the choke.

Another use for the plastic straws is shown in the photograph. Cut into sections, or used full length, they serve as wiring-harness guides wherever a neat job is desired. The color choice is up to the user.—*W1CER*

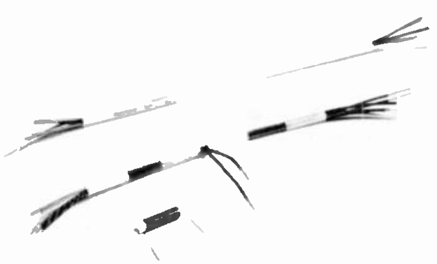


Fig. 11-10—The r.f. choke form and wiring-harness guides pictured above are made from inexpensive plastic drinking straws.

QUALITY CONTROL

FEW hams bother about quality control in the gear they construct. However, to keep down the bugs in homemade equipment, we might take a tip from industry and check components *before* they are wired into a circuit. It does not take much time to test every resistor and capacitor that goes into a project. Regardless of whether the parts come from the junk box or are brand new, they should be checked. A quick test for shorts and opens, as well as for resistances that are out of the required tolerance, is sufficient to reduce some of the trouble-shooting time involved when a gadget does not work, and can save needless rewiring. Continuity checks on coils and transformers are also worthwhile.—*Julian N. Jablin, W9IWI*

METAL SPACERS

AN excellent source of chrome-plated spacers of various diameters is an old or broken auto-radio antenna. The needed diameter spacers may be cut from the appropriate telescoping section, and one antenna will provide many, many spacers.—*William T. Hole, K9HWM/W1ANZ*

SHOTGUN-SHELL COIL FORM

SHOTGUN shells have taken on a new look! The upper portion of the shell casing is now made from rigid plastic. A *spent* shell can be converted into a coil form in a matter of minutes. Here's what to do: remove the primer cap from the *exhausted* shell by driving it out from the inside. Hitting a small punch lightly with a hammer should do the job. Next, trim off the crimped end of the plastic with a knife or razor blade. The ends of the coil can be held in place on the plastic shell body by passing the wire through two sets of small holes. An ice pick or a small-diameter drill can be used to make the holes.

The completed coil assembly can be attached to the chassis by using a 6-32 screw which has been passed through the empty primer-cap hole. A selection of shells, 410, 20, 16, and 12 gauge, will provide the experimenter with a useful assortment of coil-form diameters with which to work.

Apparently the dielectric properties of the plastic used are good. A Q-meter check on the coil shown in Fig. 11-11 resulted in a reading of 175 at 6 MHz. CAUTION: Use only those cartridges that have been fired! Even a live primer cap is dangerous.—*W1CER*

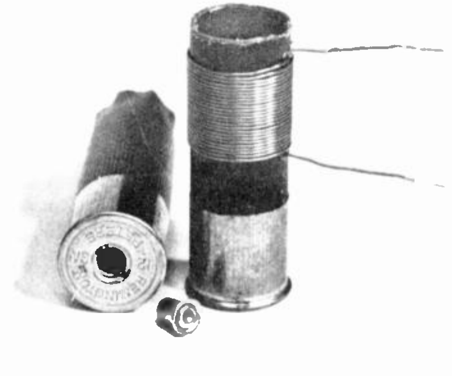


Fig. 11-11—A spent shotgun shell and a coil form made from same.

HEAT SINK SOURCE

When in need of a heat sink for power transistors, simply cut off the desired length of material from a piece of aluminum door or window channel. A six-inch length will handle two good sized power transistors with no trouble, and shorter or longer lengths can be used, depending upon the number and type of transistors employed. A good source of supply for aluminum channel is the scrap pile at the construction site of a new house or office building. Of course, if you want to purchase the material, it can be obtained from most hardware and building-supply stores. Before using a channel where good electrical contact is desired, note that there is a clear coating on the channel that must be removed.—*Bill Johnston, WA6MCU/5*

ADDING CONTROLS WITHOUT ADDING HOLES

If you desire to add controls, such as vernier tuning or sideband gain, to your commercial transceiver, you can usually do so, without drilling any new holes, by using potentiometers from Clarostat's Uni-Tite series of concentric controls. These controls come in all the standard values from 200 ohms up. Either a push-pull or turn type switch can be added to a set of these potentiometers. If desired, you can stack a wire-wound and a carbon control plus a switch. By using concentric potentiometers, it is possible in many cases to double the number of controls on the front panel without ever touching a drill. A source of appropriate knobs for concentric controls can be found in Raytheon's 400 series.—*Dave Ingram, K4TWJ*

EMERGENCY SOLDER LUG

Ever need a solder lug when wiring a project and find none in the parts cabinet? Here is a quick and easy way to make one. Locate a terminal strip; even a used and partly damaged one will do. Drill through the hole in the tie point where the lug is mounted to the bakelite strip. Use a drill just large enough to free the lug from the insulation.—*Don Raasch, WA8MAS*

WIRE DEVICE PROTECTS MOS TRANSISTORS FROM DAMAGE

Destructive damage can be done to metal oxide silicon (MOS) transistors when an electrostatic potential is applied even momentarily to the transistor leads. Sufficient electrostatic potential to be damaging can be generated by simple handling. Adequate protection during storage and shipping is provided by either soldering the leads together or by wrapping foil around the leads. Neither method is suitable, however, when the MOS transistor is to be placed in a circuit where the leads must be separated for assembly.

The solution is shown in Fig. 11-12. A loop of flexible, small-diameter, nickel wire, attached to a music-wire spring, can be slipped over the MOS transistor case and released, so that the music-wire spring tensions the loop of nickel wire around all the transistor leads, shorting them together. This permits the leads to be handled without damage to the transistor and makes it possible to safely connect the transistor in the circuit.

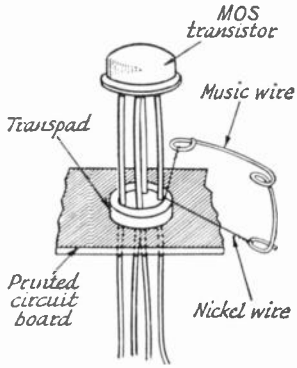


Fig. 11-12—Metal oxide silicon (MOS) transistor protected from destructive damage by wire device.

In constructing the device, a length of 0.033-inch diameter wire is bent to form a spring. A piece of 0.007-inch diameter nickel wire, long enough to form a single loop near the center of its length, is then fastened to the two outer loops of the music wire and soldered.

To attach the device to an MOS transistor, squeeze the spring so that the nickel-wire loop can be slipped over the transistor case. Once beyond the case, the spring can be released; all the leads of the transistor will be shorted together by the taut nickel wire. The protective means provided by the manufacturer, e.g., twisting the leads, wrapping foil around the leads, or soldering all the leads together, may then be removed without damage to the transistor. A transpad, which is a small disk having holes in it spaced to suit the transistor leads, can be slipped over the leads to serve as a retaining disk.

The nickel-wire protected transistor can be soldered into a printed circuit board or into circuits using other types of construction techniques. If the circuit configuration allows, the protective device may be removed without cutting the nickel wire and thus used over again. It can be employed on MOS transistors having any number of leads, since the leads always lie in a circle. Should it be necessary to take the MOS transistor out of the circuit, reattach the protective device to the transistor being removed.—*NASA Tech Brief 66-10419*

TILT-UP FEET

To give my older rigs a more modern look, I position two wedge-shaped rubber door stops under the front edge of each chassis. The new rubber feet help to tilt the controls upward, making the dials and meters more readable.—*Robert C. Mayne, WA8KRH*

MOUNTING COMPONENTS ON PERFORATED BOARD

The following method of anchoring components to perforated circuit board has several advantages over the use of "flea clips." It eliminates the cost of clips, provides a tie point for several connections, and leaves component leads long enough for possible future reuse.

Pass the component lead through the perforated board, and coil the free end into a multiple-turn loop with the aid of a forked tool such as a small soldering aid. Tin the loop with solder. Insert the desired number of leads into the loop and solder the connection.—*Melvin Leibowitz, W3KET*

EQUIPMENT LABELING

Most constructors of home-built equipment want to make their projects look somewhat commercial in appearance. One way of doing this is to use press-on letters to mark the various dials, meters and switches. The letters I employed were from sheets manufactured by the Datak Corporation of Guttenberg, New Jersey. Besides letters, this company makes sheets of numbers, punctuation marks, switch patterns, arcs and a variety of electronic symbols and titles. These markings are very neat in appearance, if applied with a little care.

Normally, press-on symbols are transferred by placing a lettering sheet over the desired area and rubbing the appropriate symbol with a ballpoint pen. However, titles are difficult to apply in crowded locations. Once attached to a panel, symbols can't be removed without being destroyed. If a press-on title hasn't been positioned in the desired fashion, another title must be used. I have found an easy method of applying these letters such that titles can be affixed to awkward locations on the equipment with relatively little difficulty and can be removed easily and reused, although not too many times.

The first step is to apply a piece of clear cellophane tape, with the adhesive side down, to a smooth surface such as a Formica table top or a piece of glass. Extend the tape over the edge of the table. The length of tape depends on the number of letters or titles required for the job.

By using guide lines, the letters can be applied evenly. The guide lines may be pressed on either the tape or the table top. I prefer to put the lines on the tape; then there is no need to scrape the lines off the table when the labeling has been completed. For a small job of a few letters, it may not be necessary to use the guide lines; however, this depends on the experience of the person doing the lettering.

After all the letters are transferred to the tape, put a second piece of tape over the first, keeping both lengths of tape parallel and smooth. Cut the second piece of tape an inch shorter than the first, being sure to cover all the titles. The result of this operation should be a lamination of the tape with the letters in the center. Loosen a few inches of the tape from the table by pulling upward that portion of the tape that is left extending over the edge of the table. It is best to handle only about four or five inches of the tape at a time; otherwise, the tape can get badly tangled. Cut off the titles as needed, leaving behind any excess tape or guide lines. After applying the titles, it isn't necessary to use any type of protective coating such as lacquer, since the letters are safeguarded by the cellophane tape. If desired, the titles can be removed and repositioned or used elsewhere by just peeling the tape and affixing it to the new location.—*Jerome F. Pumo, WB2MDR*

ADHESIVE-BACKED TERMINAL BOARD ELIMINATES MOUNTING SCREWS

The low-profile terminal board shown in Fig. 11-13 is especially useful in dense electronic circuits where mounting space and working space are limited, and where it may be undesirable or impractical to use mounting screws or other hardware fasteners. The terminal board consists of 0.012-inch-thick copper terminal strips cemented between 0.032-inch-thick fiberglas sheets which have a thin layer of pressure-sensitive adhesive backing. Scoring between terminal pairs facilitates detachment of the required number of terminals for specific applications. For soldering connections, the copper terminals are bent outward. The boards are mounted by pressing the adhesive backing onto a mounting surface in the equipment package. —*NASA Tech Brief 65-10396*

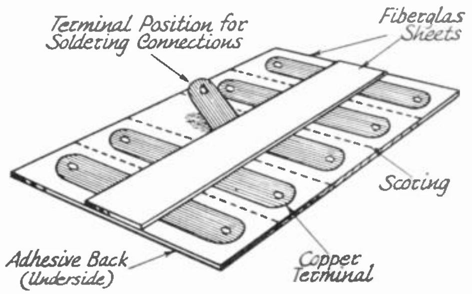


Fig. 11-13—Details of the adhesive-backed terminal board.

USING OLD COAX

Coaxial cables that are old and exhibit high r.f. losses can be put to good use in the ham shack. By slitting the vinyl outer covering lengthwise with a razor blade, the covering can be removed without damaging the remainder of the cable. The copper braid is easily separated from the rest of the coax and makes excellent grounding strap. The inner conductor and polyethelene insulation of RG-8/U and RG-11/U make high-tension cables which will handle several thousand volts. RG-58/U and RG-59/U have insulated conductors that are also usable as high-voltage cables.—*Dan Tomcik, K8ZQE*

EQUIPMENT FEET

Football shoe cleats come in many varieties. The hard rubber and nylon types that are threaded make good standoffs or feet for electronic equipment. Cleats are available from most sporting-goods stores.—*Karl Hatfield, W6BXR*

GROMMET CABLE HOLDER

One way I have found to make a chassis wiring job neater is to use rubber grommets as wire bundle holders as shown in Fig. 11-14. If the approximate number of wires that will pass through each bundling point can be predetermined, it will be easy to pick out the proper size grommets to secure a tight fit.—*Phil MacDonald, WA1CTQ*

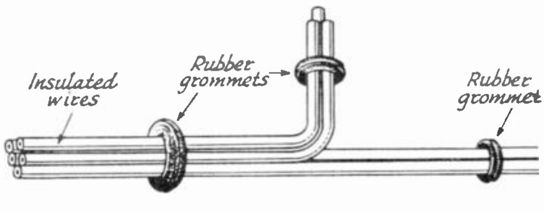


Fig. 11-14—The rubber grommets, shown here as cable holders, should be chosen to firmly secure the wires in neat bundles.

PHONE-JACK PANEL BEARING

As shown in Fig. 11-15, a panel bearing can be made from an extra phone jack by filing away the flange on the inside of the jack and removing the excess contacts, soldering lugs and phenolic insulation. The bearing will be suitable for a ¼-inch shaft if a standard phone jack is used for the modification.—*John Wallace, WA5NPE*

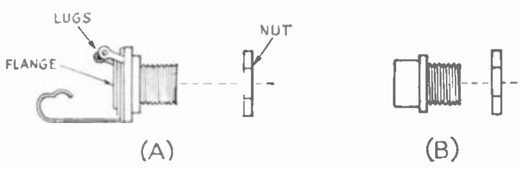


Fig. 11-15—By filing away the flange and removing the excess parts, a phone jack (A) becomes a panel bearing (B).

RUBBER FEET

Rubber feet can be made by cutting out the rubber buttons from women's discarded garters and cementing the buttons to small cabinets and other pieces of equipment where needed.—*Ray Maccio, W1SBI*

NEON LAMPS

A little-known source of small neon bulbs for use as r.f. indicators and pilot lights can be found in defunct fluorescent-light starters.—*Kenneth G. Kopp, WA4HAA*

MINIATURE TOROID CORES

With the advent of r.f. transistor circuitry, the small toroid coil and transformer have come into great favor due to the toroid's high coefficient of coupling, low losses and high permeability. However, miniature toroid cores are sometimes difficult to find.

A good source of suitable cores, both ferrite and powdered iron, is the threaded slug with a hexagonal hole through it, intended for use in an inductively-tuned coil. As shown in Fig. 11-16, these ⅜ inch long by ¼ inch diameter cores make excellent coil forms. The coils can be wound bifilar, and since only a few turns are needed, fine wire can be used without significantly reducing the Q.

Although permeabilities vary greatly with different materials, the threaded cores usually fall into two general categories: the ferrites, which are dark gray in color and are quite shiny, and the powdered irons, which are lighter in color and dull in texture. The ferrites are good to about 2 MHz., while some of the powdered irons are usable to several hundred MHz. Formulas for approximate inductance using the ¼-inch diameter by ⅜ inch long forms are:

$L = 0.65N^2$ (for ferrite)

$L = 0.02N^2$ (for powdered iron)

where L = Inductance in microhenrys.

N = Number of turns.

—*Dan Tomcik, K8ZQE*

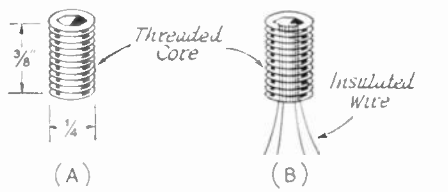


Fig. 11-16—(A) Threaded core as removed from slug-tuned coil. (B) Miniature core with bifilar-wound coils.

ANOTHER METHOD OF FORMING VINYL CABLE LACING

A hint by K0PQW on fashioning cable lacing, described in the seventh edition of *Hints and Kinks*, although relatively simple to employ, has several disadvantages. The lacing can become undone easily by vibration and cannot be used readily for harnessed wires that bend at sharp angles. Furthermore, if the cable consists of parallel-oriented wires, which is the usual case, there will be a tendency for individual wires to pop out of the slit.

A method I have used for years overcomes these objections and also utilizes the vinyl jacket from coaxial cable. Instead of splitting the jacket longitudinally, I cut the vinyl covering with a knife placed at an angle to the length of the cable. The cable is simultaneously pulled and twisted with the left hand in such a way as to make a spiral cut in the jacket.

The cable can be kept in the correct position by a simple jig consisting of a board and three nails while the knife is held by the right hand. Removing the vinyl spiral from the coax and wrapping it around the new cable completes the operation. For that "professional look," the ends of the spiral may be trimmed with a pair of scissors and secured with a couple of turns of ½-inch black vinyl electrical tape.—*Erling R. Jacobsen, K4OJY/9*

CHASSIS MOUNTING OF PRINTED-CIRCUIT-TYPE TRANSFORMERS

MINIATURE audio transformers, designed for printed-circuit board mounting, can be altered for direct mounting to any metal chassis as shown in Fig. 11-17. A brass strip is soldered to the case of the transformer to serve as a mounting plate. Two 4-40 clearance holes are drilled in the plate to accommodate the mounting screws.—*W1CKK*

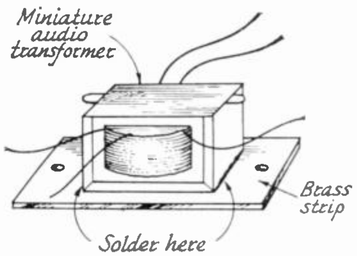


Fig. 11-17—Miniature printed-circuit-type transformer modified for direct chassis mounting.

POTENTIOMETER REPLACEMENT

I RECENTLY purchased a potentiometer by mail and received one of the new type Clarostat controls which does not have the usual threaded mounting shank. Instead, it has tabs that require the drilling of two mounting holes. Not wishing to go to all this trouble, I removed, from the old potentiometer, the threaded shank and the part to which it was fastened and slipped the salvaged parts over the shaft of the new control, as shown in Fig. 11-18. The two tabs were then bent over to secure the assembly. As a result, I was able to replace the old potentiometer with the new type without drilling any holes.—*Conrad J. Sedlak, Sr., K2HR*

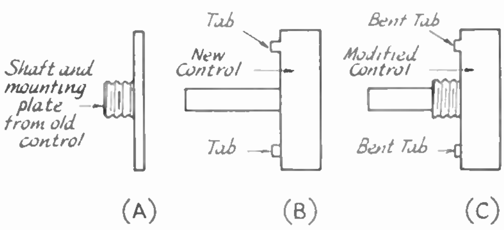


Fig. 11-18—Steps in the conversion of a tab-mounted control to a shaft mounted type

SHAFT COUPLINGS

IN the "Hints and Kinks" column of *QST* for May 1966, WB6GHB mentioned the unavailability of a commercial 3/16-inch to ¼-inch shaft coupler. Since then we have been informed that at least two manufacturers produce couplers that will mate 3/16- to ¼-inch shafts. Available from Centralab distributors is their model AK-16. The James Millen Manufacturing Company, Inc., makes three types that are suitable: models 39004-C and 39005-C, which are brass couplings, and type 39016-A, which is an insulated coupling.—*W1YDS*

MATING SHAFTS OF DIFFERENT DIAMETERS

MANY projects call for variable capacitors that have 3/16-inch shafts. This is unfortunate, as most knobs and dials take only ¼-inch rods. A coupling is required, but one that will mate a ¼-inch shaft with a 3/16-inch shaft isn't sold commercially (as far as we know). It's not too difficult, however, to machine a coupling from a brass rod (Fig. 11-19).

Obtain a ¾-inch length of brass rod, ⅜ inch in diameter. Drill a 3/16-inch hole down the axis of the shaft through both ends. With a ¼-inch bit, enlarge the hole to ¼ inch in diameter half the length of the rod. This can be done best on a lathe, but a drill press will give satisfactory results. Be sure to clamp the brass rod in a vise if the work is done on a drill press. Drill ⅛-inch holes for the 6-32 × 3/16-inch set screws about ⅛ inch from each end of the coupling. Tap the two holes with a 6-32 tapered tap and then with a 6-32 bottoming tap. After deburring the holes, screw in the set screws. Don't forget to use oil during all drilling and tapping operations.—*William C. Bakewell, WB6GHB*

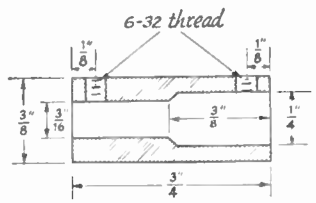


Fig. 11-19—Cross-sectional view of 3/16-inch to 1/4-inch shaft coupling.

"BANDSPREADING" A PLATE TUNING CAPACITOR

I HAVE a 5-band linear with pi-*L* network switching. After many hours of trying to tune it on 21 and 28 MHz. with the same big capacitor used on 3.5 and 7 MHz., I switched over to a two-section capacitor and used one section on 14, 21 and 28 MHz. and both on the lower frequencies. However, even one section was still too hair-triggery to tune for comfort on 21 and 28 MHz. So I altered the section as illustrated in Fig. 11-21. Fig. 11-20 shows how the capacitance varies as the dial setting is changed for both the modified and unmodified sections. The plates (rotor only) were cut with shears and buffed to round the edges. Sweepback of the cuts is not critical and the capacitance change, as each successively smaller plate is meshing, is fairly smooth, as Fig. 11-20 shows. Only the modified section is used on 14, 21 and 28 MHz.; the other section is switched in parallel with it on the lower bands. Now the linear tunes as easily on 28 as on 3.5 MHz.—*D. W. R. McKinley, VE3AU*

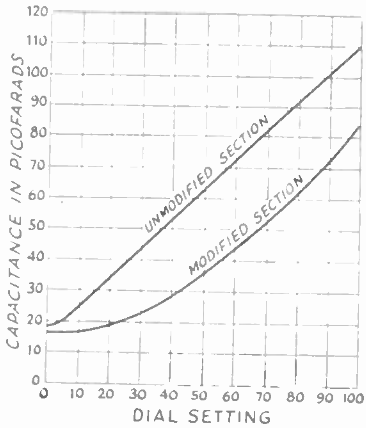


Fig. 11-20—Graph of the capacitance at various dial settings of the Hammond type 8810, two-section variable capacitor. Values are for a capacitor that has one section unchanged and the other section modified as in Fig. 11-21.

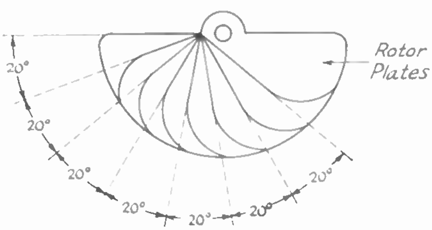


Fig. 11-21—Details of VE3AU's capacitor modification. Only the rotor plates are altered; the stator plates are left intact.

TOOTHPASTE-TUBE CAP INSULATORS

Toothpaste-tube caps are an excellent source of material for constructing feedthrough and standoff insulators as illustrated in Fig. 11-22. The feedthrough in example *A* is made by mounting a toothpaste cap on each side of a metal plate and passing a threaded rod through both caps. A spacer of insulating material is mounted at the center of the rod to prevent accidental contact between the rod and the metal plate. The nylon wheel of a curtain runner is ideal for this purpose. In example *B*, the necessary hardware is bolted to the cap and the cap in turn glued to the plate.

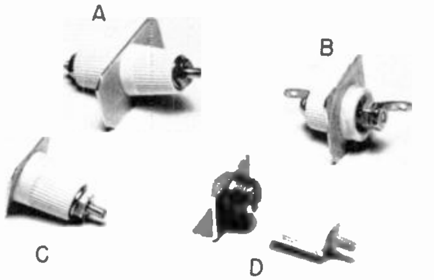


Fig. 11-22—Toothpaste cap feedthroughs and standoffs.

A non-insulated standoff is constructed by directly bolting the toothpaste cap to the plate as illustrated in example *C*. An insulated version is made by cementing a machine screw to the concave recess in the top of the cap and gluing the cap to the plate. The cap can also be bolted to the plate as shown in example *D*.

Fig. 11-23 shows yet another method of constructing a feedthrough insulator. A small insulated washer, placed at the center of the assembly, prevents a short circuit between the rod and metal plate.—*D. P. Taylor, ex-G8OD*

Fig. 11-23—Feedthrough insulator made from the nylon wheels of a curtain runner.

ROTARY SWITCH CONTACTS

A badly-burned rotary switch contact, especially on a piece of commercial equipment, was considered a major catastrophe until I found a method of easily replacing a switch contact. Recently, the same technique was applied when I modified a Viking Challenger. I added a contact to a blank space on one of the Challenger's switches.

First, find a replacement contact of correct size either on a discarded switch or an unused contact on the switch to be repaired or modified. Remove the replacement contact by carefully grinding off the head of the rivet with a small hand-held grinder (Moto-Tool or similar). Remove the damaged contact in the same manner. Make a small bend at the tip of a 6 or 8-inch piece of tinned wire and solder it to the replacement contact as shown in Fig. 11-24A.

Feed the wire with the attached contact through the proper hole in the switch wafer and snug the contact into position. Make sure the new contact lines up properly with the

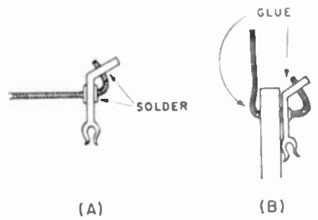


Fig. 11-24—To add or replace a rotary switch contact, (A) solder a wire lead to the new contact, and (B) glue it to the switch wafer.

rotor section. Apply a sparing amount of epoxy cement between the contact and the switch wafer. Snug up the contact to the wafer and bend the wire over where it comes through the hole in the wafer. Clamp the new contact to the wafer with a heat sink, bobby pin, or paper clip to hold it in place until the cement dries. Apply a reasonable amount of cement to the lead on the opposite side of the wafer (See Fig. 11-24B). Let it stand overnight to allow the cement to dry. Then, using a heat sink to protect the cementing job, solder in the tinned wire lead from the new contact.—*Gerald R. Neuman, WAØDIL*

NEAT COAXIAL SHIELD CONNECTIONS

When coaxial cable is to be used for inter-circuit wiring, where coaxial connectors are not employed, a neater-looking job will result by wrapping small-diameter bus wire over the shield braid of the cable as illustrated in Fig. 11-25. The free end of the bus wire can be used to make the ground connection for the shield braid. A low-wattage soldering iron should be used to secure the bus wire to the braid, care being taken not to melt the polyethylene insulating material. This system works well with all types of coaxial cable and will dress up the appearance of shielded audio cable as well.—*W1CER*

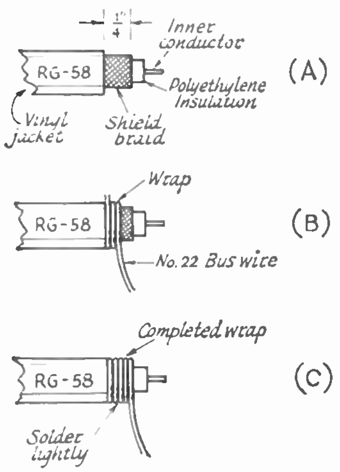


Fig. 11-25—Steps in forming a neat coaxial shield connection.

SHOCK MOUNTING

Amateurs occasionally have to protect various electronic circuits, but potting chemicals sold for the purpose are very expensive. An easy and inexpensive shock mounting can be made from cellulose artificial sponges, the ones that are hard and stiff when dry and become soft and pliable when wet. Cut the sponge into small cubes about one inch on a side. Wet the cubes and squeeze out the excess moisture. Stuff the cubes in the space between the container walls and the object to be protected. When the sponges dry they will form a solid mass that has good thermal and shock-insulating properties and the object will be firmly encapsulated.—*Melvin Leibowitz, W3KET.*

OPEN-WIRE LINE SPACERS

Small coil forms and open-wire line spacers can be made from the rigid poly tubes sold in sporting goods stores as golf club sheaths. The tubes, approximately 3 feet long and 1¼ inches in diameter, sell for only a few pennies.—*Bob De Bragga, W1YNP/6*

LABELING EQUIPMENT

Every amateur finds there are times when he wants to consult the schematic and specifications of equipment which he has constructed. Unless his memory is better than most people's he will not be able to remember which issue his project appeared in. The answer is to label the front panel of the project at the time of construction with a simple code which tells at a glance the source of the construction data. An example would be "Monimatch 56Q10," meaning the article appeared in the 10th number (October) of *QST* in 1956. Another is "Little Dipper 59H520," which refers to the 1959 *Handbook*, page 520.—*E. A. Sahm, W5FFE*

COMPACT COIL FORMS

Inexpensive double-slug TV-type i.f. coil forms may be halved to provide single-slug forms for compact construction.—*Bela V. Foldesy, W6HCI*

MAKING MOUNTING BOARDS

The use of terminal boards for mounting resistors and capacitors makes construction easier and appearance neater. It is easy and inexpensive to roll your own, and the completed board has the advantage of being transparent so there is no hidden circuitry. These boards are made by pouring some resin into a plastic container of appropriate size; the resin can be obtained from any marine dealer for about a dollar a quart. It is normally used for coating the fiberglass-cloth covering on boats. The boards are removed after hardening and drilled with the holes required. Press-in terminals are then mounted if required.—*Robert Coviello, K1WNK*

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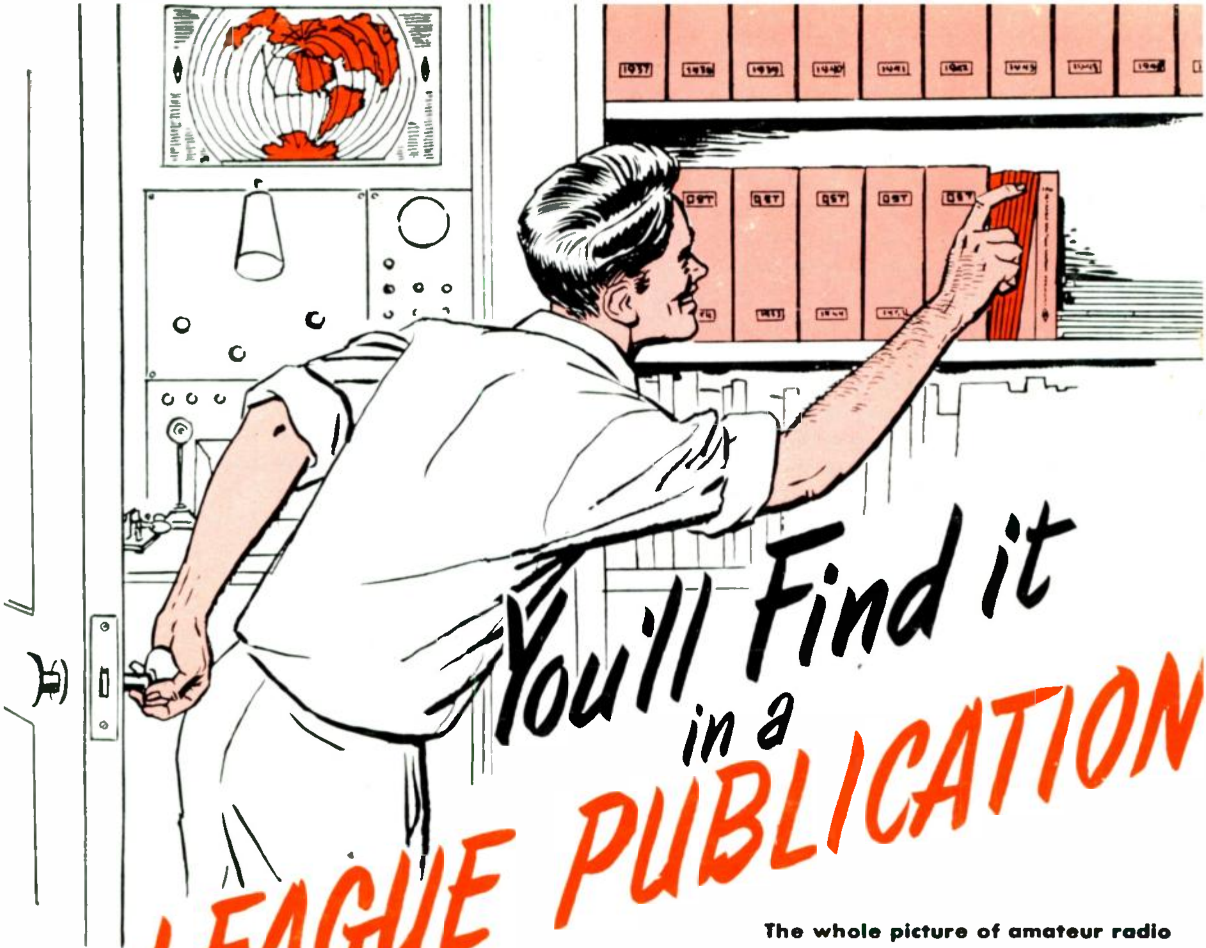

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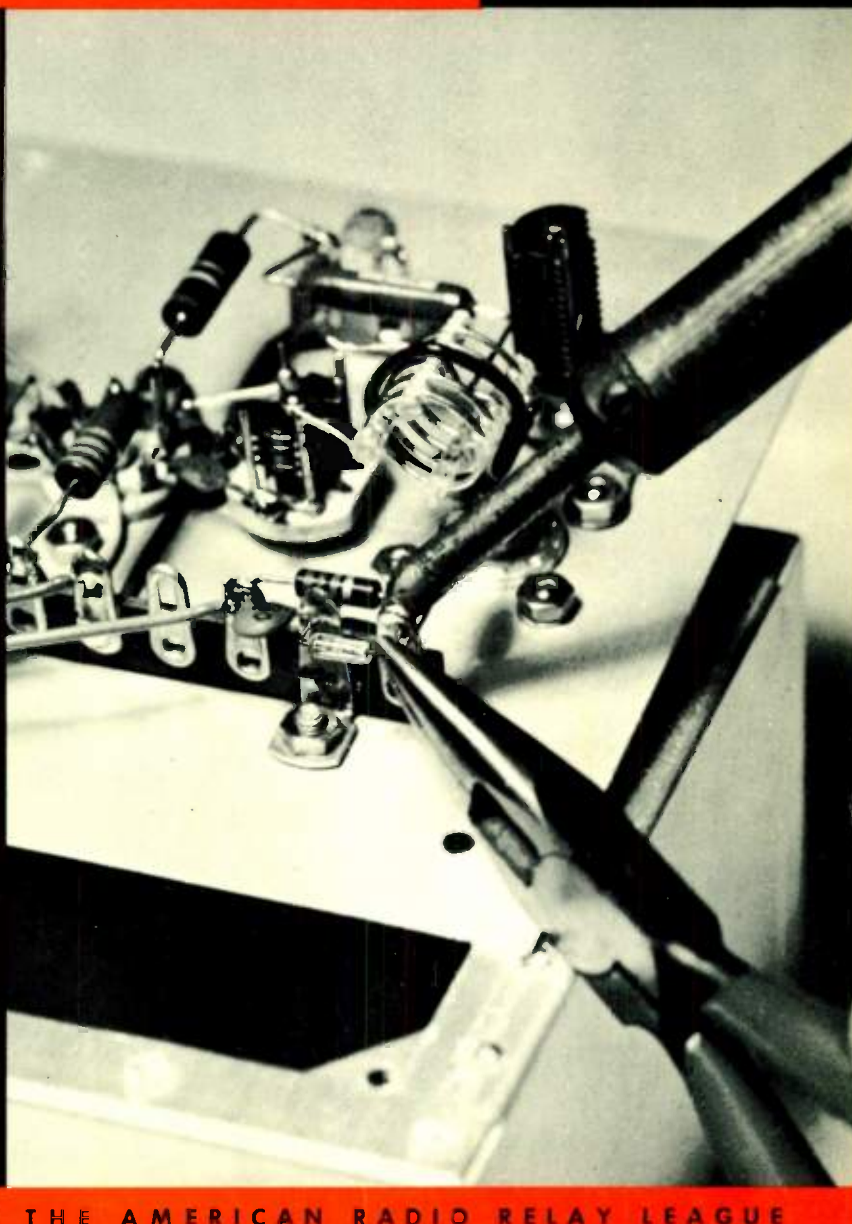

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FOREWORD

This booklet, the ninth in a series going back to 1933, illustrates two of the outstanding qualities of the radio amateur: his inventiveness in solving the little problems of amateur radio in workshop and station, and his willingness to share his work with his fellow amateurs.

It illustrates in capsule form the American Radio Relay League functioning at its best, for the book has several hundred authors, each of whom originally contributed his brainchild to *QST*, the League journal, for publication therein. Gathered here are the best of the ideas presented over a three-year span in the monthly columns, "Hints and Kinks" and "Gimmicks and Gadgets."

At least some of the ideas in this volume will be of interest to every active radio amateur—and many of them will be useful to non-amateurs interested in various phases of electronics.

And should you find your own experiments producing a handy answer to a common problem, send it in to *QST*; you'll be among the authors of Volume 10, for which a need will eventually develop as amateurs continue in their public service hobby.

JOHN HUNTOON, W1RW
General Manager

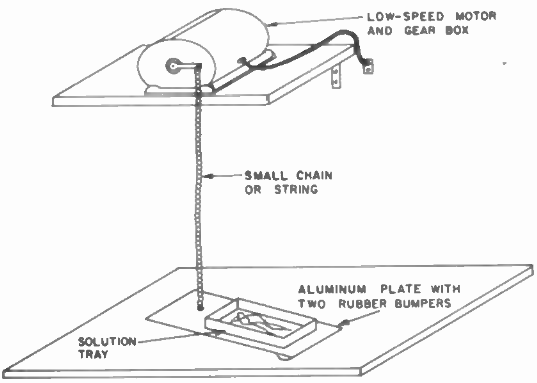
Newington, Connecticut

Hints and Kinks . . .

for the Shack and Shop

PRINTED CIRCUIT AGITATOR

After reading the article in January *QST* about etched-circuit boards, a different method of agitating the tray came to mind. I took a fairly heavy piece of aluminum, and on the under side of one end, mounted two rubber bumpers. These bumpers, or feet, allow it to rock without moving around on the workbench. A small chain, as shown in the sketch was added to the other end of the piece of aluminum and was attached to a rotating arm mounted on the output shaft on the motor/gear assembly. The amount of tray motion is adjusted by properly placing the chain on the moving arm. The assembly can be moved, cleaned, or stored by just removing the chain. – *Harold D. Mohr, K8ZHZ*



When mounting the motor above the tray, the level of agitation can be adjusted by moving the chain on the rotating arm.

EASY PRINTED-CIRCUIT LAYOUT

After reading the article on printed circuits in January 1970 *QST*, some procedures that I use came to mind. On laying out the board, I use Clear-Print graph paper, ten squares to the inch, since most solid-state components use 0.1 inch or multiples thereof, for lead spacing. The lines on the graph paper are handy references for drawing interconnections. Crossovers are placed so they cross at the gap formed by a component.

After laying out the circuit, the graph paper is trimmed to size and affixed to the board with a transparent tape. A size-60 drill is then used to cut mounting holes through the paper layout. The layout can now be used as a schematic (or wiring) diagram when painting the etch-resist material on the board. I use nail polish for this. The brush tip should be cut at an angle to allow the lines to be made finer. – *Ross W. Stevens, W6FRE*

KEEPING THE KEY IN PLACE

If the operating table has a smooth surface, keeping the key or paddle in place can be a problem. Removing dust from the rubber feet often helps, but the heavy-fisted operator still might have problems. An easy cure is to cut a piece of fine-grained sandpaper to the size of the keyer base and fasten it to the operating table (rough side up of course) with a few pieces of wide masking tape. If the operator wants to change the position of the key, he can simply move the sandpaper.

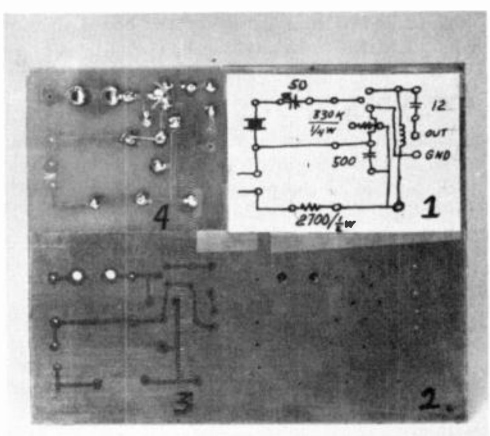
The same system can be used to keep the rotor control box, lamps, and other items from walking around the desk. – *W1FBY*

ANOTHER SOURCE FOR COIL FORMS

For those fellows who like to wind their own coils, another source for form material may be your local coin dealer. Clear plastic tubes are used by collectors for storing their coins. There are six sizes of "coin tubes" ranging from the one-cent to the silver-dollar diameter. To use the coin tubes, cut off the top and bottom sections with a fine-bladed hacksaw, or just cut off the top section and leave the bottom section for use in mounting with a small screw. – *Stan J. Zuchora, W8QKU*

SPAGHETTI

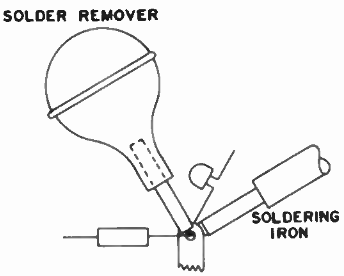
Your local hospital is an excellent source of spaghetti tubing. For medical applications, the tubing can only be used once. A request to a doctor or nurse will usually bring you enough plastic tubing of various sizes to provide a lifetime supply for ham purposes. – *W1KLK*



A sample of W6FRE's board shows the schematic drawn on graph paper, a drilled pattern, the nail-polish resist, and the final etched board.

REMOVING SOLDER FROM TERMINAL STRIPS AND PC BOARDS

Although commercially manufactured tools are available for the purpose, the method shown is handy when removing components from either pc boards or terminal strips. Cut the tip off of a small



syringe and insert a short length of Teflon tubing into the end. It should be approximately 2 inches long and 1/16-inch OD. If Teflon tubing is unavailable, the metal insert from a ball-point pen could be substituted. Wrap the metal part that goes into the syringe with masking tape to prevent burning. The only difficulty with using a metal tube is that solder tends to stick to the walls and will have to be drilled out after a few operations.

Heat the terminal strip and squeeze the syringe before the solder starts to melt. When the solder starts to flow, bring the tip of the tube up to the joint and release the pressure on the bulb quickly. The molten solder will flow up into the bulb, leaving the terminal relatively free. – *W1NPG*

MARKING ETCHED CIRCUIT BOARDS

Etched circuit boards can be neatly marked with component designations and polarities by using waxy rub-on transfer letters. Alphabets of various sizes can be bought at art supply stores. The waxy letters act as a resist, leaving the marking in the copper after the board is etched. I always include W9IWI in a corner of the board to show who made it. – *Julian Jablin, W9IWI*

GMT "HOUR HAND"

A homemade "hour hand" of thin sheet metal fixed to the same shaft as the hour hand of your lock, and set to the proper number of hours ahead (or behind) will show GMT, while the original hand will show local time.– *Tom Chaudou, WN9FLD*

HOLDING LIGHT-WEIGHT EQUIPMENT IN PLACE

Years ago, amateur equipment would stay put by sheer weight alone. Today, light-weight transceivers and the like will scoot off the desk with just a slight nudge.

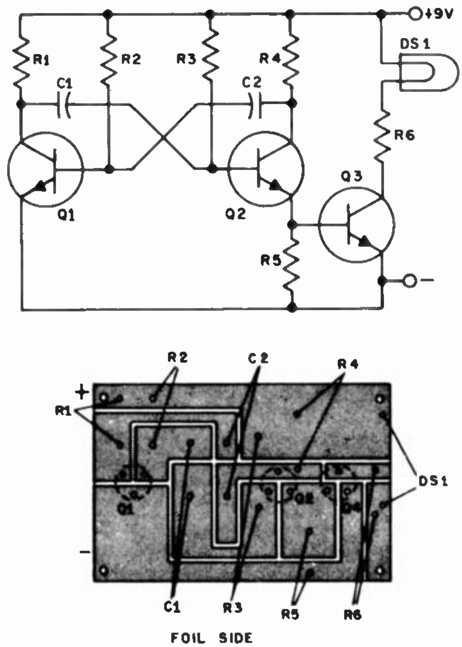
I have found that a piece of indoor-outdoor carpeting will hold them in place. The equipment feet nestle down into the nap of the carpet. The rubber backing holds the carpet material firmly to the desk top or other surface.

When stacking gear, put a piece of carpeting under the feet of the top unit. This should not be used on a vented cabinet of course, but is great for solid ones, such as speaker enclosures. – *Ed Heubach, W9AO*

ETCHED CIRCUIT BOARDS WITH NO FUSS

In the course of making a considerable number of circuit boards during the past few years, I have arrived at a style, which though not suited for many commercial requirements, is sufficient for most amateur needs. Instead of etching an elaborate pattern of lines, circles, dots, and curves, I have designed all of my boards in a mosaic, or floor-tile pattern. I find three distinct advantages to this method of layout. First, there is less copper foil to be etched away; second, there are no fine lines of foil to pop off the board when extra heat is applied; and third, there is a much greater latitude available in the placement of parts.

Anyone who has access to a Dremel-type drill can make his own boards without resorting to chemical etching. After laying out the desired pattern on paper and transferring the design to the copper foil, it is a simple matter to cut through the foil with a fine rotary saw, or a small emery saw wheel.



Shown is a light-flasher board and the pattern for the etched circuit board to build it on.

Shown is a typical circuit and the board that I would etch, drill, place components on, and have in operation in about 30 minutes time. Although this is a simple design, I have made more complex circuits in about the same time and they have remained in operation a long while without foil failure. – *F. T. McAllister, W8HKT/4*

RF INSULATION PROBLEMS (AND SOME FEEDBACK)

Recently, in the ARRL Lab, we ran into several antenna problems and came up with some answers that we feel are worth passing along. In constructing a beam antenna that will appear in *QST* and the *Handbook*, we wanted to use a gamma matching system. Instead of the conventional variable capacitor and rod, a tubular capacitor was made up. In a search for materials to separate the two aluminum tubes in the capacitor section, it was decided that a nylon tube of the correct dimensions would be ideal. Unfortunately, it was far from ideal – in fact, a very poor choice. After adjusting the gamma rod and capacitor for a match, we noticed the aluminum tubing over the nylon tube getting warm; after running about 50 watts to the antenna for a few minutes, the tube got hot enough to be uncomfortable to the touch. At 1-kW input we actually burned our fingers. After experimentation, we found that nylon is a very poor insulator at radio frequencies.

As if this wasn't bad enough, one ham called recently and informed us that the balun he was using in the kW version of the Ultimate Transmatch (July *QST*) was getting hot with only a couple of hundred watts input! In constructing the balun on the unit described in the article, Teflon was used as the wire insulation. In this particular unit, the balun showed no signs of heating no matter what the load, with well over 1000 watts going through it. In designing the balun, our concern was mostly with rf-voltage breakdown, simply because some very high rf voltages could be produced in the balun with certain types of loads. In the article we specified vinyl-nylon insulation (1000 volts or more) to be a suitable insulation. However, such material is not good in a coil where rf is present, and we erred.

The two considerations in choosing an insulation material are the dielectric constant and the dissipation factor. At 10 MHz, Teflon has a dielectric constant of 2.1 and a dissipation factor .0002. Nylon runs 3.14 and .0214 at the same frequency. The dissipation constant represents the big difference. Teflon, of course, is rather expensive unless one can purchase it from a surplus outlet. While we don't have the exact figures on Formvar insulation, this appears to be an excellent material for rf windings, too. – *W1ICP*

CLEANING EXTERNAL-ANODE TUBES

Recently I purchased a batch of 4CX250Bs for a very low price. The tubes, while used for various periods of time, were quite good electrically. The only problem was that the silver-plated parts were badly tarnished. Since I wanted to remove the tarnish, some cleaning had to be done.

I started with a wire brush followed by the use of some silver cleaner. After spending considerable time on the first tube (I have 18 of them!), I decided some other method was in order. Then I remembered a silverware cleaning demonstration I saw a few months back. Why not use the same idea with tubes? Since 4CX250s are designed to operate at temperatures in excess of 225 degrees, they can be boiled to aid the cleaning process.

WINDING COILS

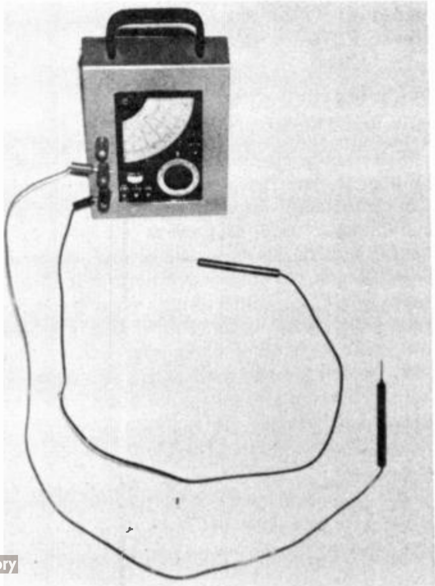
When winding coils of small gauge wire, it often becomes difficult to maintain the desired spacing and still have a neat coil. To avoid this problem, I first wrap the coil form with cellophane tape that has adhesive on both sides. Then when winding the coil, the wire may be placed exactly where it is intended to be located and it will stay put. The completed coil may be protected by covering it with a heavy coat of lacquer or varnish. – *Robert A. Pautsch, WA8KIE*

DRESS UP THAT INEXPENSIVE VOM

In most electronics stores inexpensive VOMs are available, and though adequate in their present form, their small size and lightness of weight makes them subject to breaking. At least that was true in my case.

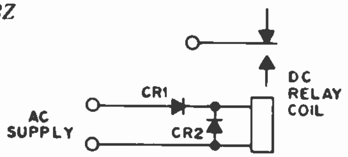
My 3 × 5 × 3/4-inch imported meter has been mounted in a 5 × 7 × 2-inch chassis (Bud AC-402) which was cut to receive the VOM. Lead weight has been added inside the chassis. Sponge-rubber lining protects the meter and prevents it from moving about. A carrying handle and a larger binding post were added to the chassis for extra convenience. The large banana jacks, which have been connected to the correct post internally, in the meter, have been a great advantage. Now most any type meter lead is usable – even hookup wire if necessary. Rubber feet have been placed on the bottom of the chassis to prevent movement of the unit and scratching of furniture. – *Evan P. Rolek, K9SQG/9*

My small VOM has been given some weight and size with the mounting in a Bud AC-402 chassis. Banana jacks were added and will accept almost any lead.



RECTIFIER FOR DC RELAYS

Some of the best bargains in surplus relays are to be found in the low-voltage dc units. Their use where no battery is available, however, often means the construction of a separate power supply. This writer has used the circuit shown here to operate relays from a filament supply. To provide the normal operating voltage for the relay, the ac voltage should be about 2-1/2 times the rated dc voltage, since a half-wave rectifier is used. CR2 serves to carry the current generated by the decaying magnetic field of the relay coil, thereby protecting CR1 against high-voltage transients. If a high enough ac voltage is not available, a capacitor in parallel with CR2 will raise the dc voltage. This writer used a 50-μF capacitor in parallel with a relay coil rated at 12 volts, 200 mA, and operated it from a 12-volt filament circuit. The combination delivered only 10 volts, but this was enough to close the relay reliably. – *Rev. C. R. Clark, WB4OBZ*



PIV rectifier rating – 2.8 times ac supply voltage.

"SHORT-FORM" BOUND ISSUES OF *QST*

Space for books is minimal at the author's QTH, so in binding back issues of *QST*, a modified procedure of WAØKDQ's excellent article (*QST*, December, 1968) was used. First, the staples were carefully removed so that the pages could be separated, and appropriate selections made.

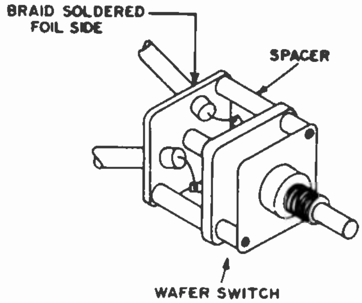
A typical selection included: covers, index, technical articles, Hints and Kinks, and various other departments and columns that the author was interested in. Care must be taken to include *all* pages which contain a given article. After binding, one or two omissions were found, and the problem was remedied by cutting out, and pasting the missing material in extra locations. The end result was a year's "meat" in one volume approximately the thickness of *The Radio Amateur's Handbook* instead of twice the *Handbook's* size. – *Frank Reeves, VE7CT*

WEATHERPROOFING LOW-VOLTAGE CONNECTORS

Salt finally corroded one of the tail lights on the boat trailer. The price of a new light was more than offset by discovering the trick that the manufacturer used to prevent the problem. The sockets for the bulbs were liberally smeared with grease, which effectively weatherproofed the metal parts, while not interfering with the pressure-contact electrical connectors. While a more suitable compound is recommended (such as Dow Corning DC-4, which is also good at rf), the author used ordinary marine grease (the kind used for pressure fittings and steering linkages) on the other lights, and with good results. The method could be used to advantage by amateurs where low-voltage connectors may be exposed to moisture. It definitely *should not* be used on ordinary rubber, since reaction between the grease and rubber will ruin the insulation. However, most modern plastics will not be affected. – *W1YNC*

WIRING COAXIAL CABLE TO A WAFER SWITCH

Here is a useful way of getting rid of the horrible mess that occurs when trying to wire up a 3-pole, 3-position, rotary switch with RG-58/U coaxial cable. Cut a small piece of copper-clad, phenolic board more or less in the shape of the switch wafer. Drill a couple of holes in it to match the distance between the screws that hold the switch assembly together. Then with the foil side of the board facing away from the switch, drill 3 holes which will accommodate the shields of the cable (a No. 30 drill is about right). Then solder the center conductors to the appropriate lugs, and the shields to the copper-clad board. This scheme results in a very neat job, and also provides a good ground for the braid through the frame of the switch. – *M. Crosby Bartlett, W9MC/WB4OBF*



ETCHING METAL PANELS

Decal labels on radio equipment often wear and peel off quickly, particularly on test equipment subjected to constant use. Etched labels, on the other hand, provide permanent identification of control knobs and dials.

To etch a steel panel, pour hot paraffin over the area to be labeled. When cooled, letter the label into the paraffin with a sharp pointed instrument, scraping the metal clean to form the letters or numerals. Neat lettering can be insured by using a lettering guide from a stationary store. Remove any wax shavings with a fine brush and place a drop of hydrochloric or nitric acid on each letter with a medicine dropper. Several applications of acid may be necessary to obtain the desired depth. When etching has been completed, wash the panel with cold water and peel off the remaining wax. The etched characters can be filled with paint or nail polish.

The necessary acids can be obtained in small quantities at most drugstores, but are highly corrosive and should not be brought in contact with the skin. Containers should also be properly labeled and have tight plastic or rubber caps. – *Joe A. Rolf, K5JOK*

SILK-SCREENING QSLs

Since I wanted to change the call sign on my old Novice QSL cards, I decided to try the silk-screen process, which I hadn't used in many years. Several calls to art and paint stores helped me locate the supplies needed.

The film used in the silk-screen process is a two-layer material; the top layer is soluble (usually with acetone) and the bottom layer is a rather sturdy plastic. The film is placed over the art work or lettering, and secured with masking tape. Instead of using a pencil to trace the design, a knife with a narrow tip is used to cut through the soluble layer, but not through the backing. When a complete character is cut it can be carefully removed, or the area around it removed, depending on what the final stencil will be required to print.

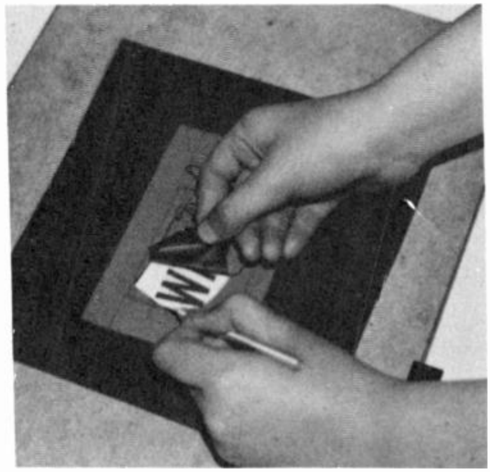
When a complete film is cut, it is placed on a flat surface (soluble side up) and the silk is brought in contact with it. Since I wanted to use water-soluble paints, acetone was applied to the silk with sufficient pressure to penetrate the mesh and soften the film. After drying, the plastic backing is removed and the stencil is ready for screening of the first color. Ordinary masking tape on the film side of the screen is used to mask out all areas that could create a mess during screening. The silk I used was 107-mesh count stretched over a 9- by 12-inch wooden frame and fastened with ordinary paper staples. A square yard of the silk costs $2.25 and a square yard of film costs $2.45. The stencil can be removed from the silk-screen frame by placing it in lacquer thinner. The screen and frame are none the worse for the experience.

The screening of the first color requires that the item to be screened be indexed on the work area (I used a piece of 3/4-inch plywood scrap). Marking the area for the card with masking tape will suffice if perfect registration is not required. A hinge on the silk-screen frame will make your process deluxe, but nails or screws for registering the frame will do nicely.

The paints used in the silk-screen process are specially formulated and I would suggest experimentation with left-over house paints before attempting to screen a project. Enough paint to handle a dozen or so cards is poured into the frame away from the stencil openings. A squeegee is drawn over the silk with enough paint and pressure to force the paint through the screen onto the card. The frame is lifted and the card removed and placed in a safe location to dry. After finishing the cards a new stencil can be put on the silk-screen frame for a second color. – *Matthew V. Oreskovic, WA2JLF*

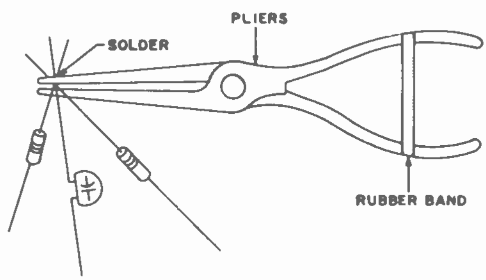
EASY GROUND-ROD INSTALLATION

Dig a hole five or six inches deep and six inches in diameter. Fill the hole with water. Set the pointed end of the rod in the center of the hole and start tamping with the rod as though you were tamping a post. Pull the rod up so the water goes down in the hole. Insert the rod in the same hole and push down again. Repeat this procedure until the rod is down to the desired depth.– *Clarence E. Berry, K9TAT*



ETCHING ALUMINUM

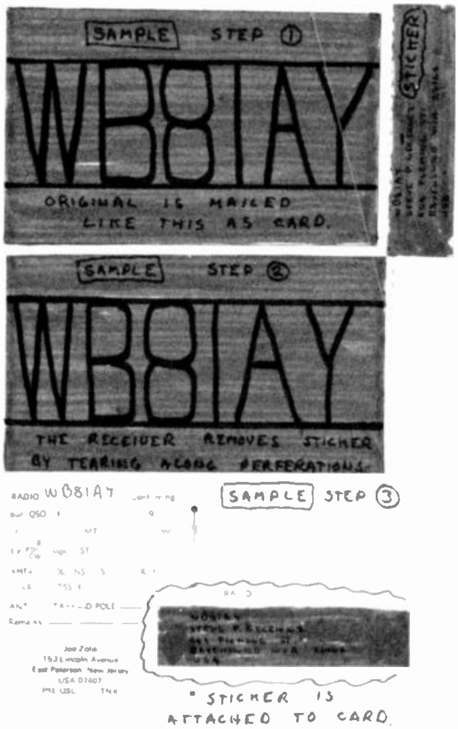
Recently, I built a version of McCoy's Transmatch. Unfortunately, the aluminum shows scratches and fingerprints. So, I etched the material in a solution of washing soda and hot water. I used two tablespoons of sal soda per gallon. The aluminum to be etched *must* be clean. Immerse the parts in the solution for three to five minutes, then remove and dry them. – *Geoffrey S. Vore, W9QBJ/WA9MZH*



THAT OFT-NEEDED "THIRD HAND"

It can be frustrating when trying to solder several leads together at one time. If only someone were near at hand to hold those elusive wires together until they were soldered! Well, here's a simple remedy for the problem. Simply encircle the handles of your long-nose pliers with a good sturdy rubber band, then grip the leads to be soldered with the tips of the jaws. The rubber band will maintain tension on the jaws, thus freeing one of your hands.

Long-nose pliers work nicely as a heat sink when soldering solid-state devices. Simply clamp the jaws of the pliers over the pigtail of the transistor, diode, or IC (between the point to be soldered and the body of the semiconductor) before doing the soldering. (This idea was borrowed from the Heath HW-101 manual.) – *WN1LZQ*



ADDRESS LABEL FOR QSL CARDS

The filling out of a QSL card takes less than a minute, assuming one has a readable logbook and other necessary information. When you multiply one minute by the number of QSOs in a DX Contest or Sweepstakes, this simple task becomes a real chore. If you are a foreign amateur with an exotic prefix, you deserve some kind of help from your fellow amateur.

My solution to this problem is to send a QSL which has a return address affixed to the card. The card shown in the photograph is a conventional QSL, except that an end portion of the card, divided by perforations, is adhesive backed and contains the proper address. Upon receipt of the card, an amateur removes the address label and uses it on his own QSL card. The only additional work is filling in the normal confirmation information, including call sign.

At present, a commercially-made QSL of this type does not exist; however, it is hoped that a forward-thinking printer will adopt this technique. – *Steve P. Gecewicz, WB8IAY*

CHEAP-AND-EASY PANEL TRIM

Adding a stripe of color to the panel of a piece of homemade radio equipment will often impart a professional appearance that might otherwise be lacking. Those ubiquitous gray Hammertone rack panels certainly need something to dress them up, and the technique described here does the job rather well.

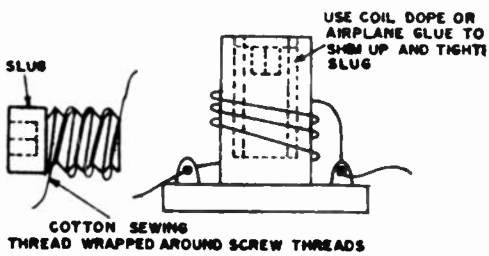
Select a roll of masking tape that is made to the width you prefer for a stripe of panel trim. (The writer has rolls of tape in various widths to meet various design requirements.) Remove from the roll a length of tape somewhat in excess of what will be needed. Next, affix one end of the tape to a solid object. Hold the free end in one hand, and spray paint the nonadhesive side the the strip your favorite color. White, black, or red contrasts nicely with gray panels. After the paint has dried, the strip can be applied to the panel, and the free ends of excess material sliced off with a razor blade.

White decals do not stand out well against a gray panel. A strip of painted masking tape can be attached to the panel, full length, above and below the row of controls. White press-on decals placed on the trim strip will be easy to read. Alternatively, black decals can be installed on a white or yellow strip.

Though the writer has not tried to use Mystic Tape (available at most hardware stores and supermarts), it should serve nicely as trim. – *W1CER*

TWO METHODS FOR TIGHTENING LOOSE SLUG–TUNED COILS

Here is a way to solve a minor problem. If you should have a loose iron core in a coil, two methods for tightening it again are shown in Fig. 2. I have used both methods and it saves a lot of trouble when critical tuning is necessary. *One word of caution;* use the glue carefully and avoid getting any on the coil turns; It may affect coil *Q*. – *Franklin Rosenberg, W6NYG*



COILED CORD FOR THE SOLDERING IRON

There must be a special section of Murphy's Law covering soldering irons. No matter how carefully you set the iron down, you always end up burning holes in its cord – or the schematic that you are working on. One cure is to replace the present cord on your soldering iron with one of the coiled appliance cords available at electrical supply houses. The cords stretch out to five feet, but coil up to about nine inches when the iron is not in use. – *W1KLK.*

SOLDERING VISE FOR SMALL PARTS

A spring-type wooden clothespin makes a handy vise for soldering small work. Mount it in a vertical position on the workbench. – *K1ZND*

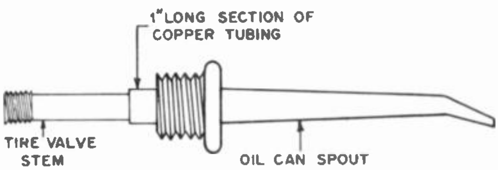
QUICK REPAIR OF HIGH-WATTAGE BLEEDER RESISTORS

If an adjustable wirewound power resistor opens, it can be repaired quickly by clamping the point where the wire has broken with a screw-type automotive hose clamp. These clamps are usually available at gas stations and hardware stores. Adding the clamp might reduce the resistance by a few ohms. – *Ernest L. Dawson, W2DTF*

CERAMIC TUBE CLEANER

I had a problem in trying to keep the lint and dust out of the cooling fins on the plates of the 8122 final amplifier tubes in my linear. They are the ceramic types like the 4CX250 family.

My solution was to solder an automotive inner-tube valve stem to the 4-inch spout of an oil can, using a 1-inch section of copper tubing as a coupler between the two. The end of the spout has an opening of about 1/16 inch and when this arrangement is connected to a tire pump, and an "armstrong" energy source applied, I have a variable-velocity air jet that is cheap and easy to build, which does the job very well. – *Ben Fidler, W7PZ*



A STABLE CAPACITOR ROTOR CONNECTION

Electrical connection to the rotor of an air-variable capacitor is usually made through the use of small brushes which rub on the shaft or through contact between the shaft and the bearings. There are times when corrosion or dirt will cause the connection to become intermittent. This becomes an important factor when building any circuit requiring good frequency stability, such as a tunable oscillator.

A remedy is shown in the drawing. First drill a hole through the shaft, then drill a hole at right angles into the shaft near the front of the capacitor. Use a No. 34 to No. 40 drill size depending on the shaft diameter. Fish a length of small-diameter, stranded copper wire (usually 27 gauge) into the hole in the end of the shaft and out through the egress hold. Solder the wire onto the shaft at the egress hole. Next, make a small brass bracket as shown in the drawing with a mounting hole and a soldering tab for a connection. Attach the bracket to the capacitor frame by means of a nut and screw. Solder the wire coming out of the shaft onto the bracket. This completes the installation. – *Gene Pearson, W3QY*

[EDITOR'S NOTE: This type of connection should be used primarily with an air-variable capacitor having a stop.]

COIL WINDING MACHINE

After reading the article on how to rewind transformers,[1] I decided to tackle a bigger job than the one discussed. A battery-powered rotisserie which has a reversible motor designed for slow speeds made the job much easier. Winding my own power transformer not only saved me a lot of money, it made me feel like a real ham again. – *Celimo F. Hernandez, WB4JLG*

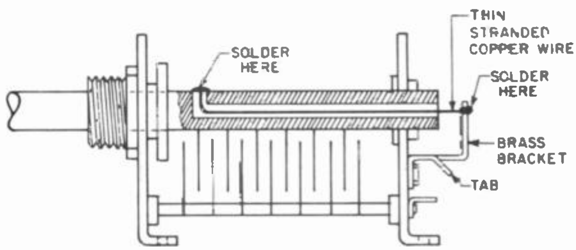
WEIGHTS FOR YOUR BUG

If your bug weights are too light to make the dots readable, take some lead sinkers (which can be purchased at most hardware stores) and flatten them to about 1/4 inch or so. The weights that I used in my case were of 1-ounce size. After the weights are flattened, saw a slit in the sinker and add it to the existing weight on the bug. – *Jeff J. Walters, WN8GNY*

WIRE SOURCE

A handy source for No. 14 through No. 6 solid copper wire is the wire sold for house wiring. Most hardware and Sears stores stock two-conductor plastic covered wire and it can be purchased in any length required. – *W1ICP*

1 McCoy, "How To Wind Your Own Power Transformer," *QST*, February, 1970.



Modification of air-variable capacitor to make a stable rotor connection.

PICTURE QSL CARDS

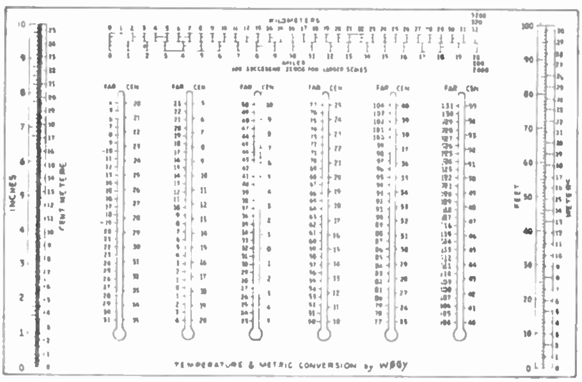
I've found in my search for a different QSL card that most picture post cards have too much gloss to take ink from a rubber stamp, such as might be used with an amateur call sign. However a

sharp single-edged razor blade can be used to scrape a portion of the card bare in a jiffy The white base material will then accept the rubber-stamped information, making a colorful QSL card. – *Edson B. Snow, W2UN*

MEASUREMENT CONVERSION CHART

At one time or other, everyone talks about the weather, amounts of rainfall, snowfall, distance between cities, and the heights of antennas. While we in the U.S. think in terms of inches, feet, and Fahrenheit, the rest of the world uses the metric scale for measuring these values. This makes it difficult to understand the true meaning in a QSO with amateurs in foreign countries.

I have prepared a chart which benefits me in all international contacts and at the same time helps me to think in metric terms, which we will adopt some day in this country. It is now necessary only to look up the measurement given and find the term that I am more familiar with next to that value. – *Donald G. Thibault, WØGY*

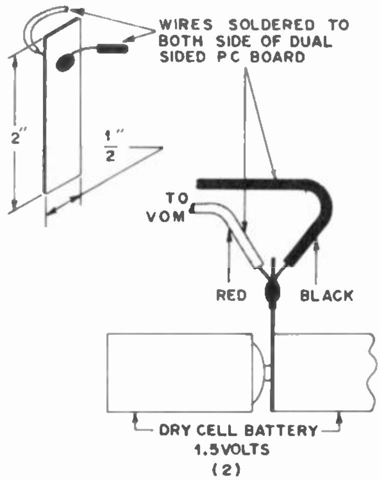


The chart designed and used by WØGY for temperature and metric conversion.

AID TO MEASURING CURRENT IN DRY-CELL BATTERIES

I have found that a scrap of double-sided pc board can be a handy aid in measuring current consumption of equipment that uses several dry-cell batteries. It could be used when charging NiCads to measure the charging current.

To avoid having to solder and unsolder connections when making current measurements, I have affixed wires to each side of a scrap of pc board as shown in the sketch. I also tinned each side of the board to retard wear and corrosion and to assure a better electrical connection. I now insert the pc board between any two of the cells, as shown, or better still, between either of the end cells and the battery terminal of the device that I am working on. When the wires from this "probe" are connected to the VOM, plugs to mate with the



VOM can be connected to the wires from the probe if desired. Current measurements can be made with no hands required, allowing observation of current consumption while making adjustments to the equipment under test. – *Ray Henry*

CIRCUIT-BOARD LAYOUT AID

The method I use simplifies matters somewhat by using the actual components in a mock-up version of the circuit board. Material required is a piece of cardboard cut large enough for all of the components and a piece of Styrofoam two inches thick by one foot square.

The cardboard is placed on top of the Styrofoam. Then using a number 60 drill, holes are drilled through the cardboard for each component. After the holes for a particular component are drilled, it is inserted into its place and the Styrofoam will keep the component from falling off. Each component is interconnected graphically on the cardboard at the time of insertion. After the layout has been completed, the components are removed and the cardboard is cut down to the desired size of the circuit board. In order to keep the component locations in their respective positions, the cardboard jig is taped to the circuit on the nonmetallic side. This prevents possible movement when the holes are drilled. – *Herbert Lott, W3CLG*

SOURCES OF FERRITE MATERIAL FOR CHOKES AND COILS

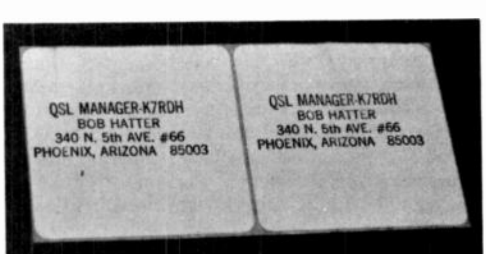
If you plan on winding your own rf choke or coil and the design calls for the use of ferrite as core material, where can it be found? One source of ferrite cores is older portable radios. These radios usually have ferrite rod antennas. The existing wire can be either unwound or cut off. Another source of ferrite cores is the horizontal output (flyback) transformer in television receivers. Use a hacksaw to remove the windings.

Many of the cores, whether from television sets or radios, are approximately 1/2 inch in diameter. This dimension is satisfactory for most bifilar choke designs, but sometimes a smaller diameter is required. These cores can be cut and ground to size, but caution must be exercised since they are brittle. If breakage does occur, not all is lost. These cores can be glued or taped together. – *Warren MacDowell, W2AOO*

[EDITOR'S NOTE: Ferrite material obtained from horizontal output transformers and loop antennas from portable radios may be usable up to 10 MHz. One particular ferrite sample tested gave good performance up to 7 MHz. In general, these ferrite cores can be used in equipment that covers the 160- through 40-meter bands.]

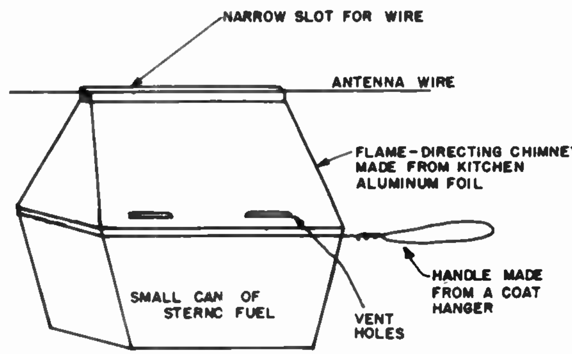
QSL RETURN ADDRESS LABELS

Having been on the DX end of operations and QSLing from DL4PS, LX3PS and XEØRDH, I have looked for quite some time for a quick and simple address label to send along with the cards to speed the QSL function and improve returns. Most good stationery stores carry a line of self-adhesive, inexpensive labels, in a wide variety os sizes, that suit this return-address problem perfectly. The sample shown is made by Avery, and is called "Self-Adhesive Kum-Kleen Unprinted Labels." An



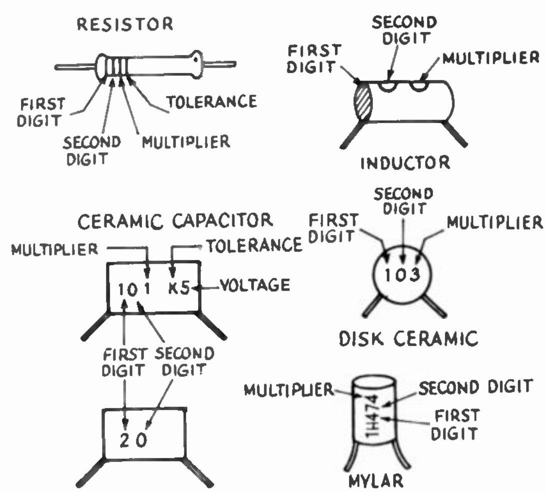
A HOMEMADE TORCH

An effective soldering torch for antenna work can be made by fabricating a hood from aluminum foil and placing it on top of a can of Sterno fuel. It works well even on cold, windy days, though it requires great care when working around foliage because the flame is completely invisible. The cost is about 30 cents. – *William Mutch, WB2JPT*



DETERMINING THE VALUES OF JAPANESE COMPONENTS

Some months ago we had fun trying to figure out the coding on Japanese components. A copy of the code was found in the modification kit for my FT-101. The color code is the same as the one for resistors and capacitors as tabulated in *The Radio Amateur's Handbook*. The drawing indicates how to interpret the markings on the Japanese components. The values are in ohms, microhenries and picofarads.



For example, an inductor marked brown, red and black would be 12 × 10^0, or 12 µH. A ceramic capacitor marked 301K5 would be 300 pF, 10-percent tolerance, and 500 volts. In general, the working voltage for ceramic capacitors is 500 unless otherwise noted. – *Noel B. Eaton, VE3CJ*

Hints and Kinks . . .

for the Receiver

LOCATING SOURCES OF MAN-MADE NOISE

About six months after moving to my present location, relatively strong power-line noise began to appear. First it was intermittent, then it gradually became more continuous and stronger. Something had to be done! Cruising the area with an a-m automobile receiver proved useless in locating the source of the noise – it was just too general.

Recalling Nelson's article in *QST* for April and May, 1966, the writer studied it in detail. For anyone having noise problems, a review of Nelson's article is highly recommended. Without attempting to cover the ground outlined in the article, let it suffice to emphasize the importance of the use of some kind of vhf receiver with a signal-level meter.

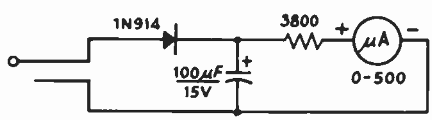
Fortunately, the author had a combination portable a-m/fm receiver which had two earphone jacks. The audio-level meter shown in the schematic diagram was plugged into one of them. The first attempt, with the audio-level meter merely involved a diode in series with the 500-microampere meter, thus rectifying the audio signal and giving a dc reading on the meter. However, the particular meter used was not sufficiently damped for the application and in the presence of fluctuating noise, the meter pointer swung violently back and forth making it impossible to use it effectively. This difficulty was eliminated by the *RC* combination shown. It was arrived at by trial and error using the receiver tuned to a broadcast station with voice modulation. These values also gave the proper amount of damping for noise sources also. However, different combinations may be required with another receiver/meter combination.

In the event that more meter sensitivity is required, a small output transformer having an impedance ratio in the order of 4 ohms to 2000 ohms (not critical) may be inserted between the diode and the plug. The low-impedance winding should be connected to the plug terminals and the high-impedance winding connected between the anode of the diode and the negative terminal of the electrolytic capacitor.

While not a problem with the author's receiver, the agc action with some models may suppress the variations in line noise. Whether or not this would affect measurements would have to be determined in a particular application.

Once a noise source becomes bothersome at the author's station, a homemade transistor receiver covering the range from 3.5 to 15 MHz is installed in an automobile equipped with a temporary 11-foot (3.4 m) surplus whip antenna attached to the car by means of insulated clamps. The portable a-m/fm receiver, equipped with it's meter, is also taken along in the search. Those who have mobile hf equipment in their cars have half the battle already won.

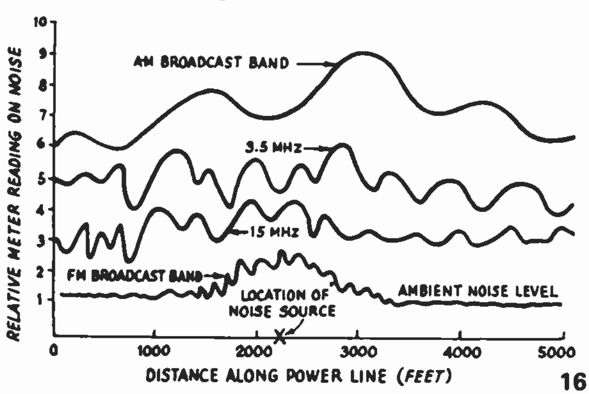
The car is driven around until the area in which the noise is greatest is found. When the noise starts to give a meter indication up into the 15-MHz range, one may expect to be within a few blocks, or perhaps a mile, from the noise source. The objective is to find a localized area where the noise is greatest. Once this is accomplished, the fm receiver is turned on. If the noise cannot be heard, the localized area is searched until an indication on the meter is shown in the fm band.



The above technique was effective in locating the line noise mentioned at the beginning of this article. However, in this case, the culprit proved to be each and every insulator on a one-mile length of power line, newly constructed using the latest state-of-the-art techniques in power-line design.

In the past year, at least a dozen power line leaks have been first located without bothering the power company. Of this number, only three required the assistance of the company's noise experts. The rest of the cases were readily fixed by local linemen, once the source was located. The method has also been useful in locating other sources of noise.

It should be emphasized that on both hf and vhf measurements, widely fluctuating meter readings can be expected as one drives along a suspected power line. These variations may be caused by radiation from down leads, ground wires and other objects. It may be advisable to make a chart showing the various peak readings for different frequency ranges. A sample one is shown which illustrates the importance of the vhf receiver in locating the exact position of the offending source. – *William L. North, W4BX*



ELIMINATION OF RECEIVER AUDIO HUM

At one time I was troubled with hum in the receiver audio. The hum would mask weak stations. My comfortable, low-impedance, high-fidelity headphones (with their low-frequency response) made this hum even more objectionable when attempting to copy weak stations.

While searching for a solution, I suspected that a filter capacitor had gone bad, but disconnecting the B+ proved to me that this was not the fault, for the hum remained. The source of the hum was found to be the proximity of the power transformer to the audio-output transformer. Of course, the answer to my problem then was to relocate the audio transformer as far as possible from the power transformer, which I easily accomplished by using extended leads.

In some receivers this may not completely eliminate the hum, in which case you may do as I did – orient the audio transformer in various positions until a null is reached (af gain fully off). When the best position is found, the af transformer is secured to the chassis. The results have been great; I have a quiet receiver down to the shot noise in the tubes and an RST-539 signal is completely readable whereas before, it was hidden in the hum. Results have been the same with a pair of Signal Corps communication headphones. – *Herbert M. Rosenthal, K4SF.*

WWV ON DRAKE RECEIVERS

It is possible to receive the 5-MHz transmissions from WWV on a Drake R-4A by setting the band switch to 3.5 MHz, the tuning dial to 3.6325 MHz, and the preselector to 40 meters. The second harmonic of the VFO beats with the 5-MHz WWV signal to produce a signal at the first i-f. – *Donald R. Stickle, K2OXP*

MARKERS FOR THE 160-METER BAND

Many communications receivers fall a little short when it comes to accurate tuning of the 160-meter band. With index marks being mostly at the 10-kHz division, it is very difficult to obtain accurate tracking throughout the entire 200-kHz range.

I have found that most neighborhood television sets radiate powerful harmonics of their horizontal oscillators. These signals are heard in the broadcast-band spectrum, and can be used as accurate markers in the 160-meter band.

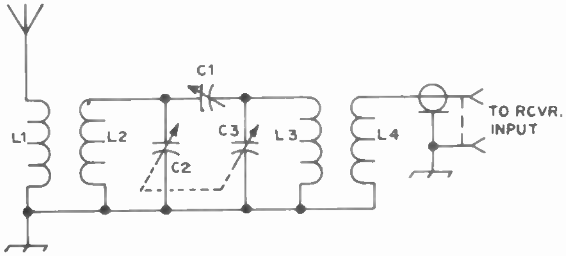
The color TV horizontal scanning frequency is rigidly maintained at 15,734.264 Hz ± .044 Hz. Therefore, the first usable amateur harmonic is the 115th providing a marker at 1,809,439.90 Hz, the 116th is at 1,825,174.16 Hz, and so on through the band.

If you aren't able to hear these harmonics, try loosely coupling your receiver into the antenna system of your TV set with a short piece of insulated wire . . . It really works. – *Robert K. Dye, W8YLN*

FERRITE LOOP FROM BC RADIO MAKES GOOD INDUCTOR FOR MEDIUM-FREQUENCY PRESELECTOR

Having good front-end selectivity is a necessity on the mf and lower hf bands in many parts of the country. Some commercial receivers are lacking in this respect, and an item by W1FTX in the May, 1972 issue of *QST* shows one way to provide some additional selectivity. The preselector shown is another method, and matches the performance of expensive commercially made units.

The circuit consists of two tuned circuits ahead of the receiver, with the coils and capacitors having



Schematic diagram of an mf preselector using ferrite-loop antenna coils for inductors.

C1 – Trimmer, 3-30 pF.

C2, C3 – Variable capacitor, dual section, 365 pF per section.

L1, L4* – 30 turns of No. 26 wire wound on a close fitting cardboard sleeve placed over the windings of the ferrite coil.

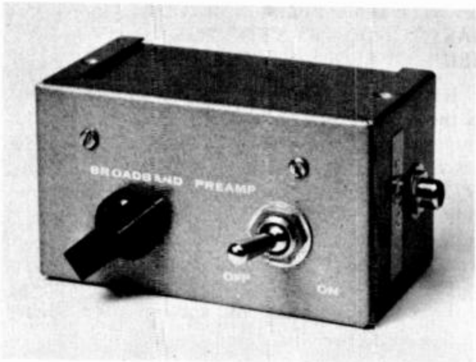
L2, L3 – Ferrite-loop antenna coil from bc radio.

* If a dual-winding coil of the type used with transistor radios is obtained, L1 and L4 may be eliminated.

values that will tune the desired frequency range. For the broadcast band, a ferrite-loop antenna coil, and a 365-pF variable capacitor can be used. Be sure to house the components in an rf shielded enclosure and use coaxial cable between the tuner and receiver input. Separate variable capacitors can be employed to provide better tracking, and C1 can be a variable capacitor to adjust selectivity. The receiver performed satisfactorily on weak signals without additional amplification. – *John W. Dell, K6TB*

AUDIO HUM IN THE HEATH SB-100

Over the past few months of operation with my SB-100, I noted the ac hum level in the receiver audio output had gradually increased. The hum was especially noticeable under no-signal conditions, or with the audio gain turned to minimum. At first, I considered the possibility of an inadequately-filtered power supply. Later checks, however, proved the problem to be a poor connection between the ground foil of the audio circuit board and the main chassis. Tightening the screws that secure the audio board to the chassis eliminated the problem. – *David E. Evans, K5SOR*



Preamp for hf receivers.

GENERAL PURPOSE SOLID–STATE PREAMPLIFIERS

Over the past few years there have been many articles describing various vhf/uhf amplifiers There are few types, however, that are good for general-purpose hf amplification. How many amateurs have listened in vain for signals above 20 meters because of a poor receiver front end?·How many transceivers have a "dead" sound when the band is out? Here is a preamp which provides usable gain up to 100 MHz. It can improve the noise figure of even a good tube-type receiver and should improve the image rejection of any receiver when used with the narrow-band modification. The noise figure of the unit described here is 2.5 dB at 30 MHz. This is sufficient to provide a 10 dB signal-to-noise-plus-noise ratio with .07 microvolt of signal at the input.

The amplifier consists ot a common-emitter stage driving an emitter follower. Generally, emitter followers are not recommended at high frequencies because they tend to be unstable, but in this design there are no tuned elements following the amplifier and hence the amplifier is quite stable.

As with any high-frequency amplifier, good constructional practices should be followed. Short leads, in-line layout, and careful bypassing are all necessary. Since the unit has a gain of more than 40 dB at frequencies below 5 MHz, all of the bypass capacitors shown in Fig. 1 should be used.

If your application calls for wide-band gain, the device shown in Fig. 1 is what you need. But if you intend to use the amplifier as a receiver preamp., the circuit shown in Fig. 2 should be included. It can be mounted in the same box as the preamp.

TABLE I

Band	*C1*	*C2*	*C3*	*L1*
80-40 Meters	47 pF	47 pF	356 pF	4 µH, 14t
20 Meters	27 pF	27 pF	100 pF	1 µH, 7t
15-10 Meters	12 pF	12 pF	50 pF	0.75 µH, 5t
6 Meters	6 pF	6 pF	50 pF	0.38 µH, 2½t

Coil and capacitor data for the tuned-input circuit shown in Fig. 2. The coil stock is 3/4-inch dia, 32 tpi (B&W 3012).

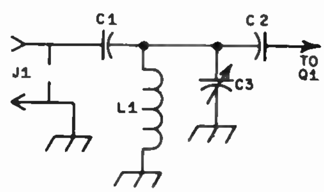
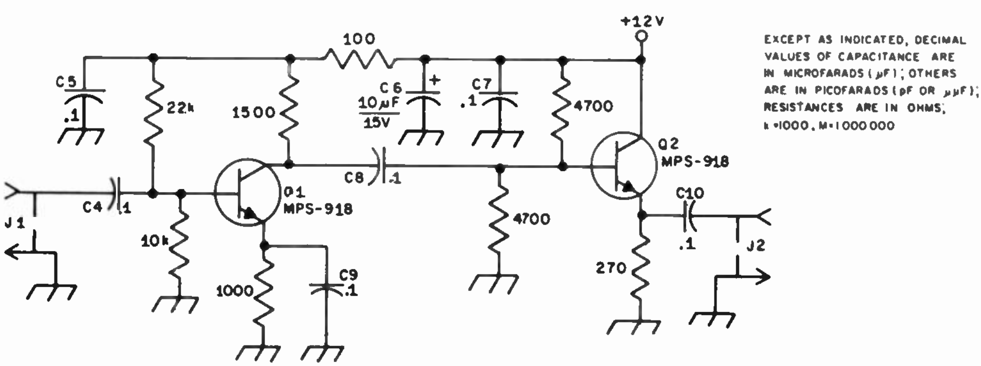
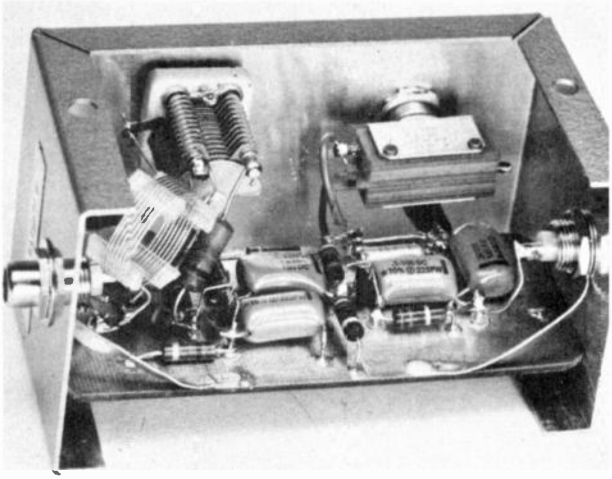


Fig. 2 – Circuit diagram for the tuned circuit. Parts values are listed in Table I.

Fig. 1 – Circuit diagram for the broad-band amplifier. If the amplifier is to be used at 100 Hz, C4, C5, C8, C9, and C10 should be 10 µF in capacitance. C4 should be omitted if the tuned circuit in Fig. 2 is used.

C4, C5, C7, C8, C10 – 0.1-µF 100-V (Sprague Orange Drop or equiv.).
C6 – 10-µF 15-V tantalum.
J1, J2 – Phono jack.
Q1, Q2 – Silicon npn rf transistor (Motorola MPS-918).



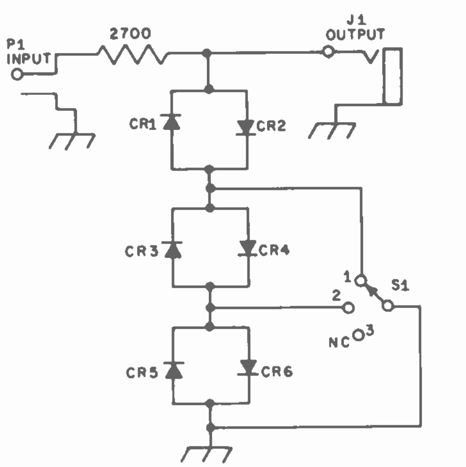


Inside view of the preamp. with the tuned-input circuit shown at the left. The switch is not included in Fig. 1. It is used by the author as an on-off power switch. The prospective builder might consider including a band switch with an "out" position if the amplifier will be used in front of a reasonably good receiver. Under some operating conditions, it might not be desirable to have the preamp. in the line.

The amplifier has a gain of 23 dB at 6 meters and a gain of 30 dB at 10 meters. It operates nicely with either a 50-ohm or 75-ohm receiver-input impedance and will serve as an inexpensive receiver accessory. The total cost, excluding the container and connectors, is about $10. – *Donald K. Belcher, WA4JVE and Alan Victor, WA4MGX*

ADJUSTABLE AUDIO LIMITER

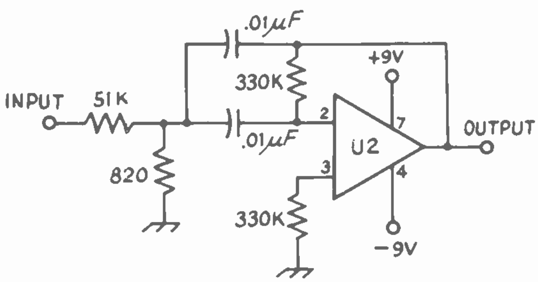
I found the "batteryless" audio limiter described by Lew McCoy, W1ICP, (July, *QST*, 1964) to be very effective. The one drawback was the one-volt peak-to-peak output which proved to be a bit too low to drive my pair of headphones. A modification to the circuit is shown in the drawing. By adding diode pairs and a rotary switch, the output can be adjusted in one-volt peak-to-peak steps. Silicon diodes are used because of the 0.6-volt drop across them when they are forward biased. Voltage and current ratings of the diodes are unimportant. I chose to use three diode pairs, but more can be added if desired. – *Stephen Pawlowicz*



Adjustable audio limiter.
CR1-CR6, incl. – Silicon diodes, any voltage and current rating.
J1 – Headphone jack.
P1 – Headphone plug.
S1 – 3-position, single-pole, single-section phenolic rotary switch.

A SIMPLE AUDIO FILTER

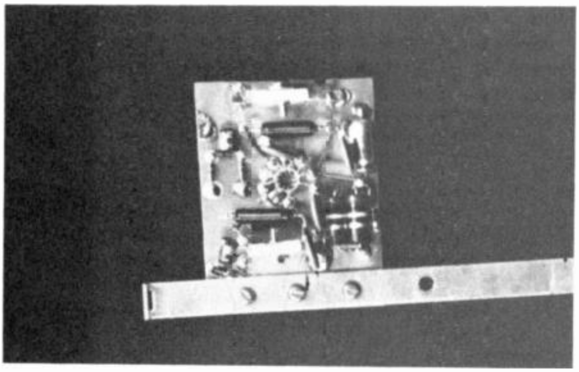
The cw performance of many less-expensive receivers can be improved significantly by the addition of an audio filter. The circuit combines simplicity and some gain. The circuit is a bandpass active filter, using an integrated operational amplifier. It has a center frequency of 1 kHz, a bandwidth of 100 Hz, and a gain of 10. The filter is powered by two 9-volt transistor batteries.



An active filter provides additional selectivity after the receiver audio circuit.
U2 – N5741V operational amplifier.

Headphones with an impedance of 600 ohms or higher can be used on the output of the audio filter. If it is desired to operate with a loudspeaker, an impedance-transformation stage is required along with some additional power gain.

The N5741V operational amplifier is made by Signetics and sells for $1. It is their short dual-in-line version of the popular 741 operational amplifier. The entire circuit can be built on a 1 x 2-inch circuit board and taped to the batteries. It can then be mounted in a Minibox or tucked into the receiver. A switch to remove power and bypass the filter is required. – *Robert R. Knibb, WA3LIO*



Preamplifier board and mounting bracket.

A SINGLE–BAND PREAMP TO IMPROVE SSB TRANSCEIVERS

It has been the experience of the authors that some ssb transceivers could stand improvements when it comes to reception. With this in mind, a single-band preamplifier was designed and constructed. After it was installed in an HW-32A, signals that were not Q5 previously were easily readable.

The entire cost of the unit is approximately ten dollars, including a Motorola MC1550G IC (designed for rf and i-f amplifier use to 60 MHz). Since elaborate test gear was unavailable for the project, the circuit had to be simple enough to be adjusted with only an "ear" and a screwdriver. Tune-up is simply accomplished by setting the variable capacitors C2 and C7 at minimum and then peaking them for loudest response near the middle of the band. A crystal calibrator connected to the antenna input will provide an adequate marker. The input and output networks are optimized for broadband operation and good stability, rather than for maximum power gain. Once the simple adjustments described are performed, no further alignment is necessary.

Calculations and results indicate that the preamplifier has a gain of approximately 30 dB on 14 MHz (the HW-32A frequency) with slightly less gain on the 15- and 10-meter bands. Preamplifier component values are given for 20, 15, and 10 meters.[1]

[1] **[EDITOR'S NOTE: The reader is reminded that additional gain at the front end of some receivers can lead to cross-modulation and overloading effects in the early stages of the receiver. There is little point in adding a preamplifier to a receiver that has sufficient sensitivity and a good noise figure. If preamplifier gain is too great for a specific receiver, as evidenced by cross-modulation and overloading in the presence of strong signals, try installing a step attenuator between the preamplifier and the input to the receiver, using only that amount of gain which will assure improved reception. Suitable circuits for attenuators are given in the receiving chapter of *The Radio Amateur's Handbook.*]**

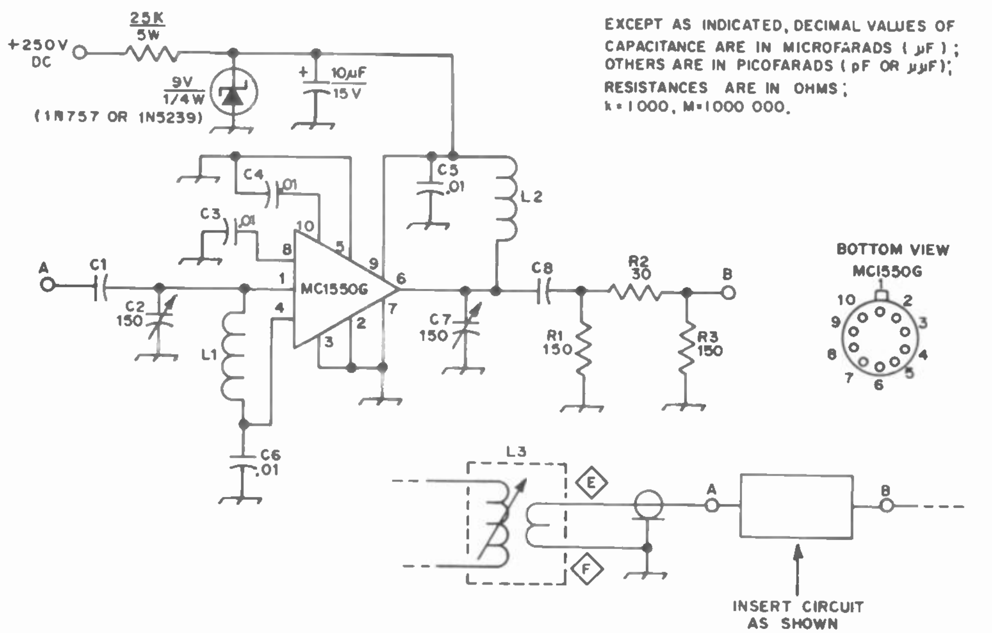


Fig. 1 — Schematic diagram for the preamplifier and the power supply. All resistors are 1/2- or 1/4-watt composition.

C1, C8 — 20 meters — 39 pF.
15 meters — 27 pF.
10 meters — 22 pF.
Dipped mica, MIL-TYPE CM04 preferred.

C2, C7 — 150 pF trimmer (Elmenco No. 424 or equivalent).

C3, C4, C5, C6 — .01 µF disk ceramic.

L1, L2 — 20 meters — 1.0 µH (J. W. Miller, No. 4602).
15 meters — 0.47 µH (J. W. Miller, No. 4588).
10 meters — 0.33 µH (J. W. Miller, No. 4586).

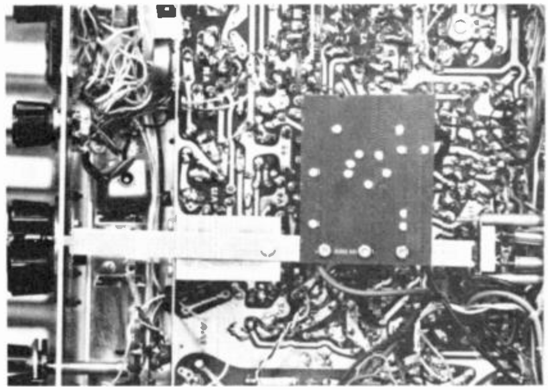
L3 — See schematic diagram of the HW-32A.

Construction

The preamplifier should be constructed on a small copper-clad board, with all leads as short as possible. Since pin 7 of the IC is internally connected to the case, there is no problem with getting the case close to the ground plane. The unit assembled by the authors used miniature Teflon-insulated standoff terminals, a technique highly recommended for rf work. Be sure that the variable capacitors are mounted so that the adjusting screw is at rf ground. This minimizes the effect of the screwdriver used for aligning.

After the preamplifier is constructed it can be mounted underneath the chassis near the original receiver rf amplifier. Use a small bracket (the bracket and the approximate location of the board are shown in the photographs). Power for the preamplifier can be obtained from a small 9-V radio battery, or directly from the transceiver power supply. The latter method was used by the authors and is shown in Fig. 1. A circuit consisting of a Zener diode and a series dropping resistor provides the necessary voltage for the IC.

Since the dropping resistor dissipates 2 watts, one with a 5-watt rating is required. It should be mounted far enough away from components which might be damaged by excessive heat. Other types of transceivers may not use 250 volts and the series-dropping resistor must be changed if the preamplifier is to be used with them. The total current through the resistor is approximately 9.6 mA. If the transceiver has a 300-V supply for example, the dropping resistor should be increased to 28,000 ohms. No increase of the power rating should be necessary. – *Donald K. Belcher, WA4JVE and Alan W. McCormick, WB4VOZ*



Preamplifier installed in Heath HW-32A transceiver. It should be positioned near the receiver rf amplifier.

HEATH HW-7 PRESELECTOR MODIFICATION

When changing bands, the critical tuning of the receiver preselector capacitor (C1) can be annoying to some operators and the following modification works quite well.

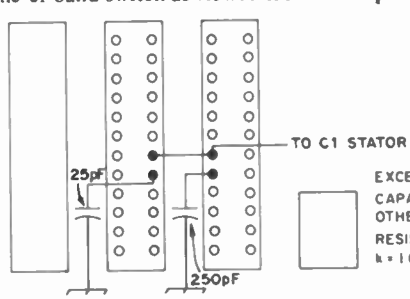
1) Replace C1 with a 50-pF variable capacitor such as a Hammarlund HF-50.

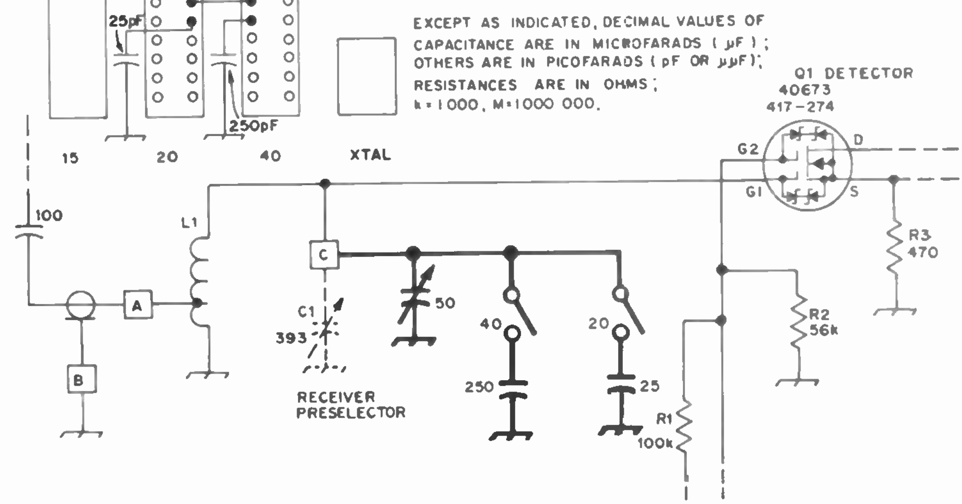
2) Connect the stator of the new C1 to pin 6 of the 40-meter band switch and pin 18 of the 20-meter band switch as viewed from the top.

3) Install approximately 25 pF of fixed capacitance between pin 17 of the 20-meter band switch and ground (I used a lug mounted under the machine screw holding the front of the cabinet on).

4) Install approximately 250 pF of fixed capacitance between pin 5 of the 40-meter band switch and ground.

The different values of fixed capacitance are switched in on 40 and 20 meters with the band switch and out on 15 meters. Each band can be peaked with about half of the variable capacitor being used. Peaking on 15 meters is still quite critical, 20 meters broader, and 40 meters quite broad. – *R.J. Harker, WN9JML*





An R-4B with the external crystal filters.

A CRYSTAL FLITER FOR THE DRAKE R–4B

Here is an easy (though expensive) modification which may be performed on the Drake R-4 series of receivers to add a crystal filter. No holes need be drilled and the receiver can be restored to its original condition in less than an hour. The modified receiver has an i-f system with a 6-dB bandpass of approximately 2.2 kHz and a 6:60-dB shape factor of 1.5:1.

The R-4 is a dual-conversion receiver with a four-pole, 6-kHz-wide crystal filter in the first i-f stage (5645 kHz). The purpose of this filter is to provide immunity to out-of-band signals and to assure adequate image rejection which might otherwise be a problem in a receiver with a 50-kHz second i-f. The companion T-4XB exciter/transmitter uses two 8-pole crystal filters at 5645 kHz – one for each sideband. If provision is made for impedance matching, it is possible to use the 8-pole transmitter filters in the receiver first i-f stage. The combination of the sharper crystal filter in the first i-f and the *LC* filter in the second i-f provides excellent selectivity for ssb operation.

Components

The 8-pole filters are available from the R. L. Drake Company at a cost of approximately $80. Included in the package are two filters, a switch, and a mounting bracket. Additionally, a set of matching transformers is required (T2 and T3 in the T-4XB). These cost approximately $8 for the pair. The only other items needed are three feet of shielded cable (RG-174 or equiv.), a metal box, and three 1/4-inch-dia rubber grommets. Any aluminum box larger than 2 1/2 × 3 × 3 inches will be satisfactory.

Step-by-Step Procedure

1) Mount the switch, bracket, and filters in the enclosure as shown in the photograph. Include two grommets on the rear of the box.

2) Route a pair of 18-in. coaxial cables through the grommets on the rear of the enclosure and connect the center conductor of each cable to the center lug of each switch pole. Connect the shields of both cables to the nearest ground lug, respectively.

3) Remove the receiver top and bottom covers.

4) Locate T5 and T6 (the filter matching transformer and the existing crystal filter). Make a sketch of the connections to these transformers (for later reference).

5) Disconnect all of the leads to T5 and T6, then remove the transformers. It is not necessary to break or drill anything; the transformers are held in place with a pair of spring clips.

6) Install the new T2 and T3 (T-4XB nomenclature) transformers where T5 and T6 were mounted. T2 replaces T5 and T3 replaces T6. Note that in both cases the high-resistance windings (about 2 ohms) of both transformers are nearest the tube socket to which they are connected. See Fig. 1. The low-resistance windings of each transformer face each other.

7) Reconnect all of the wires and components to the lugs on both transformers. *Exception:* Omit the connections between the two transformer low-resistance windings.

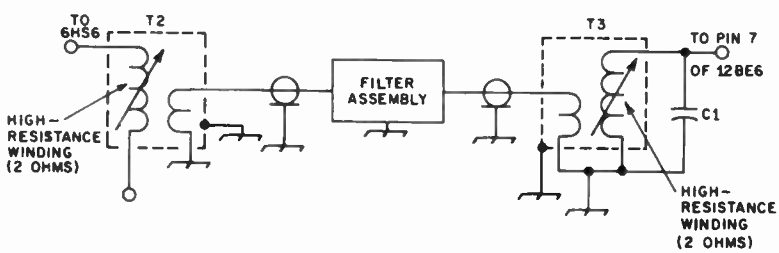
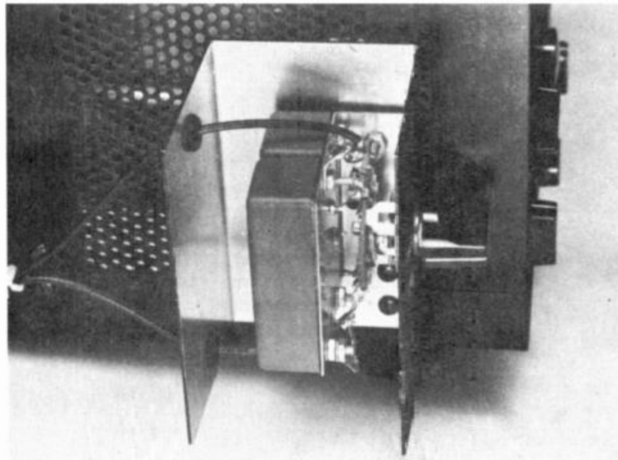


Fig. 1 — Circuit diagram of the modified i-f transformer section of the R-4B receiver. C1 is a 27-pF disk ceramic capacitor in the R-4A. The R-4B uses a 21-pF capacitor. The filter assembly consists of two filters, a ceramic switch, and a mounting bracket. T2 and T3 are the T-4XB transformer designations which replace the receiver T5 and T6 respectively.

for the Receiver



Inside view of the filter assembly built by K1JHX The box is homemade. Two of the screws for securing the receiver top cover are used to hold the assembly in place. Press-on decals and a Drake knob add a final touch.

8) Position a rubber grommet in the spare jack hole on the rear chassis apron. Route the shielded wires from the filter box through the grommet and along the chassis to the new i-f transformers. Connect these cables to the i-f transformers as shown in Fig. 2. The center lugs on the transformers are not used. The lugs to which the shields are connected are then grounded with a short piece of hookup wire.

Alignment

Set the receiver tuning dial to position one of the crystal calibrator markers in the middle of the passband. Select either USB or LSB with *both* the passband tuner and the crystal-filter switch. Adjust the **PRESELECTOR**, T2, and T3 for maximum S-meter reading. This condition occurs with the transformer slugs nearly all the way out. There should be no noticeable decrease in sensitivity or overall gain after the modification is completed.

Operation

The crystal-filter switch must be placed in the proper position for the mode of operation. The 4.8-kHz selectivity position of the passband switch is limited by the crystal filter, but the receiver is still usable for a-m reception.

The additional selectivity provided by the filter is noticed mostly while operating ssb during crowded band conditions. However, the cw performance is also improved since there is a substantial reduction of the audio image on the other side of zero beat. The entire modification requires roughly 2 1/2 hours.

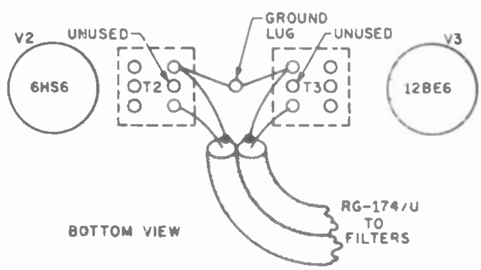
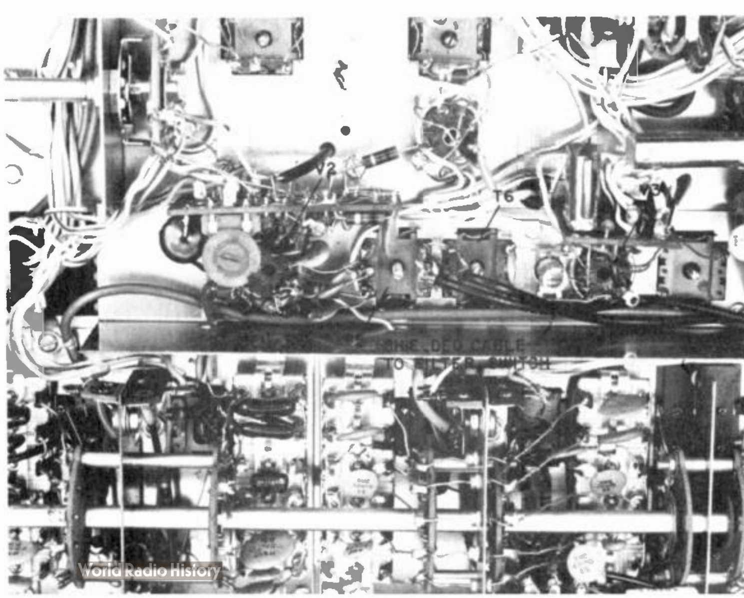


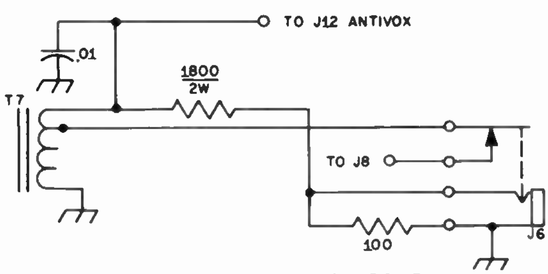
Fig. 2 — The two cables from the filters are routed through the grommet mounted on the rear chassis apron. The center lugs on the transformers are not used.

Bottom view of the modified R-4B. The leads from the filter assembly are routed through a grommet in the rear chassis apron.

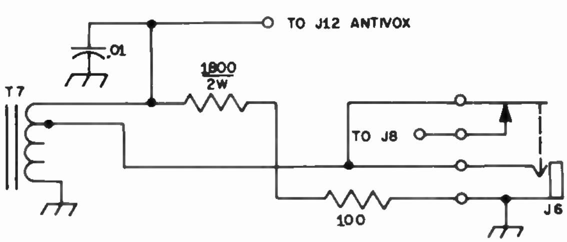


75S3 AUDIO MODIFICATION

Many amateurs use low-impedance headphones, and these headsets will not operate satisfactorily with the Collins 75-S series of receivers. A simple wiring change at the phone jack will correct the problem. Remove the orange wire going to J6, tape the end and tuck it out of the way. Connect a wire to the terminal where the orange wire was fastened and connect the other end to the terminal on the jack having a white wire (with brown and blue tracer). Simplified versions of both circuits are shown in the drawing. – *H. Dale Strieter, W4DQS*



ORIGINAL 75S-3 AUDIO CIRCUIT

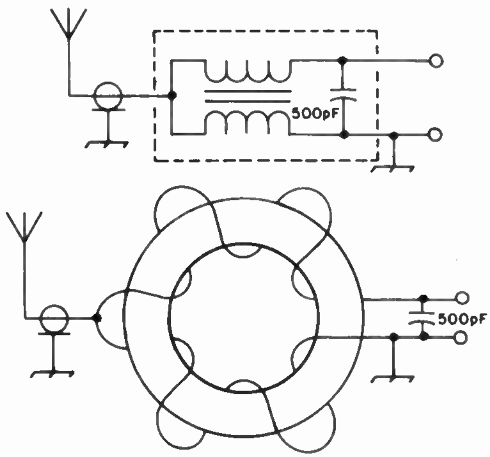


MODIFIED AUDIO CIRCUIT

ANTENNA COUPLING UNIT FOR THE WWVL RECEIVER

When I built the NAA Receiver (*QST*, October 1962) I found that I needed something in the antenna circuit to reduce bc harmonics and other birdies. A 200-turn honeycomb coil happened to serve this purpose nicely, and ever since then, I have included the coil on the various vlf receivers that I have used.

Recently when I attached the antenna directly to the WWVL receiver (*QST* November 1971) I was utterly dismayed to discover that the local crud was greatly in evidence, so much so that I couldn't find WWVL. I know of two other people in this area of the country who were experiencing similar trouble.

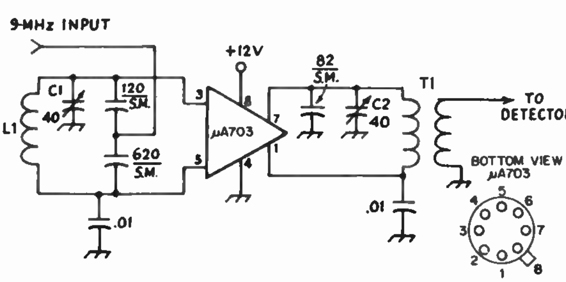


Shown is the method of connecting the 88-mH coupling unit to a WWVL receiver and antenna.

I-F AMPLIFIER FOR SIMPLE RECEIVERS

In order to get more gain from W1CER's 40-meter cw receiver (*QST* for January, 1973), I added this i-f amplifier stage. It consists of only ten components and draws about 4.5 mA. The op amp is readily available from Poly Paks or Allied Radio Shack. T1 provides an output impedance of 500 ohms. If the output capacitor tunes the amplifier to a null instead of a peak, reverse the polarity of the output winding.

It is advisable to shield IC leads 3, 4, and 5 from 1, 7, and 8. I used a strip of metal from a tin can, then soldered to flea clips, to obtain this isolation. The receiver provides good reception using only the apartment window screen for an antenna. – *Steve Maskell, K4HVN*



Schematic diagram of the i-f amplifier. Unless otherwise noted, capacitors are disk ceramic.
C1, C2 – Ceramic or compression mica trimmer.
L1 – 23 turns of No. 26 enam. wire on Amidon T-50-2 core.
T1 – Primary, 23 turns of No. 26 enam. wire. Secondary, 4 turns of No. 26. Use T-50-2 core (Amidon).

Hints and Kinks . . .

for the Antenna System

ANTENNA-ROTATOR HEATER

I was having trouble turning my antenna with a small prop-pitch motor when the temperature went below +20°F. This seemed to be caused by the lubricant thickening during these cold spells. K5BXG suggested that I use a heat strap of the type used in mobile homes to keep exposed plumbing from freezing. I purchased a 12-foot heat strap from Montgomery-Ward for $5.30 (83GR9961), which came equipped with fiber-glass insulation and a thermostat set at 35°F.

I wrapped the tape and insulation around the gear box and motor and placed the thermostat outside the insulation. The 117-volt line was run to the tower and the heater is plugged into it there. I have used the rotator at temperatures down to +7°F without experiencing any trouble. – *Harold E. Davis, W5FFW.*

ANTENNA INSULATORS AND SPREADERS FROM PLASTIC CLOROX BOTTLES

The tough plastic from discarded Clorox bottles can be used for antenna insulators and spreaders for open-wire feed line. The antenna shown in Fig. 4 has withstood five years of use, with no breakage or deterioration of the plastic.

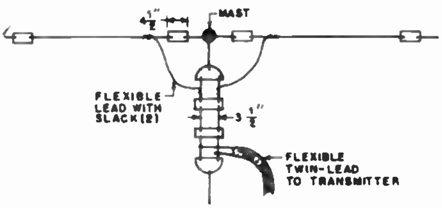
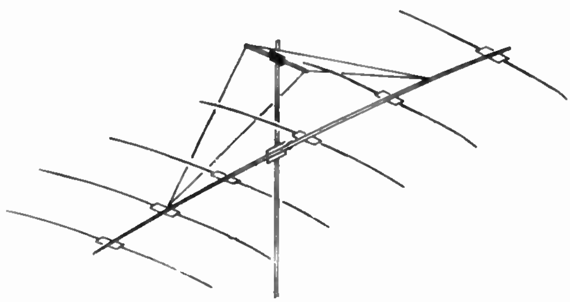


Fig. 4 — Clorox bottle antenna insulators.

The triangular plastic insulators were used to anchor each end of the feed line so that it would swing as a unit in high winds. Even though the material is extremely tough, eyelets must be used in order to keep the wire from cutting through the plastic. The plastic is folded double, for maximum strength, and more thicknesses could be used if large tent grommets are available. The material is polyethelene, so it is a first grade insulator. In making the feeder spreaders, a piece of plastic is cut to the desired width and creased. The holes are then drilled (about the same diameter as the wire), and the wire is fed through the two holes until the spreader is moved to the desired location. – *A.P. Marsh, W3MJ*

T-BRACE FOR LARGE ARRAYS

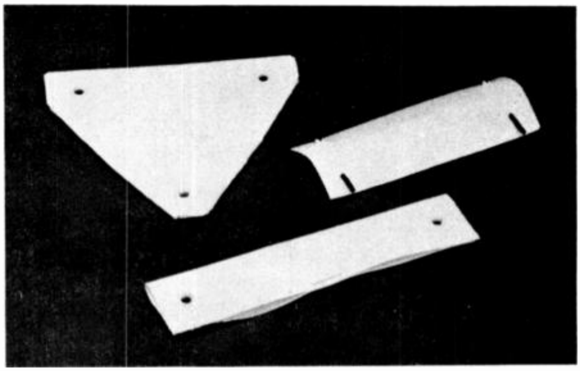
The arrangement shown in the sketch works very well for reducing lateral boom movement. The purpose of the 4-wire brace is to allow the use of a small diameter boom on a very long Yagi. In one of our models, a 6-element 20-meter monobander, the 67-foot boom is only 2 1/2 inches in diameter. The entire weight of the boom and elements tends to hold the boom in place. In order for wind to move



the boom laterally, it must move it in an upward direction. With our 67-foot boom, an 8-foot cross-bar, pinned to the mast 10 feet above the antenna, works quite well. The dimensions could be reduced a bit for smaller arrays.

Not only does the T-brace reduce the amount of lateral movement in the boom, it allows the use of a small boom diameter which reduces the wind loading. – *Alex Dolgosh, K8EUR, Antenna Specialists Co.*

The insulator type at the right separates the feed line, and triangular ones go at the top and bottom of the feed line. The long one shown can be used for center and end insulators.



A 42-FOOT CRANK-UP FOLD-OVER TOWER

A 42-foot crank-up fold-over tower.

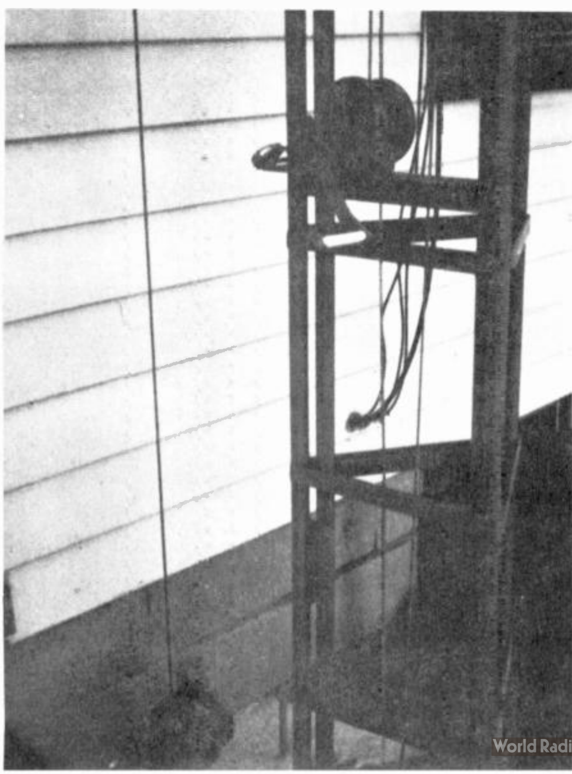
If you told a friend you were going to build a crank-up tower, you would probably get the same comments I did – "Oh yeah?" After buying some new gear recently, the thought of having to purchase a tower didn't settle too well with my budget. An article in an earlier *QST* showed a good basic design.[1] After discussing the project with my brother-in-law, we decided to undertake the construction job. He was able to borrow a welding machine and knew how to operate it.

Top-Section Construction

The plan of building the inside section first, as mentioned in the earlier article, was followed. Each leg was constructed from a 21-foot piece of 1 1/4-inch standard black pipe. Six wooden forms, made of 1/2-inch-thick plywood approximately 24 inches square, were used as spacers for the three legs. Each form had three holes, mutually spaced 13 inches apart, center to center.

Steel cross braces were made from 1/4 x 1-inch bar stock cut to a length of 13 inches and placed at 16-inch intervals along the legs. The welds and cross pieces were kept on the inside of the legs to assure that the outer section, when completed, would slide freely over the inner section during the crank-up operation. Angle stock was used to check the position of each weld by sliding a short piece of it over the outside of the leg at the weld point. The angle stock must not touch the cross brace or weld. Three guides, made from 3/4-inch angle iron, were welded to the bottom as shown in Fig. 1. The wooden forms were removed when all of the welding was completed.

Fig. 1 – The guides for the inside section are mounted about 15 inches from the bottom. The winch mounted on the side of the tower is used for crank-up. The other one is used to lower the tower to the ground.



Construction of the Outer Section

Before placing the outer-section legs in position, a guide, similar to the ones mentioned above, was welded to one end of each of the remaining 21-foot pipes. Then the pipes were fastened with rope to the already completed tower section. We assured sliding clearance for the inside section by placing 1/16-inch spacers between each guide and its associated leg. The cross section braces were carefully welded in place so that the distance between the inside and outside legs remained constant. When the welding work was finished, the spacers were removed. The final product seemed remarkably straight. Since the completed tower was a bit heavy to handle, even for two men, we disassembled the sections. An identification mark was placed on adjoining legs so that the sections could be reassembled with the same sides facing each other.

The Base Plate

A hinge on the base plate was needed to tilt the cranked-down tower to ground level. A 3-inch

[1] Filion, "A 65-Foot Crank-Up." *QST*, August, 1968.

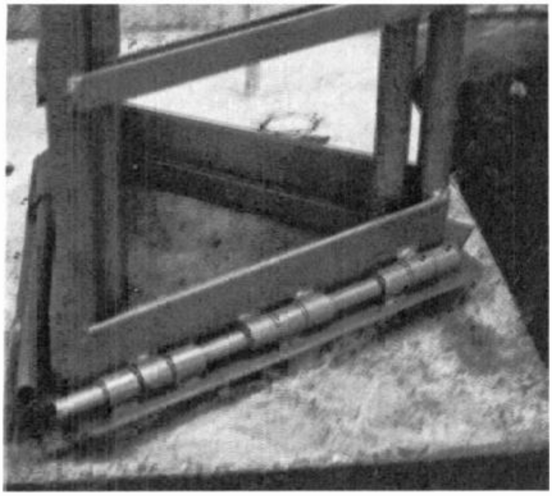


Fig. 2 — Hinge detail

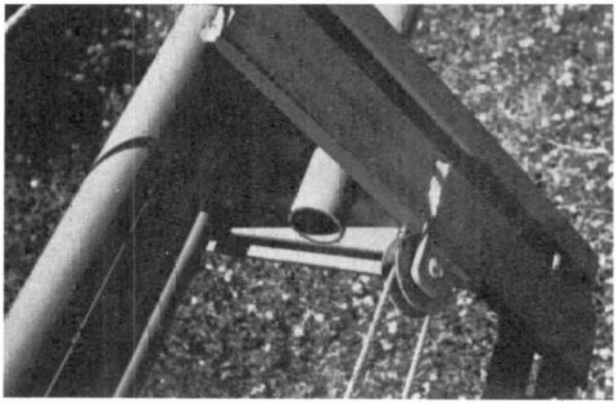


Fig. 3 — A pulley is sandwiched between two pieces of bar stock and welded to the top of the outside section.

steel plate was welded across one side of the tower and 3 pairs of 1 1/4-inch OD (7/8-inch ID) mechanical tubing, 1 1/4 inches long, were attached to it. Similar pieces of tubing were welded at three places on the base plate. Then, a 1/2-inch pipe was inserted through the tubing to form the hinge. A photograph of this assembly is shown in Fig. 2. A second set of tubing was used to lock the tower when in the upright position.

Winches

Two winches, each rated at 1000 pounds, were purchased from Sears, Roebuck and Company at a cost of $9 apiece. A 3-inch-diameter pulley, sandwiched between two pieces of 1 1/4-inch bar stock, was welded to the top of the outside tower section and a similar assembly was welded to the bottom of the inside section. Fig. 3 shows the arrangement. The crank-up winch was mounted 4 feet from the bottom of the tower. The cable from this winch was strung through the top pulley, down between the sections, and through the bottom pulley. It was then fastened to the top of the outside tower. This arrangement provides a mechanical advantage factor of 2. The second winch, mounted on a small support near the base of the tower, has its cable fed through a pulley attached to the house, and connects to the top of the first section.

Final Thoughts

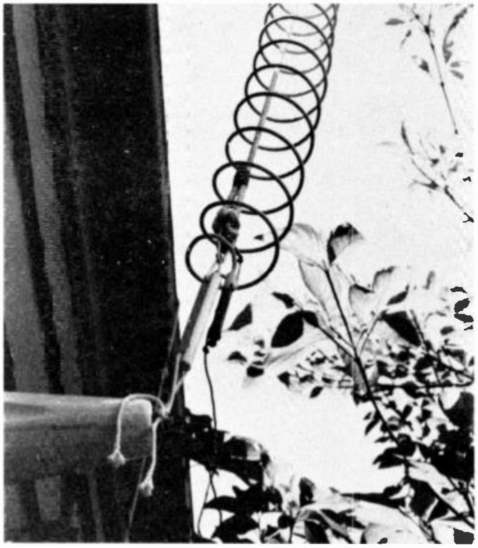
The tower was spray painted, first with a coat of zinc-oxide undercoat, and then with enamel. The lower section is supported by the house, so guy wires were not necessary. But if the builder were to place the tower away from any supporting structure, at least one set of guys should be used at the top of the first section.

I installed bicycle padlocks over the winch handles. This procedure keeps the neighborhood gang from "experimenting." I wish to thank my brother-in-law, Arnold Gross, for his help in accomplishing this project. — *Gordon H. Weiler, W9ZQK*

The house serves as both an anchor point for the fold-over pulley and a supporting structure for the lower half of the tower.

ANTENNA INSULATORS FROM A SIX-PACK

Antenna insulators are usually inexpensive but are not always on hand when needed, especially on a Field Day when they might be one of the forgotten items. I have found the plastic holder on most brands of beer sold in six-packs to be quite strong and able to support a length of wire. When cut into three pieces, one holder should be adequate for the ends and center of a dipole for all bands except maybe 40 and 80 meters, in which case the folded holders of three six-packs may be necessary to support such lengths. Seems to me that there are always a lot of insulators available and wasted on these weekend Field Days. — *Ev Taylor, W6DOR/W7BYF*



Base of the coil.

LONG HELICAL COILS FOR ANTENNA LOADING

The uses of helically-wound antennas have been described quite often in *QST* [1,2,3,4] In general, they are used where available space and height are limited. The writer wished to put up an antenna for 160 meters without the usual high poles and large dimensions. It was desired to keep within the space of an existing inverted-L antenna which and a total length of 85 feet (26 m) including a vertical leg 30 feet (9 m) high. The far end of the L was 35 feet (10.7 m) high.

The first modification used top loading at the far end of the L by adding a compact loading coil and then connecting a 20-foot (6 m) wire hanging down from it to serve as a capacitive hat. This worked quite well, but a considerable amount of base loading was needed to operate against ground as a 1/4-wave antenna at 1.8 MHz. It was found that this loaded antenna also worked well for 80 through 10 meters by selective use of L- or π-network matching for end feed. A short length of 50-ohm coaxial cable ran between the transmitter in the basement and the network located in the cellar stairway. The network was grounded to adjacent water pipes bonded together. It was found that the far-end loading coil – 20 feet (6 m) No. 22 on a 1-1/2-inch (3.8 cm) form – acted as an rf choke on the 40 through 10 meter bands.

In order to eliminate the lumped base inductance for 160-meter operation, it was decided to use some kind of long helical coil in the vertical leg of the L and hopefully improve radiation. A design was finally arrived at which had a unique coil construction. It was also easy to build and was inexpensive.

[1] Tyskewicz, "The Heli-rope Antenna," *QST* for June, 1971.

[2] Ellingson, "A Helically Wound Vertical Antenna for the 75-Meter Band," *QST* for January, 1972.

[3] Harris, "Continuously Loaded Whip Antennas," *QST* for May, 1958 and in recent editions of *The Radio Amateur's Handbook.*

[4] Sevick, "The W2FMI Ground-Mounted Short Vertical," *QST* for March, 1973.

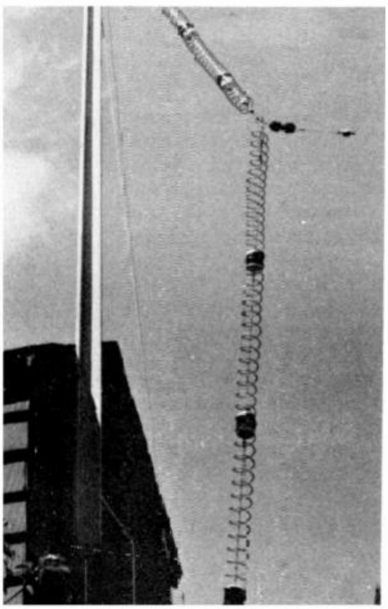


Fig. 1 — Photograph of the loading coil showing the plastic-bottle spacers. The coil in the picture consists of two 10-1/2-foot sections but could be made from one 21-foot section. The rest of the inverted –L antenna runs from the top of the mast. A guy line in the middle of the coil keeps the coil away from the building.

Construction

The helical coil is 21 feet (6.4 m) long, consisting of 122 turns of aluminum wire (TV ground wire) wound to a coil diameter of 2-3/4 inches (7 cm) with 2-inch (5 cm) spacing between turns. A total length of 90 feet (28 m) of wire is required. The coil is supported by a central 1/4-inch nylon rope and plastic bottles are used as spacers. The latter are spaced about 2 feet (60 cm) apart and secured to the rope by knots immediately above and below the bottle hole (see Fig. 1). The coil is held to the outer surface of the bottles with electrician's plastic tape. Each end of the coil is connected to a terminal made of 5/16-inch brass rod, the aluminum wire being held by brass set screws. Wire rings to hold the nylon rope and end insulators are threaded through holes in the terminals (see Fig. 2). The metal surfaces at the joints between the terminal and aluminum wire are painted to prevent corrosion by galvanic action. The coil assembly is quite light weight (under 5 pounds). It has withstood winter gales, sleet, etc. and has been in operation for over eight months with no deterioration.

The 21-foot (6.1 m) coil when inserted in the vertical leg to replace the same length of single wire was found to make the vertical effective length approximately 50 feet (15 m) for a net gain of about 20 feet (6 m) without exceeding the original overall 30 foot (9 m) height.

The antenna was found to resonate at about 1700 kHz so a series capacitor was used at the feed point. An L-matching network was used between the 50-ohm coaxial feed line and the antenna load. The voltage node was near the bottom of the long vertical coil.

The results with the long 21-foot-helix coil have been very gratifying. DX contacts were made on cw to Europe and South America with RST 569

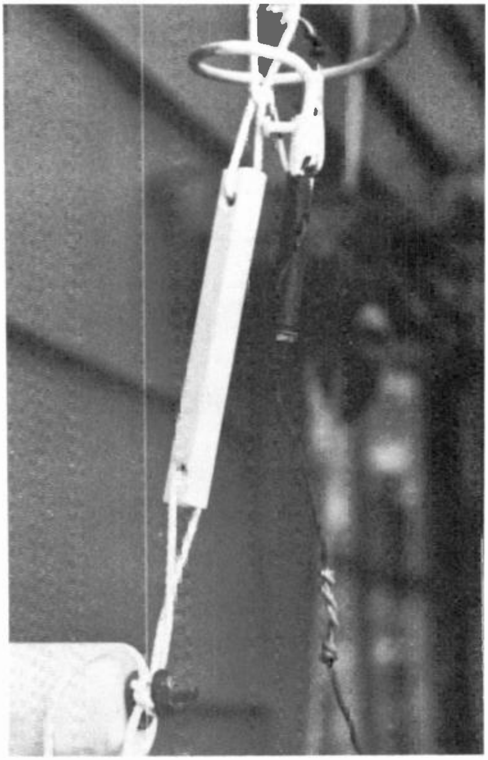


Fig. 2 — End-connection details.

reports on 160 meters. This DX had not been accomplished before the last modification was made. Also, it was found that operation on the hf bands 80 through 15 meters was very satisfactory. Compared with previous arrangements, better signal reports were received when operating on 7 MHz. At 1.8 MHz the power input to the final amplifier was 80 watts.

One wishing to increase the vertically polarized radiation for just the 160 meter band may use a longer helical loading coil. This change might adversely effect the operation of the antenna on the higher frequencies where the antenna is harmonically operated. An 11-foot (3.4 m) section of the helix alone was found to resonate at 16 MHz (1/4 wave) from which lengths for other frequencies may be calculated. It should be noted that the long helix was at the high current section of the 160-meter antenna as described so that it was more effective in lowering the frequency than at a location nearer to the far end of the antenna.

The use of radials with the antenna described above would be expected to make it even more effective. This will be tried out in the near future. – *Richard S. Briggs, W1BVL*

TILT-OVER TOWER IMPROVEMENT

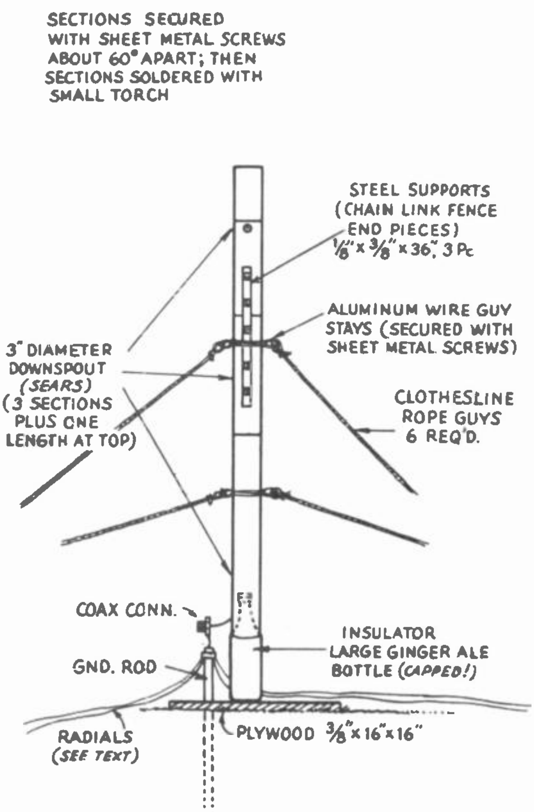
To carry W1KLK's idea of an easy tilt-over tower a little further (Hints and Kinks, May, 1970) and to gild the lily, I mounted a boat winch on the base of the telephone pole, and ran the steel cable from the winch up to a pulley at the top of the pole, then out through another pulley on the tower and fastened the cable back on the pole. Thus, I have my raising and lowering mechanism always available. The boat winch has a 5-to-1 mechanical advantage, and the doubled cable between the tower and pole has a 2-to-1 mechanical advantage. It is easy for even the XYL to raise and lower my 50-foot tower with the quad and rotator mounted on top. – *Dick Morris, WA5WIT.*

THE $15 VERTICAL ANTENNA FOR FORTY METERS

The antenna is made from 3-inch diameter downspout, purchased from Sears, with a ground system made of aluminum clothesline as radials (as many as possible). The insulator is a large empty soft drink bottle (with a cap on!) set on a piece of plywood to hold grass and weeds down. The guy wires are cotton clothesline, tied to homemade aluminum wire "eyes." The latter are attached to the antenna by means of sheet-metal screws.

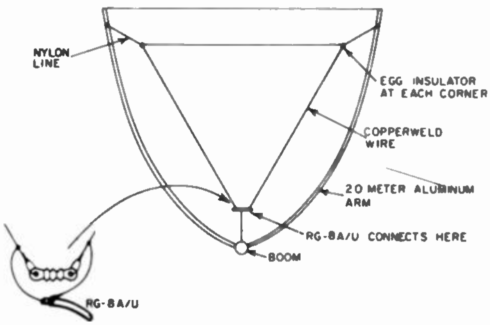
The antenna can be fed with 50-ohm coaxial cable, and the SWR with the one shown is less than 1.5:1 (7.0 to 7.3 MHz). The length of the antenna can be calculated from the formula, *Length* (feet) = 246/*f* (MHz).

The antenna has withstood two years of use, and works fine on "long hauls." – *Bob Ropes, W9JU.*



THE DELTA LOOP ON 15 OR 10 METERS

A 15- or 10-meter wire loop can be suspended inside a 20-meter loop. The wire should be supported by nylon rope. An insulator is placed at the bottom of the loop and the coax is attached directly to the wires without the use of any special matching device. Performance of the 15-meter wire is good and the SWR is low. – *Joseph Q. Wheeler, K5EVK*



TRANSMISSION-LINE MEASUREMENTS AND LINE LOSS

Quite often it is necessary to know conditions at the antenna end of a transmission line, but the relative ease of making measurements at the transmitter make the latter method attractive. The usual assumption is that such factors as SWR will be the same at both ends of the line. How valid this assumption is can best be illustrated by the following examples.

The voltage reflection coefficient at the *antenna* can be expressed in terms of the forward power (*Pf*) and the reflected power (*Pr*), *measured at the transmitter*, by the formula:

$$\rho = \sqrt{Pr/Pf}\ \text{antilog}\ \frac{(\text{line loss in dB})}{10}$$

(Also, the relation

$$\sqrt{\frac{Pr}{Pf}} = \frac{SWR - 1}{SWR + 1}$$

can be used if the meter is only calibrated in SWR.) For the calculator buffs, the antilog of a number, x, is 10^x. Once the reflection coefficient is calculated, the SWR at the antenna is given by:

$$SWR = \frac{1 + \rho}{1 - \rho}$$

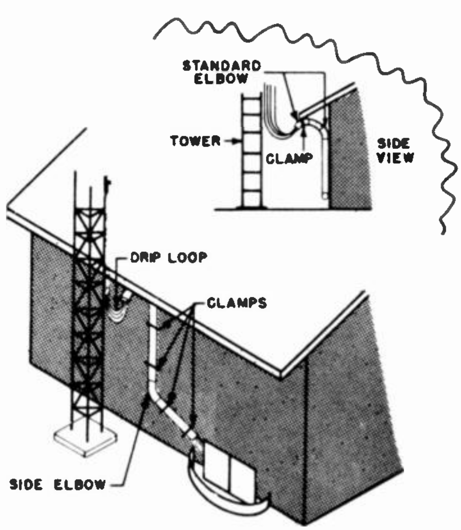
Notice that if the line loss is zero, the reflection coefficient is the same at both ends of the line and since the formula for SWR is a general one, the SWR values will also be the same. Assume that the line loss is 1 dB and that the forward and reflected powers measured at the transmitter are such that computations indicate an SWR of 2:1. The actual SWR at the antenna will be 2.45:1. Incidentally, it is the latter SWR value that must be used with graphs that give the additional loss because of SWR such as those shown in Fig. 20-8 in recent editions of *The Radio Amateur's Handbook*. It can be seen by examining that graph that using the 2:1 SWR value would result in little error in overall system loss computations. On the other hand, suppose that the line loss was 4.5 dB and that the measured SWR was still 2:1. This would mean that the SWR at the antenna was greater than 32:1 and instead of 0.45 dB, the additional line loss because of SWR would be greater than 7 dB! In fact, if the line loss were 4.5 dB and if the antenna terminals were shorted, the measured SWR at the transmitter would only be 2.1:1.

Unless the line loss is known accurately, little can be said about conditions at the antenna from measurements made at the transmitter. Some other means should be used to verify or negate the results of SWR measurements made at the transmitter should a faulty antenna system be suspected. – *W1YNC*

DOWNSPOUTS HOUSE FEED LINES

After installing my new antennas and the many feed lines that I had coming into my house, I found they were quite an eyesore. My solution was to use rectangular downspouting with the necessary elbows and clamps to match the existing downspouts on my house and place it as shown in the drawing.

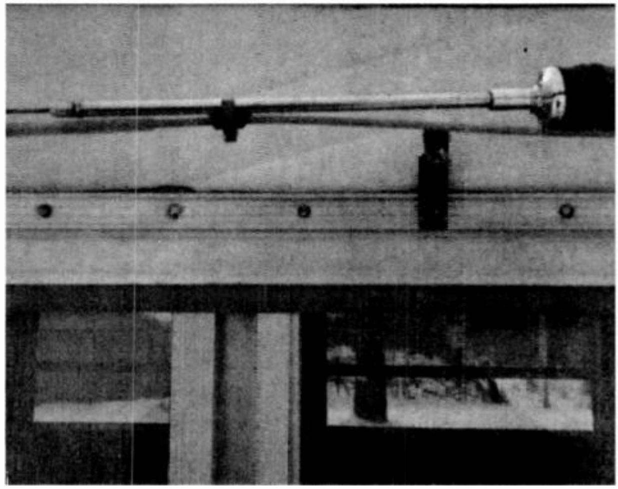
I found that flexible cables and rotator wires will thread through easily, but the solid aluminum-jacketed type is too stiff to bend around the curves inside the downspout. This type cable is placed alongside and bent to shape as inconspicuously as possible, and is then painted to match. With cables coming in from the outside, a drip loop should be provided so that water does not enter the shack during rain storms. – *George J. Poland, W8FWF*



ANTENNA ADJUSTMENTS FROM THE DRIVER'S SEAT

Push rods can be used to adjust the movable end of a loaded mobile antenna. Most hobby stores carry various lengths (up to 4 feet). In my case, I joined three of these push rods together with fiber sleeves and epoxy. The inner rods were connected with 3/4-inch long threaded rod.

The picture shows how I attached the end of the rod to the top of the mobile antenna. The push rod works almost as freely with the mast folded over as it does in the upright position. With a travel of 3 inches, my antenna covers 100 kHz on 80 meters. – *Allen Moore, WA8COT*



CORRECTION CHART FOR SWR MEASUREMENTS

It is not always convenient to measure SWR directly at the antenna. However, by using the graph shown in Fig. 1, the SWR can be obtained by measuring it at the input to the transmission line and using the known (or estimated) loss of the transmission line. The curves in Fig. 1 were obtained from the formula:

$$SWR_{out} = \frac{R+1}{R-1}$$

where

$$R = 10^{-(D/10)} \left[\frac{SWR_{in}+1}{SWR_{in}-1}\right]$$

and D is the transmission line loss in dB.

For example, if the line loss is appreciable (greater than 4 dB), the SWR at the transmission-line input will be less than 2:1 even if the line is poorly matched to the antenna. Fig. 1 can be used also to calculate the input-vs-output SWR relationship of an attenuator when its loss is known.

Fig. 2 is included so that the SWR can be calculated easily from wattmeter readings. This curve is plotted from the equation:

$$P_f/P_r = R^2 = \left[\frac{SWR+1}{SWR-1}\right]^2$$

Pf/Pr is the ratio of the indicated forward to reflected power. – *Leon W. Couch, K4GWQ*

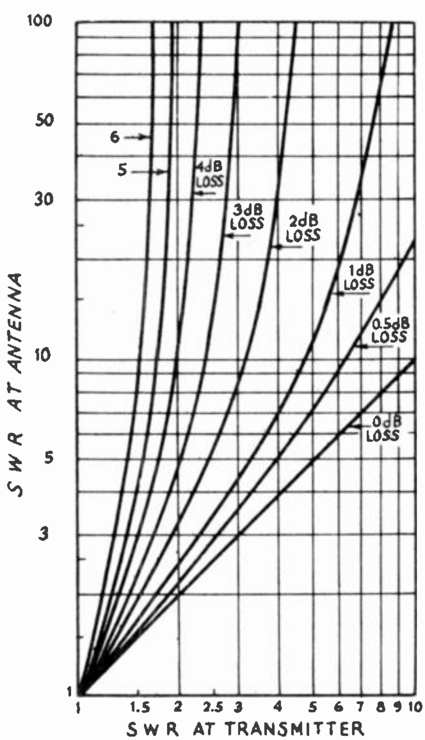


Fig. 1 – SWR at antenna vs SWR measured at the transmitter for various line losses.

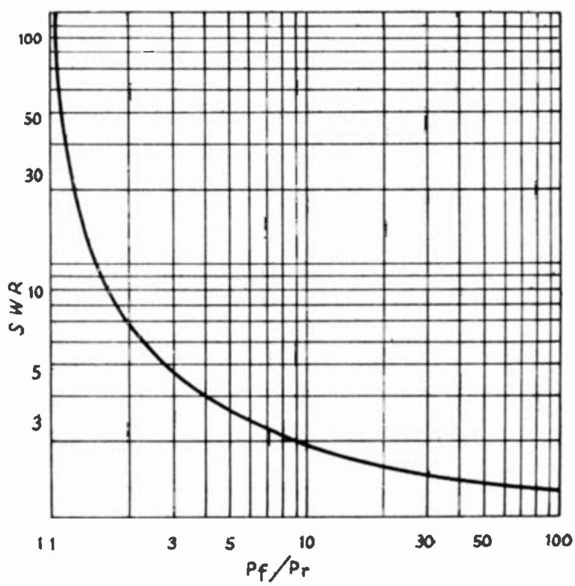


Fig. 2 – Chart for converting forward and reflected power to SWR.

Fig. 1 – Here is the dismantled prop-pitch rotator. Note the plastic-headed hammer which was used in taking the unit apart.

REPAIRING PROP-PITCH ROTATORS

Probably the best all-round antenna rotator a ham can find is a surplus prop-pitch motor. These were in plentiful supply up until a few years ago and are still listed in surplus and ham ads. No doubt many hams, like the writer, have had a prop-pitch motor go sour, and rather than throw it away have stored it in the junk box. This was our case until it was decided to see what had to be done to restore the unit to A-1 condition.

The bearings, the bearing seal, and the brushes cause the majority of failures. The bearings and seals are "off the shelf" standard items and are readily obtainable. Worn out brushes cause the major problem because exact replacements are unavailable. However, there is a "dodge" for this problem, if you'll excuse the pun. More about this when we discuss the motor repairs.

A problem develops in the amateur use of prop-pitch units because they were designed to operate in a horizontal position, and hams mount them vertically. This means the gears and bearings may not get adequate lubrication, and thus can dry up and bind.

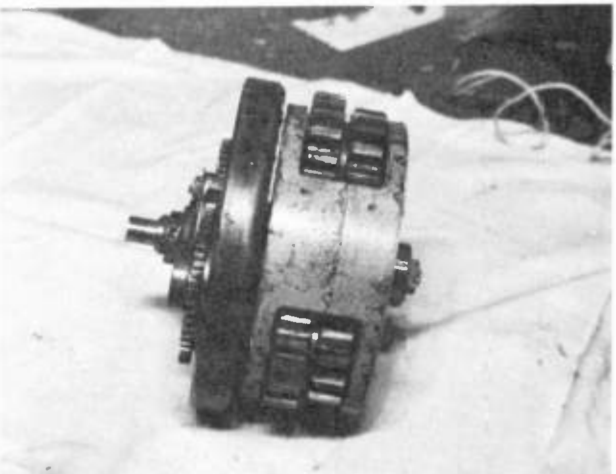


Fig. 2 – This is the gear-housing section – the heart of the rotator.

Taking the Unit Apart

Before dismantling the unit, paint a stripe down the side of the case so you'll be able to align it correctly during reassembly. Also, as you take the unit apart, make a sketch and keep notes. The prop-pitch motor assemblies are complicated and the notes and sketch will help when you reassemble the piece. Don't use a metal-faced hammer. Use a plastic hammer or blocks of hard wood. You'll probably destroy the gaskets when you take the unit apart, but replacement rubber "O" rings are available from most rubber-supply houses.

Fig. 1 shows what you'll have when the main components are separated. Fig. 2 pictures the gear-housing section, and Fig. 3 shows this section opened up.

Naturally, after I repaired my own unit I quickly acquired the reputation of being an expert in prop-pitch motor repair. Consequently, I rebuilt several motors for friends! Most of the units I repaired had bearing failures on the small motor drive shaft because of lack of lubrication. For the most part these were New Departure shielded bearings, No. 3200. A much better bearing for replacement is the New Departure No. Z99500. This bearing is almost the same but is sealed and permanently lubricated. It costs only a few cents more.

There are many versions of the prop-pitch rotator made and what we say here may not be true in all cases, as far as the bearings are concerned. To locate bearings, look up your local bearing distributor in the Yellow Pages. Usually the

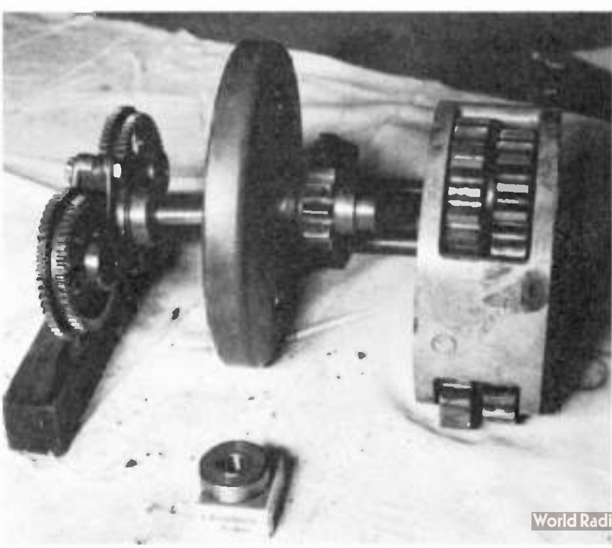


Fig. 3 – View of the opened gear housing to show the arrangement of the various gears.

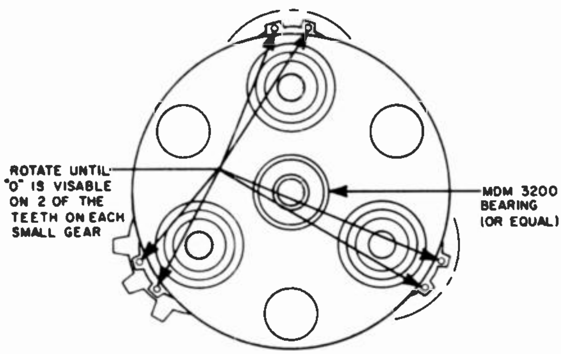


Fig. 4 — This drawing shows the small gears with the "Os" pointing out, the necessary arrangement when reassembling the gear housing.

distributor will be able to identify the bearings and provide a replacement. Also, most automotive parts houses have a stock of bearings and seals.

Getting It Back Together

After you have cleaned the gears you can reassemble the unit. Many people who have dismantled the gear boxes were never able to put them back together again. I thought there must be a simple answer to the problem but it evaded me. If you put the inner pinion gear in, either the ring gear would not go on or the shaft gear would not mate with the assembly. Any combination always ended up with one of the gears failing to go into place. There was always one gear with a tooth half out of mesh!

Then I noticed that two of the teeth on one of the smaller gears of the large planetary unit were marked with an "O." I checked the other two gears and they were marked the same. I rotated each of the gears with the "Os" facing out, and the whole assembly dropped right into place! Fig. 4 shows the assembly with the marked gears in their correct positions.

Reassembly procedure is as follows: Place the planetary assembly on the work bench (with the smaller gears up) and rotate the gears until the "Os" face out. Next, pick the assembly up and slip the pinion gear into the center, then place the unit on the table. Then set the ring gear over the larger gears in the planetary section. Again, carefully pick up the assembly and install the small planetary

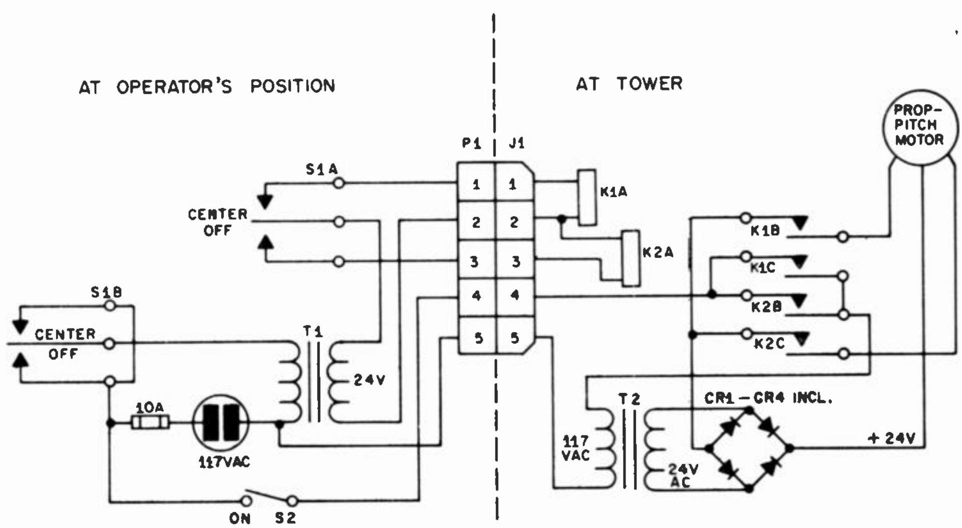


Fig. 5 — Control and power supply for the prop-pitch motor.
CR1-CR4, incl. — 25 A, 50- to 100-volts PRV.
J1 — 5-pin male connector.
K1, K2 — Dpst 24-volt ac coil (Potter and Brumfield PR7AY or similar).
P1 — 5-pin female connector.
S1 — Dpdt, nonlocking, center off, spring return (Switchcraft No. 25312 or similar).
S2 — Spst toggle.
T1 — 24 V, 1 A.
T2 — 24 V, 8 to 10 A.

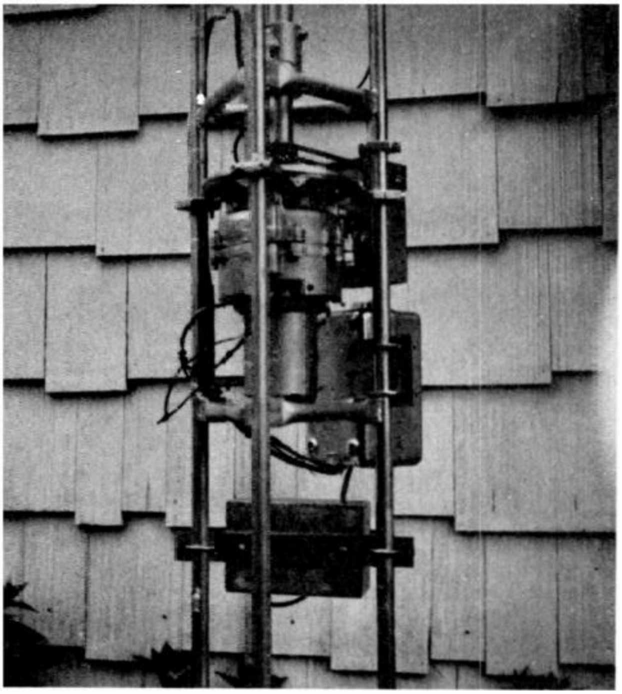


Fig. 6 – Here is the rotator installation at W8ZCQ.

drive shaft into the center bearings. This may be tricky, as the assembly must be kept intact. You may have to tap this drive shaft into place, then secure with the nut. Next, slip the large drive shaft over the smaller gears of the large planetary system. Now place the upper half of the housing over the assembly, then install the lower half of the housing over the smaller planetary unit. Orient the assembly so that your paint stripe lines up, and bolt the gear housing together.

One more point in the reassembly is to reverse the front-end bearing seal. This will place the lip of the seal toward the outside. Therefore, when the unit is mounted vertically water won't be drawn down into the housing. Also, don't use ordinary oil or grease for lubrication. The best oil to use is Mobil Avrex-903 aircraft oil or equal. This type will provide a free-turning operation in cold temperatures. Frankly, I prefer to leave the case dry and pack the bearings with Randall plastic-sleeve bearing lubricant. This is a silicone grease that will provide several years of trouble-free service.

The Brush Problem

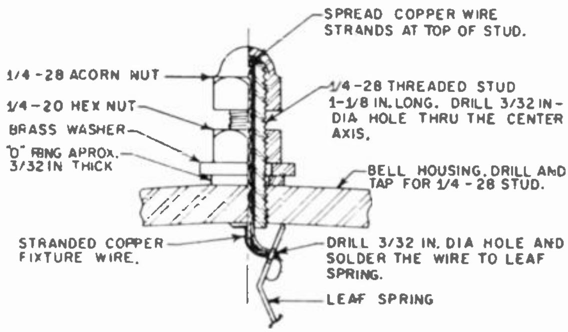
Most of the hams using prop-pitch motors operate them on ac and this creates a problem. The motors draw excessive current, which in turn causes burnt brushes and pitted motor commutators. If this has happened to your unit take the armature to a motor shop and have the commutator turned down and undercut. Exact replacement brushes are not obtainable. However, Dodge alternator brushes are similar and can be used. They must be modified slightly. The springs, caps, and flexible leads differ from those of the prop-pitch motor. Clip the alternator brush leads at the cap and do the same to the old motor leads at the brushes. Use the old motor caps and springs. Twist together the leads from the old motor brushes and solder them. Presto! Replacement brushes!

It is not a good idea to operate the motor on ac if dc is available. Four low-cost 25- to 50-A silicon diodes at 50- to 100-volt rating, used in a bridge circuit, will make the motor get up and go as it never went before. Current drain will be greatly decreased and life expectancy will be extended.

I have found that the rotator will operate much better if the power supply is mounted at the tower and remoted with relays from the shack. Fig. 5 shows the details of the power supply and switching system. The 117-volt ac was supplied to the tower through type "UF" direct-burial wire. If you want a really good rotator, resurrect that old prop pitch mechanism! – *Dan Umberger, W8ZCQ*

HAM-M ROTATOR MODIFICATION

Ham-M rotors sometimes develop an intermittent connection at the rotor which causes meter fluctuation at the control box. The arm of the potentiometer is driven by a leaf spring which presses against the bell housing. Eventually the teeth in the leaf spring cut a groove in the housing and two things can happen: The drive mechanism can slip, causing incorrect readings, and the ground contact can cause erratic meter indications.



Both problems can be cured by taking the following steps.

1) Remove the bell housing and mark a point about 3/16 inch away from the center point where the leaf spring has been bearing.

2) Drill and tap a hole at this point (No. 3 drill).

3) Cut a section of a machine screw about 1 1/8 inches long. This screw will be used as a threaded stud.

4) Drill a 3/32-inch diameter hole through the center of the stud (longitudinally).

5) Using an "O" ring washer or a grommet, a brass washer, and a hex nut, tighten the stud into the tapped hole as shown in the diagram.

6) Drill a 3/32-inch diameter hole through the center of the leaf spring. Then attach a flexible wire (lamp cord without insulation) to the spring and solder it in place.

7) Pass the flexible wire through the hole in the stud while lowering the bell housing back into place.

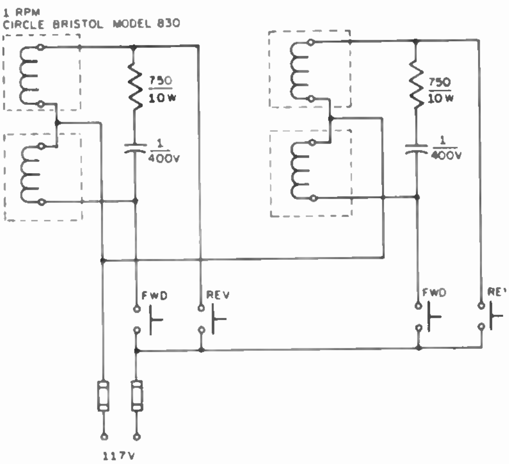
8) Cut off the flexible wire approximately 1/8 inch above the stud. Bend the wire over and spread it out on top of the stud.

9) Drop a small flat brass washer into an acorn nut, then tighten it on the stud over the copper strands.

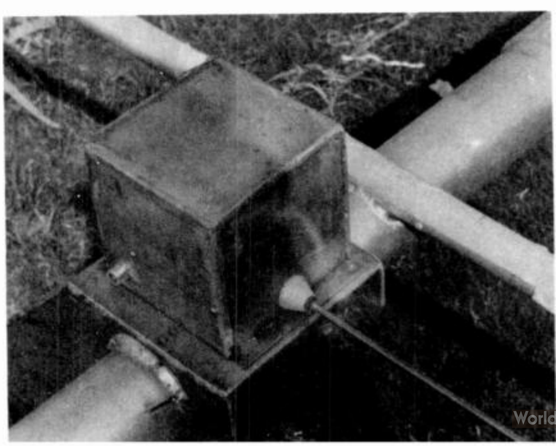
10) Paint the stud and nuts if they are not brass. If it is necessary to disassemble the rotator again, the flexible wire must be replaced. The screws and acorn nut were purchased at a local hardware store. Taps and drills of the proper size cost less than 50 cents each. – *George Spencer, VE2MS*

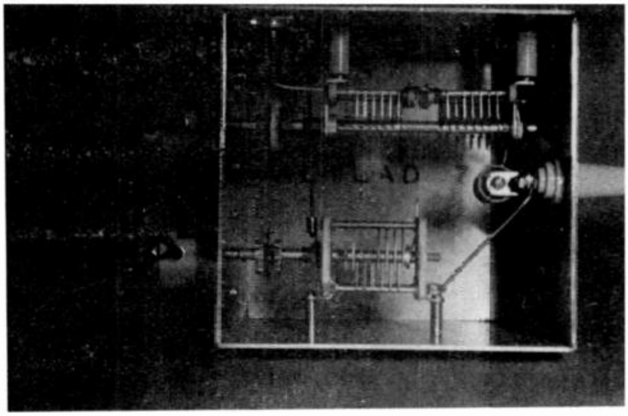
REMOTE TUNING THE OMEGA OR GAMMA MATCH

Here is a way to tune the Omega or Gamma match without leaving the operating chair. Each variable is driven from a small one-rpm high-torque reversible synchronous motor. These motors are made by Circle Bristol Co. and can be purchased from Minarik Electric Co. in Los Angeles, California. The motors are 2 inches in diameter and 2 inches long. They operate on 117 volts ac and have friction clutches that slip at approximately 20 inch-ounces.



Remote tuner.





Interior view of tuner.

For reversing, each motor requires a 750-ohm, 10-watt resistor and a 1-uF 400-volt capacitor. The two motors are mounted on the outside of the box as shown, with the shaft connected to the capacitor by means of a flexible coupling.

Five 16-gauge wires run from the motors to four push-button switches at the operating desk. The control leads at the antenna are run in a loop with the feed line to permit the beam to turn its full rotation.

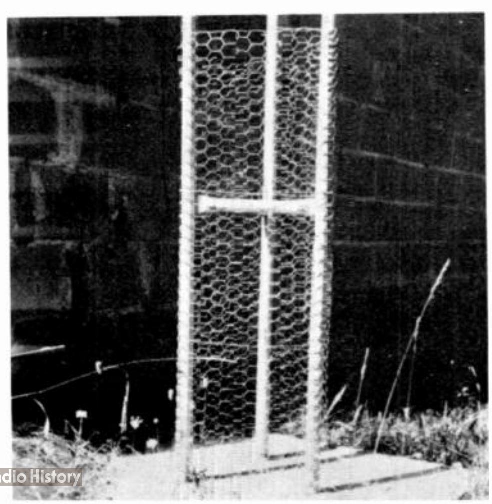
For weatherproofing, two pieces of auto radiator hose were slipped over the motor and cemented to the side of the box. Covers for the end of the hose were cut from gasket material and cemented on with epoxy. A 1/8-inch hole was drilled in the bottom of each cover to prevent water accumulation.

Selsyn motors have been used for tuning the capacitors, but they require motors at each end – one transmitter and one receiver. My method requires only switches at the operator end. *–Roy M. Landrum, W6IVT.*

TOWER SAFETY

To keep the kids from climbing the radio tower and getting hurt, enclose the lower portion of the structure with chicken wire as shown. – *Robert C. Mayne, WA8KRH*

Screening used to keep small children from climbing an antenna tower.

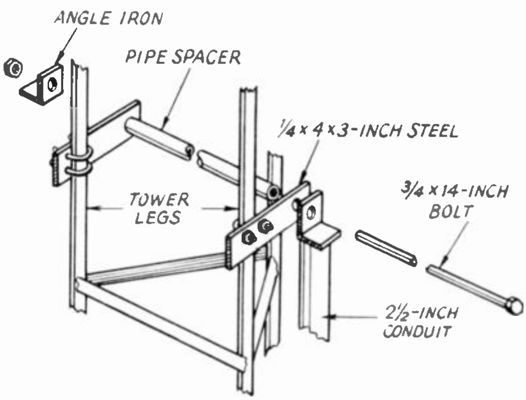


A TILT-OVER TOWER

Cut-and-try adjusting of elements is considered by most antenna enthusiasts to be the only way to get *maximum* performance from an array. In order for the amateur to adjust elements, he must invest in an expensive crank-up or tilt-over tower, or he must be willing to climb. Since none of these ideas seemed attractive, this author decided to design and build an inexpensive fold-over system which would permit easy access to the antenna.

What came off the drawing board was a design for a 30-foot tilt-over support with a mast extending five feet above its top. These modest dimensions were chosen because a large safety factor was desired without the use of guy wires. The tower hinges on a cradle 12 feet from the ground.

Fig. 1 — Hinge bearing detail.



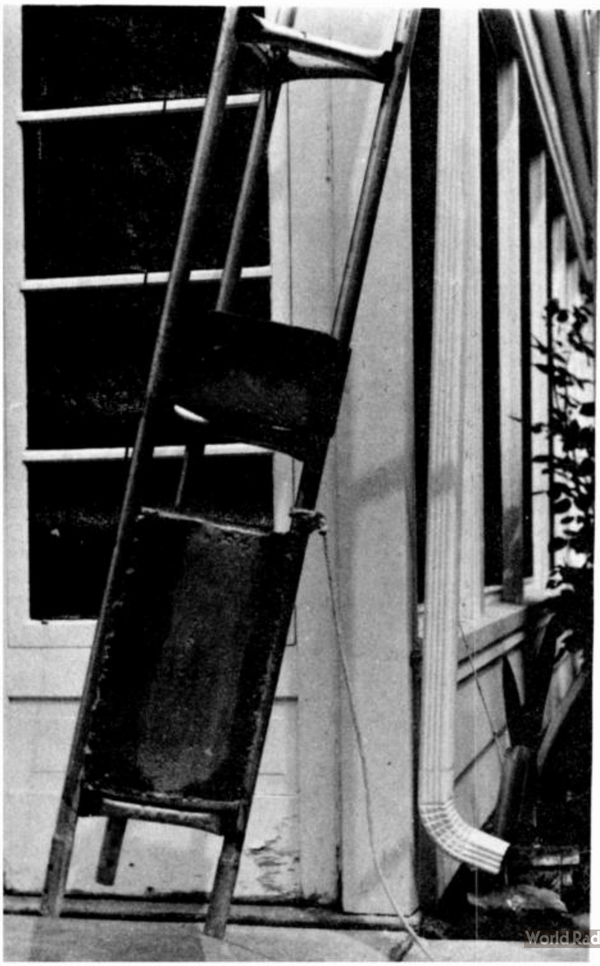
Assembly and Installation

It is assumed that the builder has a reasonable knowledge of how towers are installed. A free-standing 35-foot-high support for a triband quad requires about 1 1/3 cubic yards of concrete in the base. A hole of approximately 40 inches per side was used for this tower.

The cradle was made of three 10-foot lengths of 2 1/2-inch galvanized heavy-duty electrical conduit. (Don't use "thinwall" – there is a big difference.) The three legs, arranged in a triangle, are spaced slightly greater than those of the tower section. Permanent spacing of the bottom of the legs was accomplished with a 1/2-inch diameter threaded rod and nuts, and the top was held in place with a plywood template. The bottom of the cradle was placed on a layer of crushed stone, 2 inches deep. Temporary guy ropes were used to hold the cradle upright. Then, a layer of sand one inch thick was poured around the bottom of the three conduit legs and over the crushed stone. The purpose of the sand and stone was to prevent water accumulation. After these steps were taken, concrete was poured into the hole and smoothed on top. The concrete base was allowed to set (72 hours), at which time the guy ropes and the plywood template were removed.

To extend the cradle to sufficient height, another 10-foot piece of 2 1/2-inch diameter galvanized conduit was cut in half and attached to two of the lower legs, using the couplings supplied. The final arrangement is shown in the photograph. Before these two 5-foot pieces are installed, angle brackets with a clearance hole drilled through one face (for a 3/4-inch bolt) should be welded to the unthreaded ends. The couplings were used to align the holes and were then welded in place.

The two lower tower sections were assembled on the ground. The bearing hardware was located 11 feet, 8 inches from the bottom. To aid the folding process, two 15-foot ropes were used, one attached to each end of the assembly. Strong ropes are recommended. This 20-foot section was then set vertical against the cradle and "walked" up about 3 inches. It was secured in place using a 3/4-inch bolt through the bearing plates.



Both counterweights are shown here. The upper weight is easily changed if the amateur decides to use a lighter (or heavier!) antenna. The bottom weight must be formed to insure that it cannot slip out when the tower is in the folded position.

for the Antenna System

The top section was prepared on the ground by first installing the rotor and mast. Then, the hinge section was folded over and the top piece bolted in place. When tilted to the upright position, without the antenna, the tower was ready for permanent counterbalancing. A triangular piece of plywood was fitted into the bottom of the lowest section to serve as a base for the concrete. Wooden forms were attached to the sides of the tower for a distance of about 2 feet from the bottom. I used wire to hold them in place. Then the concrete was poured into the form until the tower balanced, with an inch or so more added to allow for the loss of weight as the concrete cured.

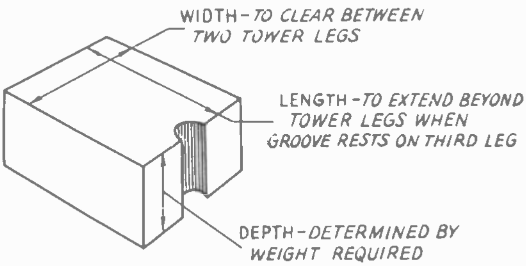


Fig. 2 — Second counterbalance with groove to allow placement in the triangular tower. The weight can be determined experimentally as described in the text.

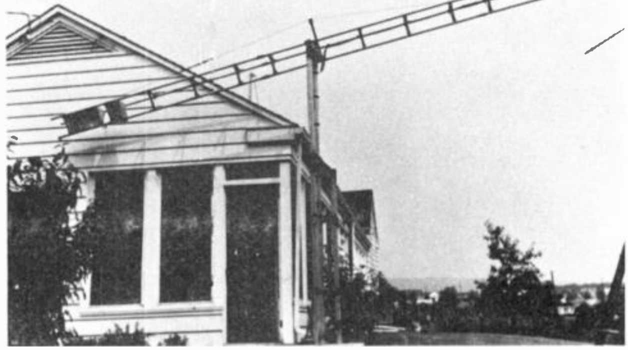
After the large counterweight had set, the side boards were removed and the tower folded over. At that point the quad was attached to the mast. The entire assembly then became top-heavy and another counterbalance was needed to bring everything back to equilibrium. The approximate weight was determined by standing on a bathroom scale and pulling down on the tower legs at the second counterbalance point. When the system balanced horizontally, the scale reading was subtracted from the builder's own weight. The proper amount of concrete was then mixed and poured to form a shape similar to the one shown in Fig. 2. After setting, the block was placed in the tower section.

The bearing bolt was adjusted to a point where no binding occurred. Strap iron, welded across the two sides of the cradle assembly, provided permanent spacing. This part of the job was left until last because the adjustment of the bolt determined the distance between the cradle arms.

The stress cable was a precaution against tower collapse. It is probably unnecessary, but the writer likes it. Belt and suspenders all the way! Stainless-steel hose clamps were used for holding the bottom of the tower in place.

Results and Operation

The tower can be raised or lowered in 8 seconds. While the cost of new parts was about $125, this figure could have been reduced

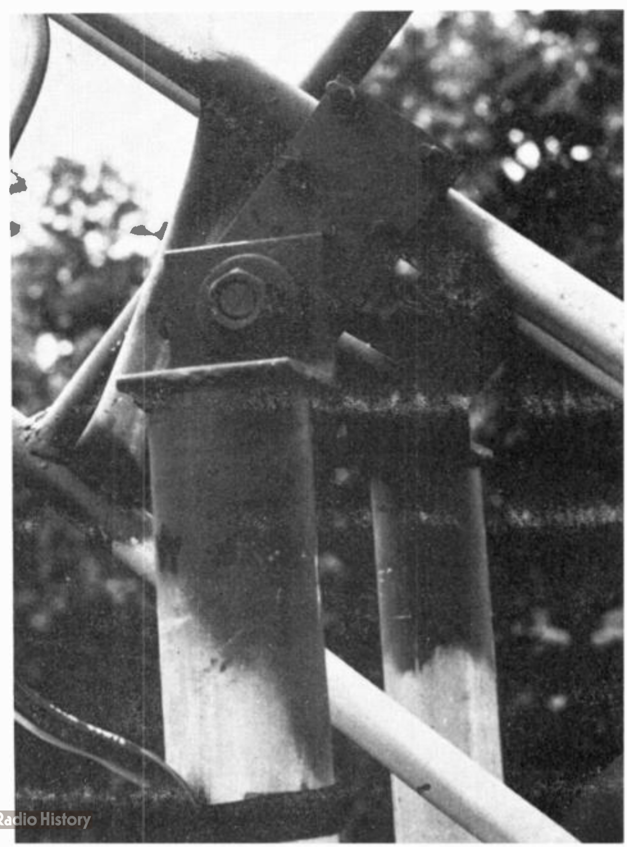


considerably if the parts were purchased from a scrap dealer. The concrete was delivered at a cost of $26. The energetic builder can mix his own for much less.

Of course this system can be enlarged by adding tower sections. But then guying would be required and the convenience of quick fold over would be lost.

A note of thanks goes to W3GTL, W3OQV, and ex-W3YXC for their help with the construction, to the author's secretary for typing the original manuscript, and to the XYL for donating part of her rose garden. They were all in favor of keeping the OM's feet on the ground! – *Tom Freedom, W3HVE*

[EDITOR'S NOTE: Think safety! As with any tower, especially tilt-over and crank-up types, care must be exercised at *all* times. No one should be standing under either end during the folding process. Any modifications to the system should be clearly thought out before starting the job. Removing the antenna (or rotor) without anchoring the top of the mast to the ground could cause an unexpected raising of one end of the structure and an equally fast lowering of the other end! Establishing speed records for tower tilting or antenna tuning are just not worth the risks.]



The entire hinge assembly can be coated with rust-proof paint. A loop is needed in the coax at this point to allow the tower to fold without stretching the feed line.

The Ham-M rotator contro .

DELAYED – ACTION BRAKING FOR ANTENNA ROTORS

Do you cringe when you let go of the TURN switch on your rotator control box? Or, have you watched that large array or felt the tower while someone turned the antenna? If so, you're all too aware of the torque stress that the rotator gear box is subjected to as the antenna comes to rest at the heading you've chosen. That vision of stripped or broken gears need no longer gnaw at you if you're willing to make a few changes to the rotation system. For those of you who own Ham-M rotators we offer this work-and grief-saving information.

How the Damage Can Occur

The Ham-M control box has one switch that handles all of the switching functions, S1 of Fig. 1. Contacts 4, 7, and 8 apply voltage to transformer T1, which supplies voltage to the indicator meter.[1] Contacts 6 and 7 of the same switch are used to energize T2. This function immediately activates the brake-release mechanism. At the same time, a third set of switch contacts (1, 2, and 3) determines the direction of rotation. When the antenna reaches a certain heading the operator returns the switch to center position. It is at this point when the solenoid releases the brake wedge so that it can drop back into place on the ring gear, abruptly halting the movement of the antenna and mast. The larger and heavier the antenna, the more it will tend to continue its travel, in which case the mast may absorb the torsion, the tower may twist, or the brake will shear the ring gear!

The possibility of rotator damage can be greatly lessened by installation of the simple gadget described in this article. It will hold the brake open while the antenna coasts to a stop.

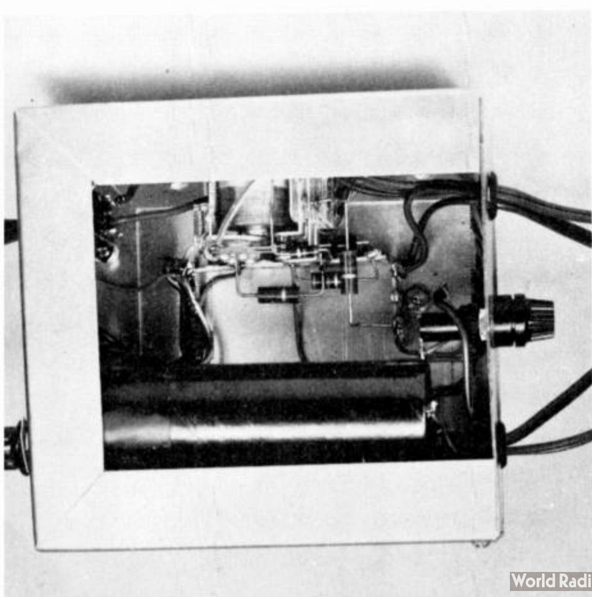
The Circuit

The shaded lines in Fig. 1 show part of the original Ham-M circuit. The dark lines represent the additional connections needed to perform the brake-delay functions. When S1 is activated K1A immediately closes, allowing C1 to charge through R2. K1C is used to apply voltage to T2 which, in turn, opens the brake. Depending on which way the lever is pushed, the antenna turns either left or right. When S1 is released, voltage to the rotator is interrupted by S1C, but K1 remains energized, keeping the brake open until C1 discharges through R2, R3, and R1. The time required for the voltage from C1 to drop to a point where K1 deenergizes is determined by the setting of R1. The range is from 2 to 8 seconds. Two neon lamps, DS1 and DS2, are used to provide visual indication of the brake position.

Construction

No special wiring precautions are necessary. The control circuitry added to the rotator is completely contained in the lower unit. Four short pieces of line cord interconnect the two boxes.

[1]A modification listed in the Ham-M instruction book mentions how to change the switching arrangement to allow continuous monitoring of the antenna heading. S2 in Fig. 1 is incorporated in the circuit for turning off the control box.



The top view of the homemade chassis shows the location of the components. A bottom plate is permanently attached to this unit using 6-32 screws which also hold the rubber feet in place. The four short interconnecting leads run through rubber grommets on the rear of the chassis. An eagle-eyed reader will note that these wires *should* have been secured inside the cabinet to prevent them from being pulled loose. The large electrolytic capacitor is mounted to the bottom plate using two small terminal strips.

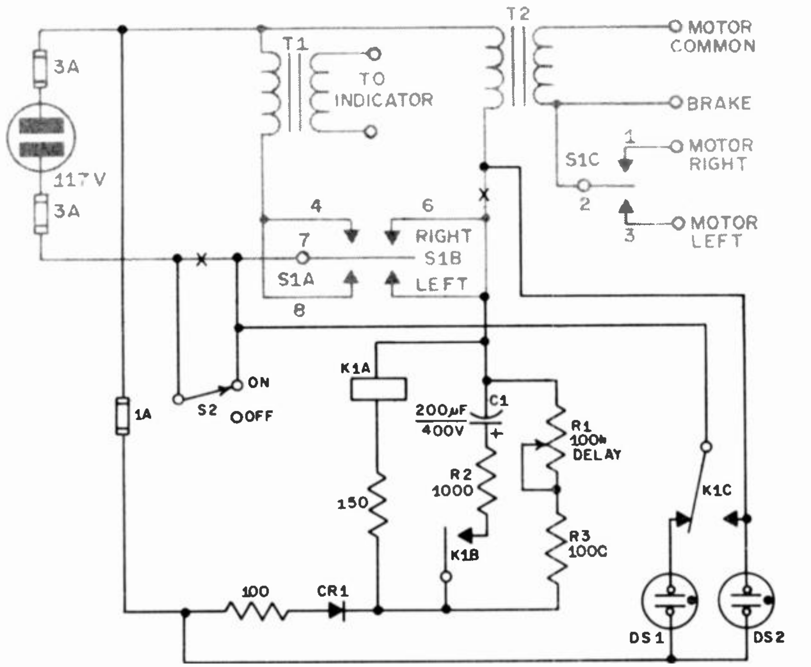


Fig. 1 – Diagram of the modified Ham-M rotor-control box. Fixed-value resistors are 1-watt composition. Connections must be broken at the two places marked "X." The shaded lines indicate original wiring and the heavy lines are additions to the original circuit. Parts designations not listed below are for text reference.
C1 – 200-µF, 450-volt electrolytic.
CR1 – 1000-volt PRV, 750-mA silicon rectifier.
DS1, DS2 – Neon panel lamp, 117 V ac.
K1 – Dpdt, 3-A contacts, 5000-ohm coil (Potter & Brumfield, GPD coil and GP11 contact set).
R1 – 100,000-ohm linear taper composition.

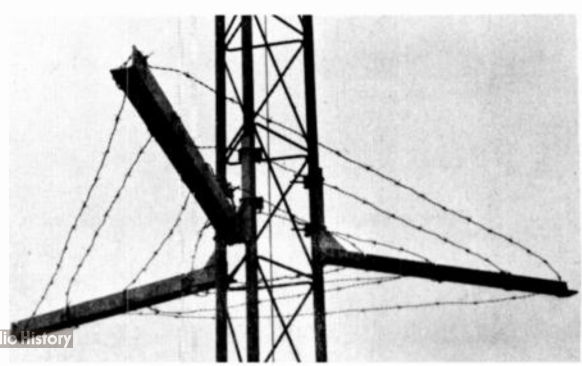
The homemade chassis shown in the photograph is 6 x 6 x 2 inches. It was designed to allow the Ham-M control box to sit on top of it. A Bud AC-1413 aluminum chassis could be used if the builder doesn't want to construct his own. A bottom cover should be used on the chassis to prevent the operator from accidentally contacting ac voltage.

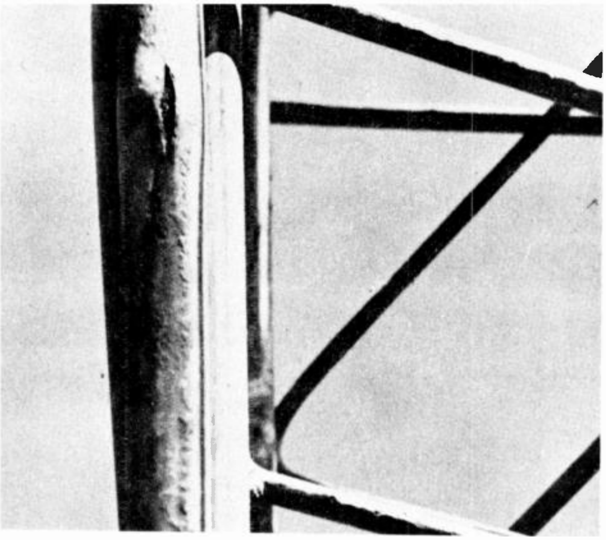
Operation

Front-panel control of the delay is desirable. Different time periods are required depending on prevailing winds and the size of the antenna. The operator soon gets a feel for when to let go of the switch to have the antenna stop at the right place. On extremely windy days the delay time should be short to keep the array from windmilling. But on reasonably calm days, the antenna will come to a full stop in less than 5 seconds; therefore the delay time should be set to near maximum. The antenna usually drifts less than 10 degrees. – *W1FBY*

PROTECTION AGAINST UNWANTED TOWER CLIMBERS

My 70-foot tower is located 250 feet away from the house, and in the summer is hidden completely by several trees and bushes. This is great for the aesthetic beauty of the property but caused great concern when I discovered that small children were climbing up and down the entire structure as a dare – hanging a red handkerchief at the uppermost point as proof! Chastising did no good at all as there were always new children arriving at the climbing age! The device shown has worked quite well for several years. Basically it consists of two pieces of angle stock approximately 3 feet in length – with a triangular reinforcing piece welded at the joint. Four angle cuts are made as notches in the upper part of the long pieces to anchor barbed wire which is strung around the arms. The whole affair is above reach to prevent anyone from unwinding the wire. The only disadvantage is the nuisance of having to take a small ladder to the tower when I want to climb it myself. Peace of mind, however, is excellent, knowing that no one will be killed by falling from my tower while playing "dare," or any other game! Entire cost was about $15. – *Gene Hastings, W1VRK.*





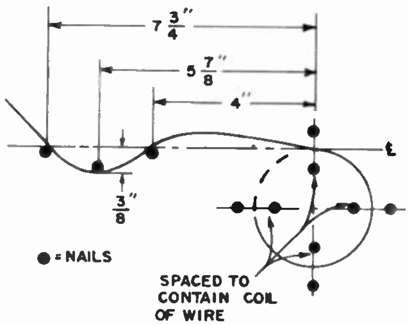
SEALING TOWER LEGS

Fold-over towers that have steel tubing for legs can be damaged by water accumulation. When my tower folds over, the open ends of the legs are exposed and rainwater can collect therein. In winter, the water could freeze and split the tower legs.

Certain precautions should be taken when the tower is installed. First, the tower sections should be checked to insure that there are no obstructions which might block any water or condensation. Then, the exposed ends of the legs at the hinge section should be sealed. I used corks which were first soaked in spar varnish. – *Dr. Ben Sloan, WA5WOT.*

GETTING THE CURL OUT OF STEEL-CORE ANTENNA WIRE

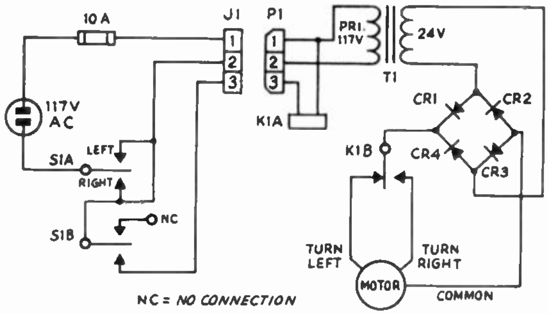
Alumoweld or Copperweld wire is great for antennas, if only it didn't curl so! The straightening die shown worked well with No. 12 wire. Good-sized nails (4-inches long or so) are driven into a 2 × 6-inch plank in the pattern shown in the diagram. Hold one end of the wire *firmly* and steadily pull the wire from the coil through the nail pattern as shown by the solid line. The resulting straight wire is a pleasure to work with. – *Charles H. Gould, W4LZO*



Getting the curl out of steel-core antenna wire.

PROP-PITCH ROTOR CONTROL CIRCUIT

I use a simple control system for my prop-pitch motor assembly which requires only one relay, one transformer, and three wires. The diagram shows my hookup. – *Bob De Bragga, W1YNP*



Circuit diagram of the prop-pitch rotor control.
CR1-CR4, incl. – 50-V, 25-A silicon rectifier.
J1 – Three-connection jack (Cinch Jones S-303-CCT).
K1 – Spdt power relay (Potter and Brumfield PR6AY).
P1 – Three-connection plug (Cinch Jones P-303-CCT).
T1 – 24-V, 10-A.

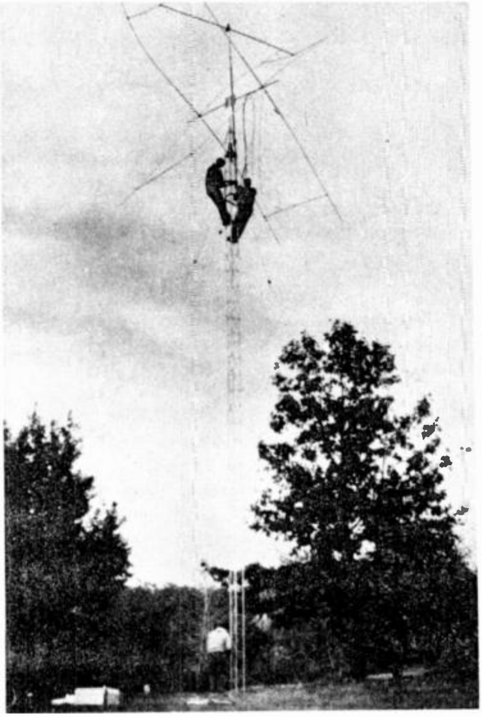
DUAL-FUNCTION COAX

To permit use of my mobile antenna when running the mobile rig on the workbench, I installed a length of RG-8/U from the cellar to the garage with a wall-mounted SO-239 on each end. Also, I use a short RG-8/U patch cable from the car antenna to the SO-239 fitting in the garage. As an extra benefit, I find this coax handy for piping 12 volts dc from the bench power supply to the car battery for an occasional overnight charge. – *Raymond DeMers, W2KVP.*

PLASTIC TUBING FOR QUAD ARMS

Shown in the photograph is a two-element three-band quad built with inexpensive materials. The tubing used in this model is 3/4-inch PVC plastic purchased from Sears and Roebuck. The cost is less than one dollar per ten-foot length. On each spreader arm, ten feet from the boom (one full length of tubing), a plastic tee connector is attached for the purpose of holding a crosspiece. Then an additional section of pipe is added to the spreader arm to make up the required length for 20 meters. The two top 7 1/2-foot cross sections are split at the center and are connected with a 14 1/2-foot-long pipe. At the center of this piece is a tee connector which fits the extended mast. The additional support from the mast eliminates spreader-arm twisting.

A spacing between elements of 0.12 wavelength is used to keep the input impedance of the driven



The entire mechanical arrangement can be seen here. Plastic cross-bracing is used to help support the spreaders. W1FLM is handling the ropes at the base of the tower while K1DPB (right) and W1FBY start tightening the hardware topside.

element in the area of 50 ohms. The ends of the spreaders support the 20-meter elements while the 10- and 15-meter elements are strung on the cross-support members.

Mechanically, the entire quad is very flexible. The arms tend to bow but this doesn't seem to create any problems. One of the interesting features of PVC tubing is that water will not adhere to its surface. Low temperatures have no noticeable effect on the tubing either. – *Roger Kaul, W1FLM*

PREVENTING WIND–WHISTLE IN HY–GAIN TRAPS

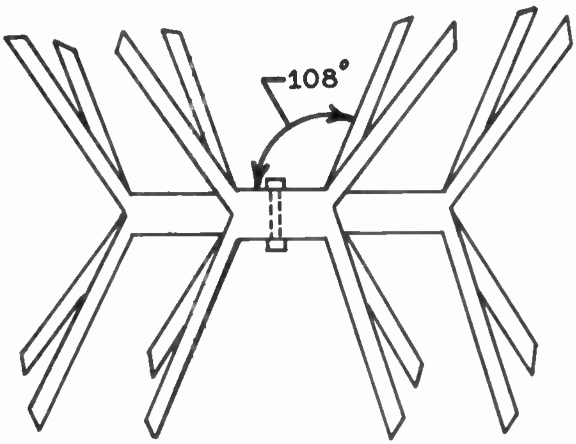
Some owners of Hy-Gain trap vertical and trap triband antennas experience annoying whistling from the traps, even in a gentle breeze. This can be cured by applying masking tape over the drain holes and then, with a pencil, puncturing holes in the tape where it covers the original holes. The irregular edge of each hole will stop the "piccolo" action.–*Katashi Nose, KH6IJ*

GROUND ROD REMOVAL

I have had good luck in removing ground rods by taking an 18- or 24-inch pipe wrench and rotating the rod several times before starting the pulling process. This seems to effectively break the adhesion between soil and rod and polishes the rod somewhat, with the result that the pulling process is made less difficult. – *N.E. Loofboro, W9IQB*

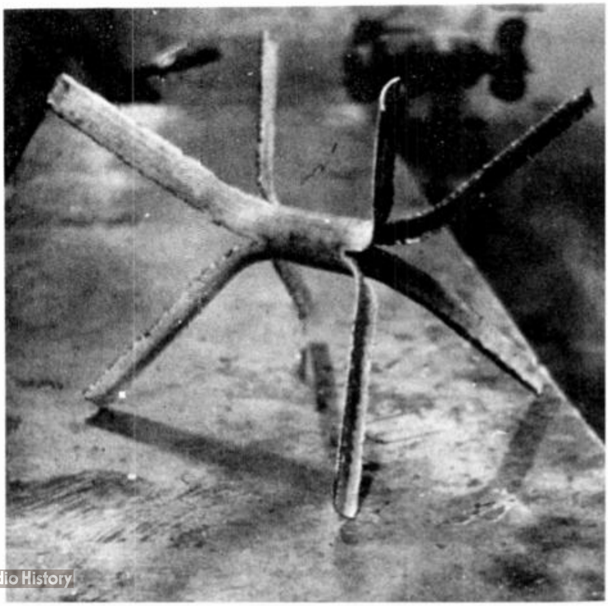
SPIDER QUAD MOUNT: SIMPLIFIED

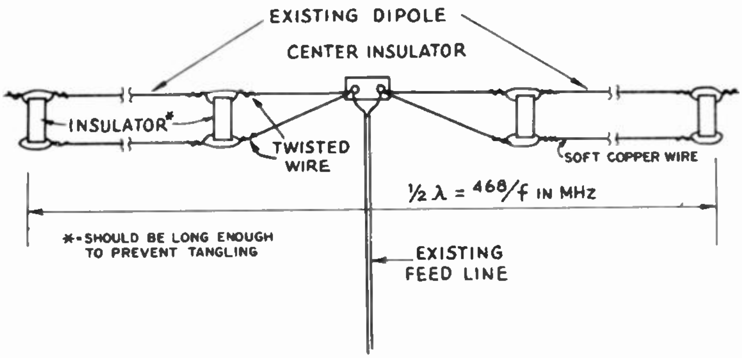
There seems to be a growing interest in the spider quad. The photograph shows my version of a hub or "spider" mount. Using a 2-foot length of 2-inch diameter steel pipe, a mount can be constructed easily. Two cuts, 10 inches long, are made through the diameter at each end of the pipe. This leaves 4 inches in the middle for the boom. The cut ends are then bent to an angle to suit the desired spacing. The unit shown in the photograph is bent to 108 degrees. The spreaders may be attached to the boom mount with hose clamps, bolts, or wire.



The beauty of this design is that it can be made to any size desired. Also, it can be enlarged to a four-element version as shown in the sketch.

One of these spider mounts is in use at KP4DJI (constructed by KP4DIO and KP4DJI) using bamboo spreaders. The results have been excellent. – *Lynda B. Crowley, KP4DIP*





PIGGYBACK ANTENNA FOR THE TEN-METER BAND

Most amateurs from Novices on up use dipole antennas for the eighty- and forty-meter bands. In many cases, these two antennas were all the Novice needed since the fifteen-meter band could also be covered with the forty-meter dipole.

However, with the advent of the new ten-meter subband for Novices, a simple and inexpensive method of getting the needed coverage is to use a "piggyback" antenna. It can be easily added to an existing dipole, eliminating the need for additional supports or feed lines. Also, it will have no effect on either an eighty- or forty-meter dipole.

Of course, performance will not be as good as that obtained with a beam, but it should not be sold short either. A KH6 was worked during a recent contest with a power output of 1.8 watts. – *Robert M. May, II, WA4DEG.*

LOW-COST WIRE FOR ANTENNAS AND GROUND RADIALS

Recently, while scanning the pages of a non-radio "wish book," the *Sears* catalog, the writer spotted what seemed to be a 1st-class bargain in antenna wire – neoprene-jacketed No. 10 solid aluminum wire at 2 cents a foot! Not bad, eh? And this style of conductor is also available in sizes 8, 6, and 4. The prices, respectively, for the latter are 3 3/4 cents, 4 1/2 cents, and 5 3/4 cents per foot.

Since neoprene is resistant to acid, oil, and abrasion, it makes an ideal insulating and protective agent for buried radials in amateur antenna systems. Similarly, the neoprene protects the wire from corrosion and weathering when the conductor is used for the radiating portion of an antenna. The insulating jacket tightly encircles the aluminum wire. It is unlikely that moisture could seep in between the sheath and the wire to cause deterioration of the aluminum.

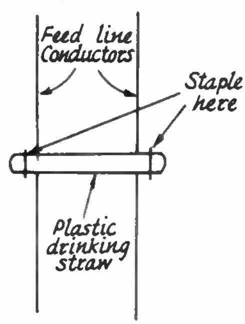
A 150-foot length of the No. 10 wire was tried as an end-fed random-length antenna. The job of erection was much simpler than if copper wire of comparable gauge had been used. The lighter aluminum was easy to draw taut, single-handed. No doubt this material would be suitable for use in any wire-type antenna system where minimum cost, lightness of weight, and long life are requisites. The neoprene jacket contributes to the strength of the antenna too.

Sears lists this wire in its catalog section on electrical supplies. The conductor is specified primarily as "weatherproof outdoor cable" suitable for overhead wiring on farms. – *WICER.*

REPAIRING 450-OHM OPEN-WIRE LINE

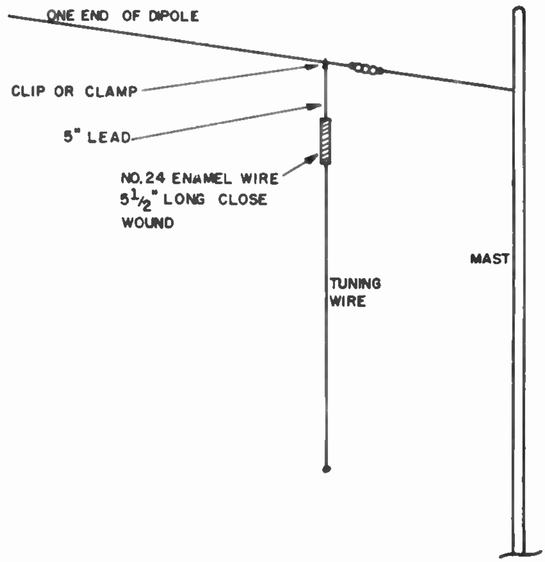
I have long runs (300 feet or so) of 450-ohm open-wire line running to various antennas. The spacers sometimes let go, and here's a quick, simple way to make on-the-spot repairs.

Cut some plastic drinking straws into pieces approximately 1-1/2 inches long. (Standard plastic spacers are about one inch long.) Take these and a set of cutters and a small stapler with you when you inspect the feed line. If any spacers are missing or broken, cut a 1/4- to 1/2-inch slot in each end



of one of the drinking straw pieces. Place the straw piece between the two conductors and position one conductor in the slot at each end. Use the little stapler to staple the excess straw snugly at each end around the conductor.

These straws, in lengths of 2 inches or less, are strong, and very easy to use. If stapled snugly, they will be almost weatherproof, but if such weatherproofing is necessary for long-term use, it is suggested that some form of liquid sealer be dabbed around the ends of the straws. – *Gary L. Foskett, W1ECH*



A 160-METER SHORT DIPOLE

While searching through the *Hints and Kinks* publication I saw an idea by K7CRO using loading coils at the ends of a 40-meter dipole so it could also be used on 80 meters. Since I live on a city lot just long enough for my 80-meter dipole, I thought this idea might be used with an 80-meter dipole to get a 160-meter antenna. After several hours of trial and error I finally found the right combination of coil and tuning wire that would work on 160.

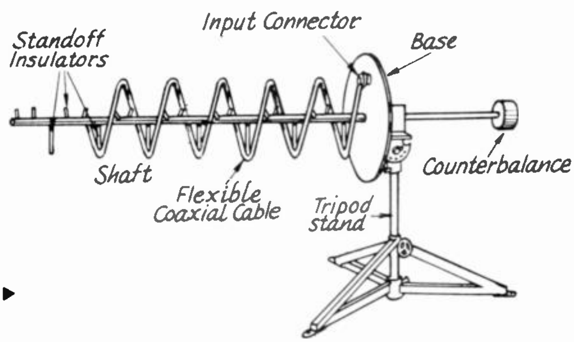
The coils are close-wound on an 8-inch piece of golf-club-protection tube (which has an OD of 1 1/4 inches) using No. 24 enameled wire for a length of 5 1/2 inches. To one end of the coil I attached a 5-inch clip lead, and to the other end an 8-foot length of "tuning wire" using No. 26 wire. The coils and their tuning wires are clipped to each end of the 80-meter dipole and are allowed to hang straight down. After tuning up on 1810 kHz I cut 2 to 3 inches at a time off each tuning wire until the SWR dropped to 1 to 1. The final length of each tuning wire was 6 feet 6 inches.

The addition of these loading coils raised the 80-meter resonance point about 100 kHz but it could be lowered again by increasing the length of wire clipped between the antenna and the coil. The coils permit the dipole to be used on both bands. – *Neil Klagge, WØYSE*

ECONOMICAL WEATHERPROOF HELICAL ANTENNA

Previously, helical antenna elements have been formed from soft copper or aluminum tubing, shaped with a custom-machined mandrel. Antennas made by this technique (and of this material) are expensive, and are susceptible to corrosion. Both of these problems have been solved by using a semi-rigid coaxial cable to form the helical element.

The helix of the weatherproof antenna illustrated here is made of a foam-dielectric Heliax transmission line that has been shorted at each end. The helix is formed by mounting the transmission line on standoff insulators which are attached to the antenna shaft. By using this technique the helix can be formed with any diameter, pitch, or taper without requiring expensive tools or techniques. Because the conductor is sealed in the outer plastic jacket, the resulting antenna element is highly corrosion resistant, and may be used at seacoast installations with minimum maintenance. – *NASA Tech Brief 70-10016.*

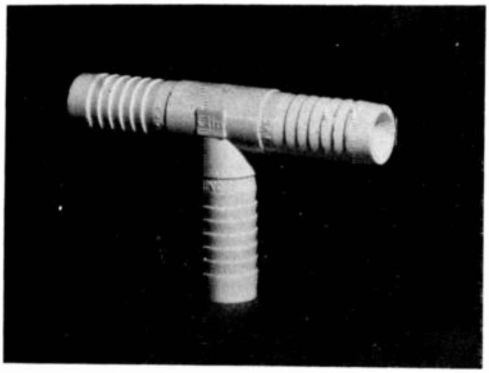


The inexpensive helical antenna has been made of flexible coaxial cable which has its plastic jacket retained. The method offers a high degree of protection against the corrosive elements at a seacoast location.

A CHEAP BOOM-TO-MAST FITTING

I have found a very strong boom-to-mast fitting at the local hardware store which cost me only 29 cents. The manufacturer, U.S. Pipe, sells it as a plastic plumbing "T," but as any amateur can readily see, it will work very well as a center insulator for small antennas.

The unit pictured here has an outside diameter of 3/4 inch and an inside diameter of 9/16 inch, making it acceptable for use with different sizes of

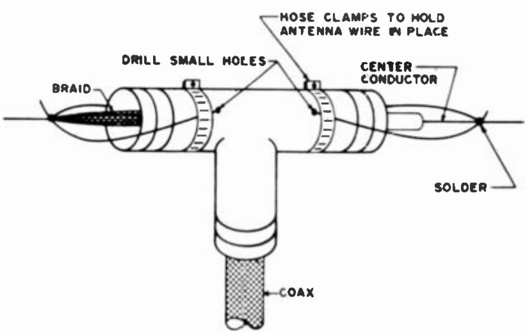


antenna material if shim stock of some kind is used. The T has a wall thickness of about 1/8 inch and is very strong. Each of the three ends will extend for 2 inches into the boom or mast element.

My use of the T has been with the Two Toter (*QST*, July 1971), which now breaks in half rather than into thirds as suggested by Campbell (after all it's for *two* meters). Don't overlook the new plastic plumbing PVC material in your hardware stores when building new antennas. – *Bill Creany, W6OUN*

CENTER INSULATORS FROM PLASTIC PLUMBING TEES

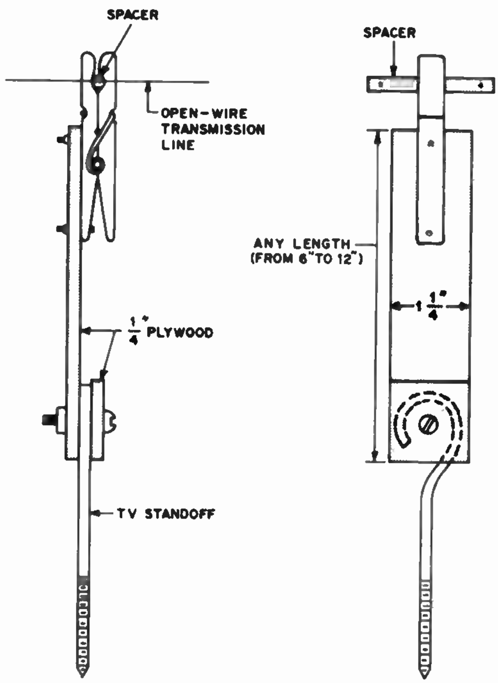
Another of the many ways that a plastic plumbing T might be used in the construction of antennas is as the center insulator for a wire dipole. I use one of 1/2-inch diameter size so that the coax can be passed through the vertical portion and the braid and center conductor extend outward through each of the two ports where connection is made to each half of the dipole.



As shown in the drawing, I have drilled a pair of holes for the dipole halves to pass through to make a loop and then is soldered to the coax center conductor and braid that is passed through the center of the T. Some may want to add a hose clamps as I have done, which helps to hold the antenna wire in place, though the material seems strong enough to do the job without help. A further refinement might be to seal the ends of the T with a bathtube sealing compound to make the installation more watertight. – *J. Ingram, Jr., WB4BKX*

SUPPORTING OPEN-WIRE TRANSMISSION LINE

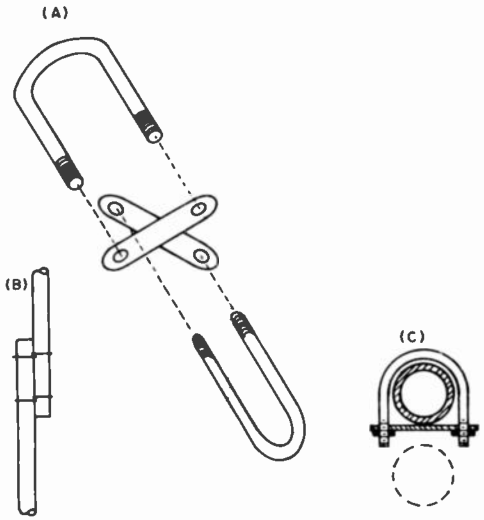
Here is a simple yet effective insulator for supporting open-wire transmission line. It is made from 1/4-inch plywood, a clothespin, and a TV-standoff insulator. The circular plastic insulator is removed from the standoff and the parts assembled as shown in the drawing.. Plastic clothespins are best since they are weatherproof. Mounting the clothespin is accomplished by separating the two halves, fastening one section to the plywood with small machine screws, then replacing the remaining part. It is wise to bend the spring to increase its tension before reassembling the clothespin. The completed insulator should be protected with



several coats of paint. After the insulators are installed in place, the open wire is supported by inserting the spacers into the jaws of the clothespin. – *Bruce W. Campell, WA8OJR*

A QUICK SPLICE FOR MASTS

Pictured here is a quick and easy means of splicing masting or thin-wall tubing, such as electrical conduit or TV masting, which otherwise would not mate because of the difference in sizes. Each splice requires four U-bolts and associated parts which may be available in most hardware stores. I use the ones with a bright finish, which don't seem to rust too fast.



The idea is to interlock the clamps as shown in the drawing at A. With two pairs interlocked like this you can now pass the ends of the pipes through them as shown at B. Prior to tightening of the nuts, this arrangement will be very unstable but will become very rigid when the slack is taken out of the U-bolts.

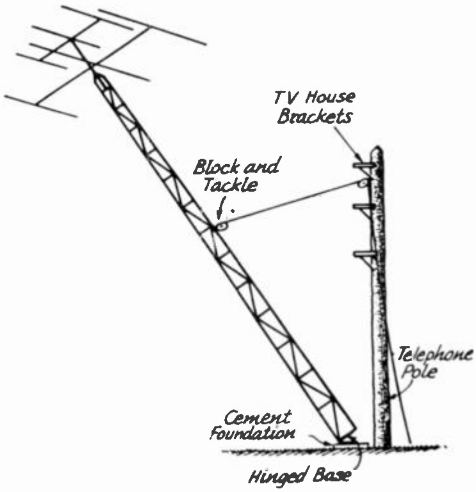
With some sizes of pipe and U-bolts you may find that the threads do not extend down the shank far enough to effect a tight fit. An over-sized nut, as shown at C, may then be used as a spacer, which will provide extra threads and allow a good grip on the pipes.

This arrangement is used to support small antennas at a height of about 20 feet. Proper guying is important for a mast of this type. – *William L. Smith, K4RJ*

TOWER SAFETY

Recently I had occasion to make some minor repairs on my quad, which necessitated climbing the tower and drilling new holes in the face plate. Since the plate is heavy guage steel, an electric drill was needed to complete the job. The decision confronting me was whether to take a chance on drilling only two holes, which would not take over five minutes, or to postpone the job until a safe extension cord could be purchased. The only extension cord I had of suffcient length was a heavy-duty two-wire cord with no ground wire.

Like most hams, I only have time to make antenna repairs on weekends, so I decided against postponing the work. My thoughts were on how to use the available equipment with no risk. Taking a four-foot length of heavy gauge aluminum guy wire, I strapped one end securely to the metal handle of the electric drill with a U bolt. After mounting the tower, I secured the other end of the wire in the same fashion to the tower itself. This wire served two purposes: first, to hold the drill in the event that I dropped it, and second, to act as a good, safe ground connection. Confidently I drilled the two holes, knowing that now, if any defect did manifest itself, the tower and not I would take the brunt of any short. –*Peter Donchik, WB2VFR*



Details of the easy tilt-over tower.

EASY TILT-OVER TOWER

A tilt-over tower costs a bag full of money if you want a structure that does not require any guys and is large enough to hold a big beam. My approach uses a surplus telephone pole obtained from the power company. The local branch moves a lot of their lines around and doesn't reinstall older poles. A request to their office produced a 30-foot pole within two weeks. Then, a used TV-type 40-foot tower was purchased for $25.

Getting the pole set in the ground was a problem until I found a power-company crew who put up clothes poles in their free time. A cement foundation for the hinged base of the tower was poured next to the pole, and eight-inch TV house brackets were used to secure the tower to the pole. The easiest way of getting the tower up straight was to first put the brackets on the pole, next mount the first three tower sections in the brackets, and then align the tower with a level. Once the tower was correctly positioned, the cement was poured around the hinged base. A block and tackle from the local "rent-all" is used to raise and lower the tower.

The wisdom of the tilt-over approach was proved a week after the beams were up. My 13-year old rotator burned out. Back came the block and tackle; the array was lowered, rotators exchanged, and the antenna raised again. The structure is quite strong – it hardly moved in several winter storms that damaged a number of other antenna installations in the area – and the total cost was only $60. – *W1KLK.*

A RECEIVING LOOP FOR 160 METERS

Small shielded loop antennas can be used to improve reception under certain conditions, especially at mf and in the lower portion of the hf band. The foregoing is particularly true when high levels of man-made noise are prevalent, when the second-harmonic energy from a nearby bc station falls into the 160-meter band, or when QRM exists from some other amateur station in the immediate area. A properly constructed and tuned small loop will exhibit approximately 30 dB of front-to-side response, the maximum response being at right angles to the plane of the loop. Therefore, noise and QRM can be reduced significantly or completely nulled out, by rotating the loop so that it is sideways to the interference-causing source. Generally speaking, small shielded loops are far less responsive to man-made noise than are the larger antennas used for transmitting and receiving. But, a trade-off in performance must be accepted when using the loop, for the strength of received signals will be considerably less than when using a full-size resonant antenna. This condition is not a handicap on 160 or 80 meters, provided the station receiver has normal sensitivity and overall gain. A comparison between the loop illustrated here and a 180-foot end-fed inverted-L antenna (resonated and matched in impedance to the receiver) indicated a signal difference of approximately 15 dB, the loop being the less effective antenna. Measurements were made on local and sky-wave signals while using a calibrated step attenuator in the antenna line to the receiver. A front-to-side ratio of 30 dB was observed while using the same test setup. Thus, a shielded loop can be used as the expurgator of a variety of receiving problems if made rotatable.

In order to assure the sharp directivity (bidirectional) of a small loop, the overall length of the conductor must not exceed .08 wavelength. The loop discussed here has a conductor length of 20 feet (6 m). At 1.810 MHz, 20 feet is .037 wavelength. With this style of loop .037 wavelength is the maximum practical dimension if one is to tune the element to resonance. This limitation results from the distributed capacitance between the shield and inner conductor of the loop. RG-59/U was used for the loop element in this example. The capacitance per foot for this cable is 21 pF, resulting in a total distributed capacitance of 420 pF. An additional 100 pF was needed to resonate the loop at 1.810 MHz. Therefore, the approximate inductance of the loop is 15 μH. The effect of the distributed capacitance becomes less pronounced at the higher end of the hf spectrum, provided the same percentage of a wavelength is used in computing the conductor length. The ratio between the distributed capacitance and the lumped capacitance used at the feed point becomes greater at resonance. These facts should be contemplated when scaling the loop to those bands above 160 meters.

The radiation resistance of small loops is extremely low, thereby rendering them quite inefficient for transmitting applications. However, they can be used for that purpose if one is willing to accept a sacrifice in signal level, and if the impedance of the system is matched satisfactorily. A discussion of this subject appeared in *QST* for March, 1968 (McCoy, "The Army Loop in Ham Communication").

Construction

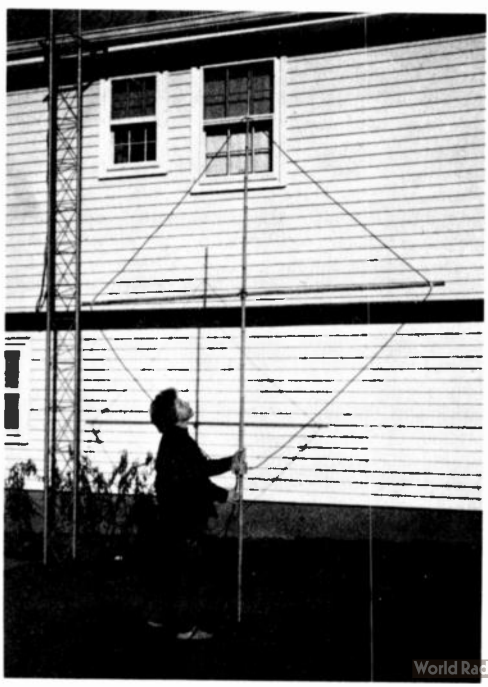
There will not be a major difference in the construction requirements of the loop if coaxial cables other than RG-59/U are used. The line impedance is not significant with respect to the loop element. However, various types of coaxial line exhibit different amounts of capacitance per foot, thereby requiring more or less capacitance across the feed point to establish resonance.

Shielded loops are not affected noticeably by nearby objects, and therefore they can be installed indoors or out after being tuned to resonance. Moving them from one place to another does not affect the tuning.

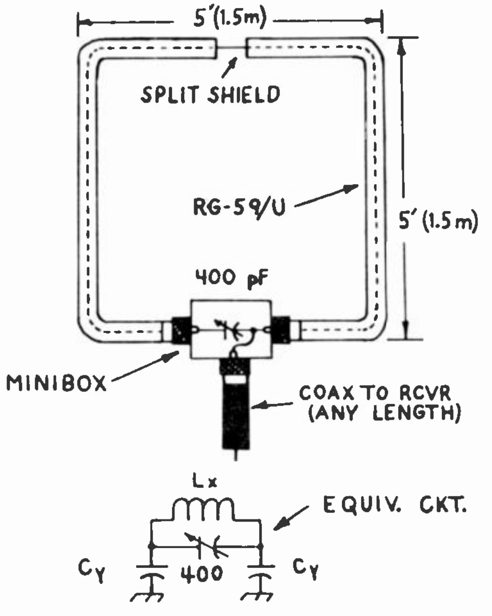
In the model shown here it can be seen that a supporting structure was fashioned from bamboo poles. The "X" frame is held together at the center by means of two U bolts. The loop element is taped to the cross arms to form a square. It is likely that one could use metal cross arms without degrading the antenna performance. Alternatively, wood can be used for the supporting frame.

A Minibox was used at the feed point of the loop to contain the resonating variable capacitor. In this model a 50- to 400-pF compression trimmer is used to establish resonance. It is necessary to weatherproof the box for outdoor installations.

The shield braid of the loop coax is removed for a length of one inch (2.5 cm) directly opposite the feed point. The exposed areas should be treated with a sealing compound once this is done.



The 160-meter shielded loop. Bamboo cross arms are used to support the antenna.



Schematic diagram of the loop antenna. The dimensions are not critical provided overall length of the loop element does not exceed approximately .04 wavelength. Small loops which are one half or less the size of this one will prove useful where limited space is a consideration.

Cy – Distributed capacitance between center conductor and braid.

Lx – Inductance of center conductor.

Performance Notes

This receiving loop has been very effective at W1CER in nulling out second-harmonic energy from two local bc stations. During DX and contest operation on 160 meters it helps prevent receiver overloading from nearby 160-meter stations that share the band. The marked reduction in response to noise has made the loop a valuable station accessory when receiving weak signals. It is not used all of the time, but is available when needed by connecting it to the receiver through an antenna-selector switch. Reception of European DX stations has been possible with the loop at times when the transmitting antenna was totally ineffective (noise).

Long-term testing showed that the effects of approaching storms (with attendant atmospheric noise) could be nullified considerably by rotating the loop away from the storm front. It should be said that the loop does not exhibit meaningful directivity when receiving sky-wave signals. The directivity characteristics relate primarily to ground-wave signals. This is a bonus feature in disguise, for when nulling out noise or QRM one is still able to copy signals from all compass points!

Those wishing to compensate for loss of efficiency when using a loop should consider placing a well-designed preamplifier in the line to the receiver. One possibility might be a common-gate JFET (MPF102). The gain of such a preamplifier will be approximately equal to the loss in the loop, and the common-gate JFET preamplifier exhibits good immunity to overloading and IMD products.

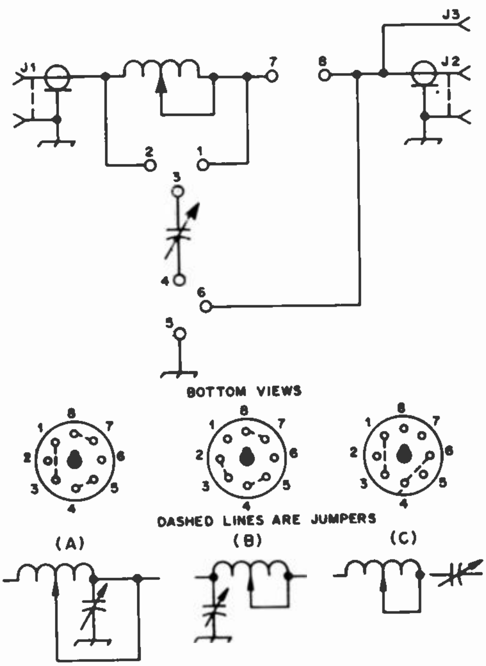
For receiving applications it is not necessary to match the feed line to the loop, though doing so may enhance the performance somewhat. If no attempt is made to secure an SWR of 1, the builder can use 50- or 75-ohm coax for a feeder, and no difference in performance will be observed.

The *Q* of this loop is sufficiently low to allow the operator to peak it for resonance at 1900 kHz and use it across the entire 160-meter band. The degradation in performance at 1800 and 2000 kHz will be so slight that it will be difficult to discern. – *W1CER*

A QUICK-CHANGE PLUG FOR THE APARTMENT DWELLER'S DILEMMA

Another method for changing from one type of tuner to another when using The "Apartment Dweller's Dilemma," *QST* October 1971, can be speeded up by using an octal socket and three old tube bases in place of the banana plugs and jacks recommended. After wiring, a circle of light cardboard can be cemented over the top to keep out dust. If desired, the letters A, B, and C can be painted on the side for quick identification.

I have maintained the original numbering scheme and as can be seen in the drawing, three different versions of the tuner are possible. – *Bob Richardson, W6WHM*



Shown is the schematic of the original circuit of the Transmatch and the three different circuit possibilities. When the original circuit is wired to an 8-pin octal socket, the combinations can be quickly changed with 8-pin plugs, wired as shown.

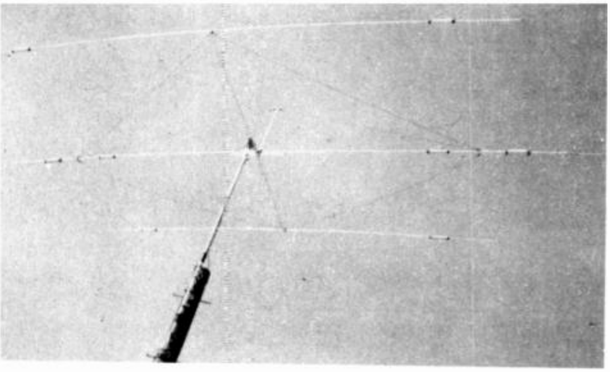
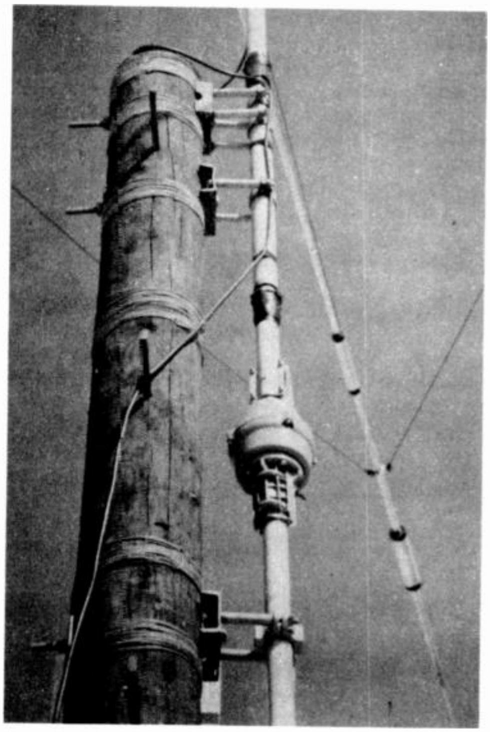


Fig. 1 — KØCOU's 50-pound beam mounted atop a utility pole.

SIMPLE METHOD OF MOUNTING A ROTARY BEAM ON A UTILITY POLE

Fig. 2 — Sketch showing the hardware used to attach the thrust bearing and rotator pipe to a wooden utility pole. No dimensions are given as they will vary in size of the pole and the materials available to the builder.



In some areas of the country used utility poles are available to amateurs at little or no cost. However, it's a problem to mount a large antenna on a pole, and little information is available from antenna or rotator manufacturers, except on mounting beams on towers.

The antenna system shown has been in service for one year, and it has stood the test of the elements, including a severe sleet storm and several summer storms, one with winds gusting to 90 m.p.h. No problems have yet been encountered with the antenna, a 50-pound Mosley TA3340, or the rotator, a Ham-M. Overall height of the system is 40 feet.

After consulting with several metal firms, I located a 15-foot length of 2-inch o.d., 3/8-inch wall aluminum tubing for the mast. Aluminum was picked because of its light weight (the amst weighs only 20 pounds), and durability. A thrust-bearing type of mounting was chosen to avoid excessive sideways strain on the rotator by the lever action of the antenna and mast. A 3-foot, 21/8-inch i.d. aluminum tube was used for the bearing.

After the hardware (Fig. 2) and thrust bearing were mounted on the pole as shown in Fig. 3, the 15-foot section of aluminum tubing was pushed through the 3-foot thrust bearing, and the antenna was attached to the top of the mast. Then a 3-foot section of pipe was attached to the base of the rotator. Next the mast was pushed up to the position shown in the photographs, the rotator clamped to the mast, and the pipe at the base of the rotator secured. Lighting protection was provided for the installation by running a ground wire directly from the base of the rotator to a ground rod buried at the foot of the pole – *William N. Kendall, KØCOU*

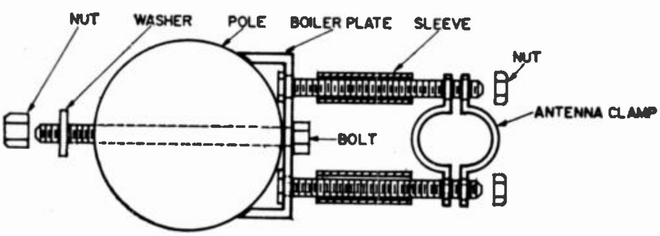
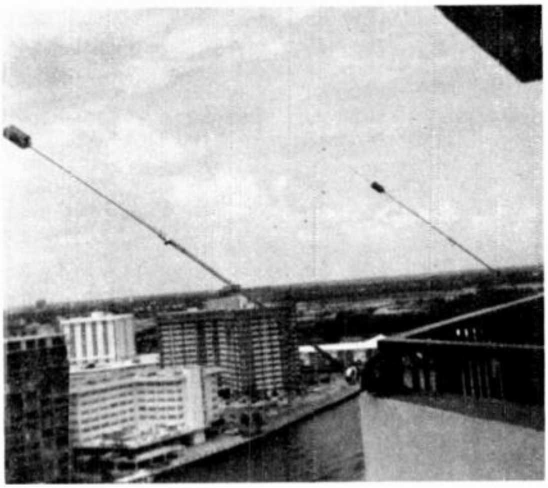


Fig. 3 — A closeup of the installed rotator and mast.



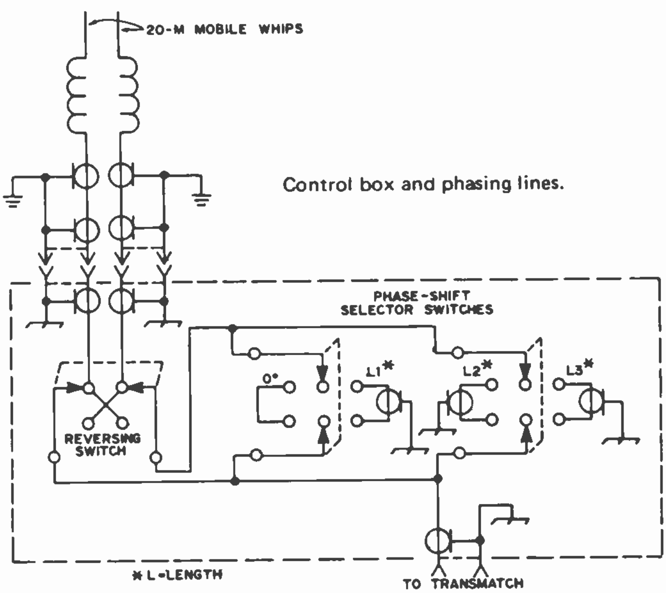
A CLIFF DWELLER'S ANSWER TO THE ANTENNA DILEMMA

I recently moved from my own home in Short Hills, New Jersey, to a 19-story condominium building in Hallandale, Florida. I am on the 18th floor and have an outdoor terrace on the northwest corner of the building with a clear shot in almost all directions. A perfect spot to mount a Hustler 20-meter mobile whip was right on the terrace railing. The results were excellent and I was able to work the world with a transceiver. However, there was one major drawback – QRM from all directions. Receiving was very frustrating especially when I tried to keep schedules with friends back in New Jersey. I finally obtained permission to put up a long thin wire on the roof of the building. This antenna worked fine on all bands but similar trouble with reception still existed.

The answer was a directional antenna pointed to the north with a good front-to-back ratio in order to minimize some of the very strong QRM from South and Central America. It was decided to try two Hustler mobile whip antennas fed out of phase for end-fire directivity. Fortunately, my terrace railing ran north-south, making it convenient for a close-spaced two-element array.

Charts showing the horizontal patterns of two vertical antennas for various spacings between radiators and different phase angles between currents can be found in *Antennas*, by Kraus and the first edition of *Radio Engineer's Handbook* by Terman. It was assumed that the currents were equal in magnitude when the patterns were derived.

The charts, at best, could only serve as a rough guide because no attempt was made to equalize the currents in each antenna. Also, both ends of the terrace railing were not identical in respect to the many reflecting surfaces of the building contours. Neither did the terrace railing and supports provide an adequate ground plane for the two whips which, for convenience, were not vertical but pointed away from the building at a 45-degree angle. The whips were originally mounted 1/8 wave apart but later moved to approximately 3/16 wavelength for improved eye appeal. The spacing was not critical. Standard ball type mounts were used and fastened to the railing posts with metal brackets and U bolts. Two identical lengths of RG-58/U were used as separate feed lines and ran to a junction box in the radio shack.



Control box and phasing lines.

Considerable experimentation on received signals showed that generally the best phase shift to use was obtained with a 6-1/2-foot (2 m) section of RG-8/U added to the north-side whip. The front-to-back ratio on reception (which was later confirmed on transmission) was at times as high as 6 S units. However, the amount of phase shift necessary and the resultant front-to-back ratio varied considerably with the vertical angle of arrival of the signal. At times during a fade, there appeared to be no rejection and a few seconds later on the same signal the rejection was fantastic. There were times that a greater phase shift was necessary and a 15-foot section (4.6 m) of added coaxial cable was used for best results. If expressed in degrees, the phase shift used varied from about 50 to 120 degrees.

In order to facilitate the rapid switching in of various lengths of phasing line, a control box was built using four Federal switches that I happened to have on hand. However, rotary switches could be used as shown in the diagram. With the control box, I can insert any one of three different phasing lines into either antenna, to reverse directivity. When the two whips are used, it is necessary to match the combination to the transceiver. Any matching network can be used as long as the transceiver sees approximately 50 ohms. The length of line between the control box and the matching network should be as short as practical to minimize losses.

Using the charts as a guide, one can see there are many possibilities for using the phased whips. If conditions permit, three whips can be used in a triangular setup for 6-way directivity switching. – *William Tucker, W4FXE*

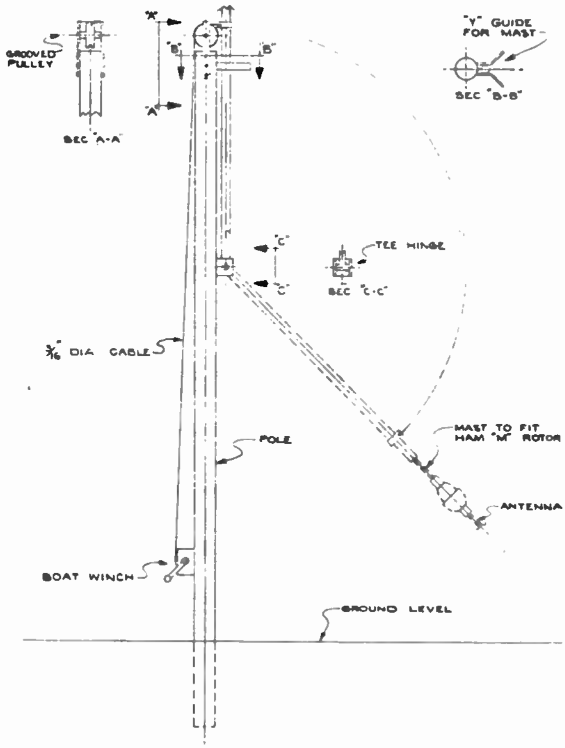
A 15-METER DIPOLE MADE FROM CONDUIT

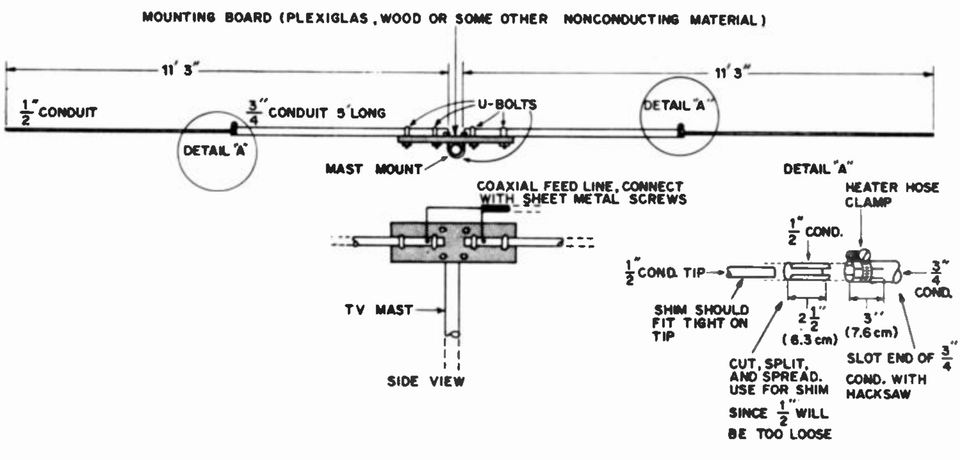
My place sits in a draw and, in fact, it's almost a canyon. There is a steep mountain within 75 feet of the house and it towers over my roof on three sides. Naturally, the only open direction heads nowhere, so a QSO with a station 200 miles away was DX for me.

Also there was a problem of where to anchor wire dipoles and this conduit dipole seemed to be the answer. The dipole shown in the drawing is mounted on a 10-foot section of TV mast which is erected on the bottom edge of my roof. Since I have built this antenna, I have been able to work ZLs, KXs, JAs, and VKs. While this may not sound impressive to some, from my location it's terrific! – *Jim Young, WN6SVW*

HOMEMADE TIP-OVER TOWER

A simple tip-over tower can be constructed from 2-inch steel pipe as shown in the drawing. The total height is 60 feet, but anything up to this height could be used. – *Walter Roberts W4KTD*





Construction details of the 15-meter dipole. Conduit comes in standard lengths of 10 feet, and 3 pieces are required – one 3/4-inch diameter piece and two 1/2-inch pieces. Four U bolts to fit the 3/4-inch conduit and two heater-hose clamps for 5/8-inch ID hose are also required. The mounting board is 4 × 18 inches (10 × 46 cm) and is fastened to the mast by means of two 1-1/2-inch U bolts. Tune-up is accomplished simply by sliding the tips in (or out) until the lowest SWR reading is obtained.

Hints and Kinks . . .

for Test Equipment

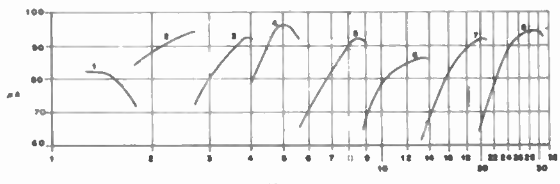
HIGH-ACCURACY FET DIPPER

Shown in the photograph and diagram is a sensitive dip meter that cannot be drawn off scale in either direction. It is possible to get an indication of resonance down to 0.5 μA on the meter when coupled to a circuit 2 to 3 inches away. Another advantage of this unit is that there are no spurious responses on any range. Also, there is no need for a sensitivity control. The readings shown on the graph were taken with a fresh battery (9 volts), but satisfactory readings are possible down to 7 volts.

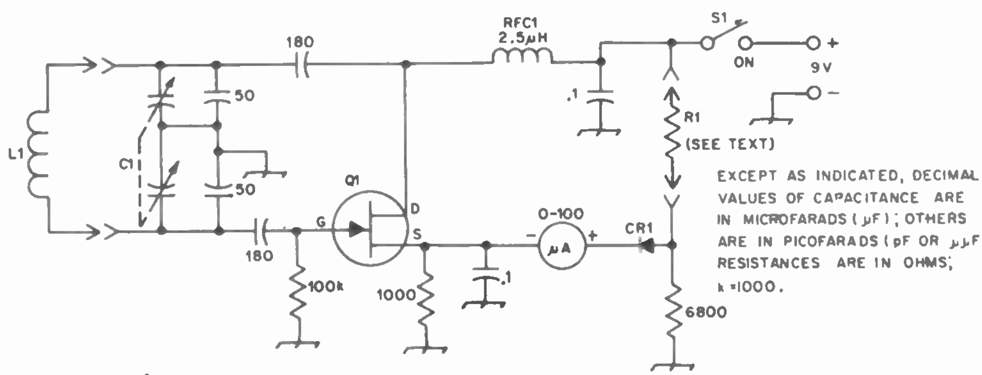
All components, excluding the range coils, have been housed in a metal box measuring 4 x 2 x 1-1/2 inches. The coil forms are of local design and are 7 mm in diameter (0.28 inch), mounted on a base that fits a 9-pin tube socket. The coil winding for L1, starting with the highest frequency range, is 12 turns of No. 22 wire, close wound. The next four lower ranges are wound using wire two gauges thinner, with each successive coil covering about the same amount of space as the first, 3/8 inch. The three lower frequency coils were made from i-f transformer cores. The coils were removed from the transformer and placed over the 7-mm forms, then turns were removed until the desired range was reached.

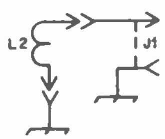
If there is concern by the builder for the lack of coil values, or a tuning chart on the face of the dip-meter, the reason lies in my different means of readout. The unit is quite small, which would make a chart difficult to calibrate and read. It would be only an approximation anyhow; therefore, an additional coil, L2, is added as a pickup loop. Thus at J1 there is a sampling of the oscillator frequency that indicates a dip at the resonance point of the circuit under test. The sample is read out on a

The FET Dipper has power applied. With no resonant circuit near, the meter reads 90 percent of full scale when one of the coils is plugged in. The jack J1 at the bottom feeds a portion of the oscillator signal to a frequency counter.



The approximate frequency range and the meter readings for each of the eight plug in coils used in the FET dipper.





Circuit diagram of the FET dipper. The values for L1, L2, and R1 are given in the text. Resistors are 1/2-watt, 10-percent tolerance, composition.
C1 — 365 pF per section, air variable (J. W. Miller 565-8).

CR1 — 1N34A or equiv.
Q1 — MPF102.
R1 — See text.
S1 — Spst miniature slide switch.

frequency counter and indicates the frequency with greater accuracy than before possible. One of the pickup loops is just visible in the photograph (in the coil nearest the dip-meter).

CR1 was added to prevent the meter from going negative when closely coupled to some circuits. R1 is a part of each plug-in coil. The amount of resistance is found experimentally by using a variable resistor in place of R1, and adjusting for an approximately 90- to 95-percent full-scale reading on the meter. Measure the value of the variable resistor, then replace it with one of approximately the same value (in the coil form). In my case, each resistor was in the 10k- to 33k-ohm range. With R1 and CR1 connected as shown, the meter can never read off scale, in either direction. – *Peter Lumb, G3IRM.*

The frequency and voltage monitor. The device was connected to the commercial power line when this photograph was made. Parallax creates an apparent error in the meter indications shown.

A FIELD-DAY AC-POWER MONITOR

Here's a gadget that will be especially useful on Field Day outings or, for that matter, any place where portable ac power generators are put to use. In fact, the device is even handy to have in the ham shack if one wants to keep an eye on the power-line frequency and voltage.

The voltage indicator is a 0- to 150-volt ac meter. The frequency-indicating portion of the circuit uses a pulse-counting detector and a 0- to 1-mA meter. The frequency indication is virtually independent of the voltage amplitude for values above 50 volts, and when calibrated at 60 Hz its frequency accuracy in the range of 50 to 70 Hz is within one Hz or better, depending on the linearity of the basic movement.

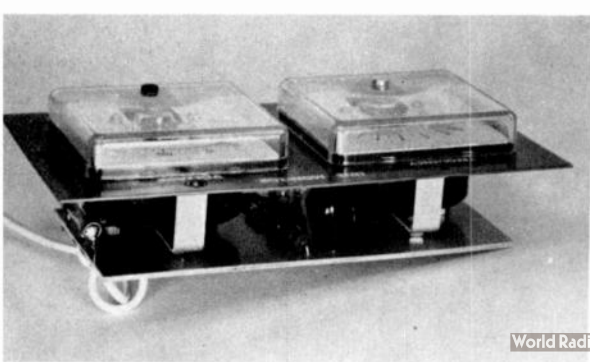
The Circuit

The schematic diagram of the complete monitor is given in Fig. 1. M1, connected directly across the line, meters the voltage. In the frequency-measuring part of the circuit CR1 and CR2 are Zener diodes connected back-to-back. During the peak of a cycle of the line voltage waveform, depending on the polarity, one diode is forward-biased and will conduct. At this time the other diode, through its avalanche action, will conduct current in the same direction but will regulate the voltage at its rated value, 15 volts. R1 is the voltage-dropping resistor. As the polarity of the line voltage reverses, so does the action of the two diodes, and 15 volts across the pair is developed in the opposite polarity . The resultant voltage at point A in the circuit is almost a square wave. Its frequency is the same as that at the input, and the amplitude is 30-V pk-pk (15 volts from zero in each direction, positive and negative). C1 and R2 differentiate this signal to form positive and negative pulses at point B. These pulses are rectified in the full-wave bridge rectifier and the direct current delivered by the rectifier is metered by M2. R3 is used to calibrate M2.

As the frequency increases, the number of rectified pulses per second increases, causing M2 to read higher. Conversely, a lower frequency produces a lower reading. The time constant for the differentiating circuit takes into account the loading imposed by the rectifier bridge and the milliammeter, and was chosen for a maximum frequency of 100 Hz.

Construction

Perhaps suitable meters, the most expensive items in the instrument, are available to the prospective builder from his surplus-parts box. But if everything must be purchased new, the cost can be held below $16.00 even if a metal chassis box is purchased. By changing the values of C1, R2 and R3 from those shown in Fig. 1, almost any sensitive meter may be used for M2. However, a meter having a 0-1 scale on the face makes it easy to obtain a direct-reading frequency indication, with 100 Hz represented by a full-scale reading. As shown in one of the photographs, an etched circuit board may be used to mount the parts, the board itself being mounted directly at the meter terminals. However, many other construction techniques are suitable. No particular precautions are necessary in the construction except that for safety reasons care should be taken to keep all parts of the circuit isolated from any metal enclosure which may be used.



The front-panel assembly of the monitor contains the complete circuit. During construction the two meters are first mounted on the front panel, and then a circuit board having a pattern and component layout to mate with the four meter terminals is mounted at the back of the meters. R1 and C1 are prominent at the near center of the board, with F1 visible at the left.

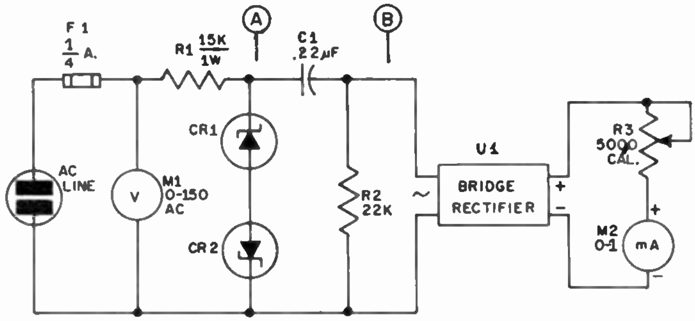


Fig. 1 — Circuit diagram of the ac power monitor. Resistances are in ohms, k = 1000. Components not listed below are for text reference. For 240-volt operation, R1 should be 33K composition with 2-watt rating.

C1 — Mylar.
CR1, CR2 — 15-V 500-mW Zener diode, 1N5245 or equiv.
F1 — Pigtail or clip mounted.
M1 — 0-150V ac (Shurite model 850 or equiv.).
M2 — 0-1mA dc (Shurite model 850 or equiv.).
R2 — 1/2W.
R3 — Linear taper, low wattage. (Mallory type MTC 53L1 or equiv. may be used for circuit-board mounting.)
U1 — Full-wave rectifier bridge, 50-V (Motorola MDA 920-2, HEP 175, or equiv.). Four silicon diodes of the same rating may be used instead, if connected in the full-wave bridge configuration.

Adjustment and Use

The frequency meter may be calibrated from the commercial power line. Connect the instrument to the line and, while being careful not to touch any portion of the circuit, adjust R3 for a reading of 0.6 mA to indicate a frequency of 60 Hz. That's all there is to it!

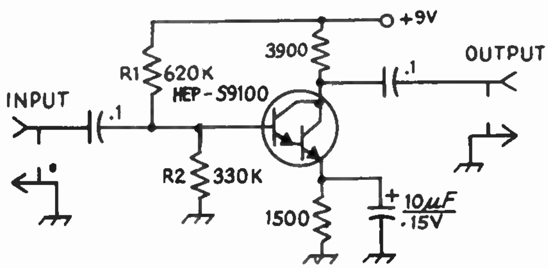
When calibrated in this manner, even with the inexpensive meter shown in the photographs, accuracy of the frequency calibration was within 5 percent when compared with an electronic counter over the range of 20 to 100 Hz. Voltage excursions from 50 to 150 volts changed the indication on M2 by less than the needle's width. With an instrument such as this in use next Field Day, you'll *know* whether or not your generator is putting out the right voltage and frequency for your amateur equipment. – *K1PLP*

SIMPLE OSCILLOSCOPE PREAMPLIFIER

Having spent considerable time trying to find a simple ready-made circuit for use as an oscilloscope preamplifier, I finally designed one which would serve my purpose. Since my oscilloscope is an old Dumont 274 which was designed primarily for audio work, I needed a solid-state amplifier with a voltage gain of approximately 100, and which could be powered by a 9-volt battery.

Shown in the circuit is a small-signal voltage amplifier which uses a Motorola HEP S9100 Darlington pair as the active amplifying device. This amplifier has a voltage gain of approximately 100 over a frequency range from 20 Hz to over 30 kHz. The amplifier is powered by a 9-volt transistor battery. The input impedance is nearly equal to the parallel combination of R1 and R2, while the output impedance is roughly 20,000 ohms.

The amplifier could have been built using two separate transistors, but since the HEP S9100 is inexpensive ($1.32), it was used. If it is desired to use reverse polarity in the circuit, use a Motorola HEP S9120 pnp Darlington pair. – *J. H. Ellison, W6AOI*



A simple oscilloscope preamplifier.
R1, R2 — See text.

A LOW-COST SCOPE CAMERA

One piece of equipment that most amateurs and experimenters never seem to have available is an oscilloscope camera. This instrument is extremely useful for making permanent records of almost any pattern displayed on a scope. Probably the major obstacle in obtaining this equipment is the price; most laboratory cameras sell for many hundreds of dollars. Even the new scope camera made by Polaroid lists for about $180. However, the introduction by the Polaroid Corporation of the new Big Shot camera provides a solution to the amateur for an inexpensive oscilloscope camera.

The Camera

The Big Shot camera is a fixed-focus, fixed shutter-speed Polaroid camera. Selling for less than $20, it is designed to take close-up portraits using flash cubes and color film. The shutter speed is set at 1/60 second and the lens opening is slightly adjustable around f/25. With the use of black-and-white (type 107) film and a minor modification, the Big Shot makes a very nice scope camera.

The camera is focused at about 38 inches (97 cm). In order to fill the entire picture area with a five-inch CRT screen, it is necessary to reduce this distance to about ten inches. A Kodak +3 Portra Lens, Series 6 (available at most photography stores) fills the bill quite nicely. The +3 indicates the magnification and the series number indicates the diameter of the lens mount. The Series-6 size fits perfectly over the Big Shot lens and requires no adapters or holders.

Preliminary Tests

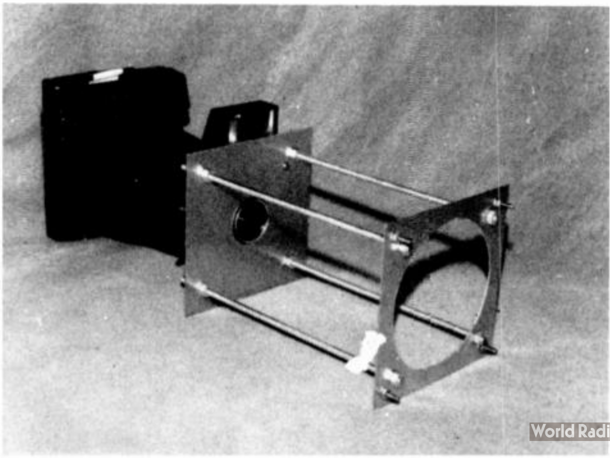
When you have obtained the camera and the Portra lens, some preliminary tests are necessary to determine the correct distance to space the camera from the oscilloscope. Set up the scope with about two feet of table space in front of it. Allow it to warm up and obtain a stable trace on the CRT, adjusting the controls for a sharp, medium-intensity trace.

Place the Portra lens over the Big Shot lens by carefully pushing and twisting it so that it threads its way into the plastic Big Shot lens mount. When it is securely mounted, adjust the Big Shot lens to the lightest setting (largest opening). Load the camera with type 107 black-and-white film and do not use flash cubes.

Find a method to support the Big Shot, on its side, which will place it about ten inches away from, and directly in line with, the face of the CRT. It is imperative that the camera be exactly perpendicular to the oscilloscope. Find a convenient spot on the front of the scope from which to measure and check the distance at several locations on the front of the camera. Assuming that the face of the CRT is flush with the front panel of the scope, position the front of the camera about 9-3/4 inches (25 cm) away for the first test picture.

When you are satisfied that all is ready, darken the room, hold the camera steady, and snap the shutter. Develop the picture for 15 seconds, following the instructions supplied with the film. Study the result and make any necessary adjustments to the scope (probably the intensity control will need touching up for best results) or to the lens/CRT distance. After several attempts, you should have a sharp, well-exposed print. At this point, carefully note the distance from the front of the camera to your reference location on the scope. You now know where to locate the camera to produce good oscillograms. The next step is to devise a way to conveniently keep it there.

Fig. 1 — Photograph of the camera adapter mounted on the camera.



The Mounting Bracket

The mounting bracket is nothing more than a simple set of spacers designed to allow repeated positioning of the camera in front of the oscilloscope. It consists of two metal plates and four spacing rods. Fig. 1 shows construction of one bracket which was made for a 4-1/2-inch Tektronix scope. Different scopes may require slight changes.

Cut two six-inch (15 cm) square aluminum plates and find the exact center of each plate. In one plate, using a coping saw or a nibbling tool, cut a circle which is slightly larger than the face of your CRT. Position the circle so that its center coincides exactly with the center of the square plate. In the other plate, punch or cut a 1-1/2-inch (3.8 cm) diameter hole, exactly centered.

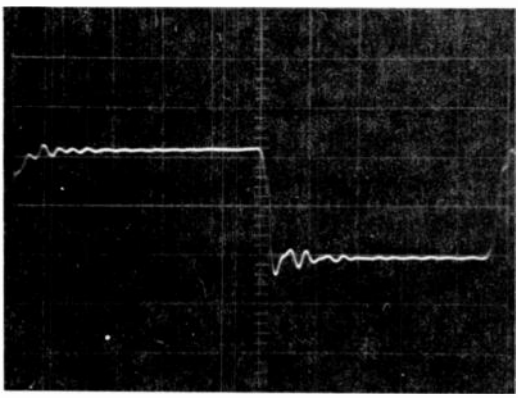
In each corner of one plate, about 7/8 inch (2.2 cm) from each adjacent side, mark the location for a spacer rod. Lay the two plates together and drill the four holes in each plate. The spacers I used were 1/4-20 threaded rod, available at most hardware stores and requires 1/4-inch (0.64 cm) holes.

The plate with the small hole also requires holes for two small mounting ears to attach it to the camera. (see Fig. 2). The ears mount to the housing on the camera which holds the flash-diffusing lens. The sides of this housing are conveniently 90 degrees to the front of the camera and drilling into them will not affect the operation of the camera. Find a location near the bottom of the housing to fasten a small 90-degree ear on each side and drill a hole for a No. 6 machine screw. Attach an ear to each side and lay the aluminum plate with the small hole on the front of the camera. Adjust the mounting ears so that the plate lies flat and tight against the front of the camera. Center the lens in the 1-1/2-inch hole and mark the location of the holes required to attach the plate to the ears.

One other operation may be required on the plate with the large hole. Some oscilloscopes have recessed threaded posts around the CRT. These provide a good way to align the camera with the scope if some sort of mating plugs are provided on the mounting bracket (see Fig. 3) I used 8-32 machine screws located so they would line up with the four posts on my scope. If your oscilloscope has a similar feature, you may want to provide mating plugs.

When all drilling operations are complete, cut four spacer rods about 10-1/2 inches (27 cm) long. Thread a 1/4-20 nut onto each end of the rods and insert one end of each into the 1/4-inch holes in one of the aluminum plates. Thread another nut onto each rod after the plate has been attached, but do not tighten them securely. Repeat the same procedure for the second plate.

Adjust the nuts so that very little of the rod protrudes from the oscilloscope plate; the extra length of the rods should stick out behind the camera plate. Next, space the two plates so that the camera is the correct distance from the scope. Be sure to take into account any space between the scope plate and the front panel of the oscilloscope. In my case, the CRT-to-lens distance was 9-3/4 inches (25 cm) and the space between the plates was 8-3/4 inches (22 cm). Measure carefully at each corner of the mounting bracket and tighten the nuts securely.



Sample photograph made with the setup discussed in the text.

Attach the mounting bracket to the camera by means of the two ears and the project is complete. Set up the scope as before, place the front plate against the scope, and take a test picture. If the construction of the mounting bracket was carefully done, you should have an in-focus, centered oscillogram. If any adjustments are required, the focus can be corrected by changing the distance between the plates, and the centering can be corrected by adjusting the two spacer rods on the side which requires movement.

Use of the Camera

To use the oscilloscope camera, simply place it against the scope and snap the shutter. The room should be darkened to provide maximum contrast. If desired, the mounting bracket could be enclosed with metal or cardboard sides to keep ambient light off the scope tube. Care should be taken to assure that the camera is held firmly against the scope to prevent movement while providing the proper spacing and centering.

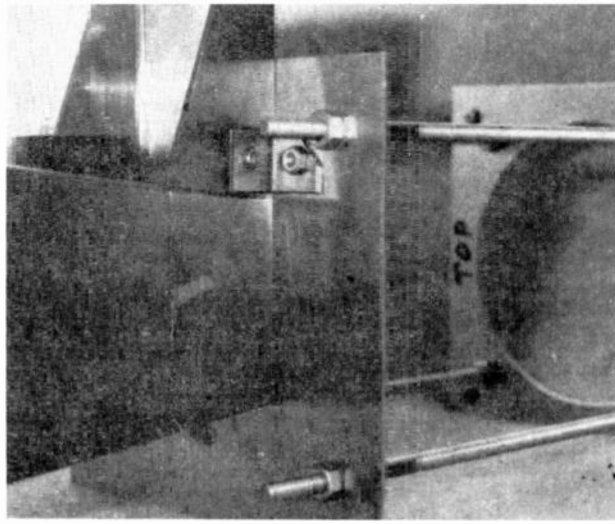


Fig. 2 – Camera-side view of adapter. Note ears for mounting to the flash cube diffuser.

One note of caution should be interjected at this point. Since the camera has a fixed shutter speed at 1/60 second, slow sweep speeds will not be reproduced completely. The shutter will open and close before the electron beam has a chance to move all the way across the screen. On my scope, a sweep speed of two milliseconds per centimeter is the slowest I can expect to photograph well. My CRT is ten cm wide and the shutter remains open for 16 of the 20 milliseconds it takes the sweep to travel the entire width. Therefore, the whole sweep is not exposed on the film. However, the persistence of the CRT is long enough to make a reasonable image show up, even on the unswept portion. A good rule-of-thumb is not to expect to record anything slower than one cycle of a 60-Hz waveform.

Some Notes

The +3 Portra lens worked out well for a 4-1/2-inch CRT. For smaller oscilloscopes, possibly a +4 or +5 lens will be required to fill the entire

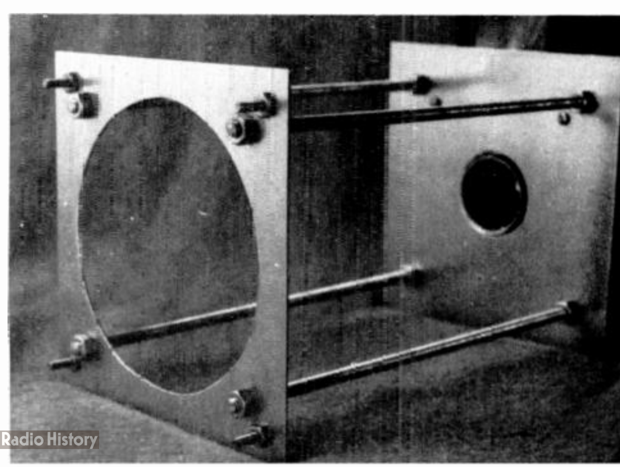


Fig. 3 – Close-up view of the adapter. Note screws used for aligning adapter by means of scope posts.

picture area. In any case, the Series-6 mount fits nicely over the Big Shot lens.

It is nice to be able to see the graticule lines when viewing an oscillogram. On the Tektronix and some other scopes, graticule illumination is provided. This makes the lines show up as white on a black background. If there is no illumination on thė graticule of your scope, the lines will not appear in the picture.

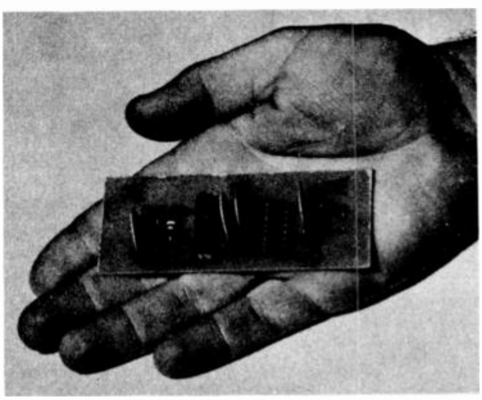
One way to circumvent this handicap is to provide some outside illumination for the CRT. Hewlett-Packard scope cameras have an ultra violet lamp included which makes the CRT glow slightly, causing the graticule lines to appear as black on a white background. You may want to experiment with a small pilot lamp somewhere in the mounting bracket, positioned so that it evenly illuminates the CRT face. An alternative is to try exposing some scope pictures without darkening the room. However, this may produce unwanted shadows on the CRT.

Conclusion

The oscilloscope camera works extremely well, providing quality almost equal to that from a laboratory camera. By proper adjustment of the scopes intensity control, very fast rise and fall times can be recorded using the type 107 film which is rated at a speed of ASA 3000. The camera is slightly inconvenient to use, because of its large size, but this is overcome by its low price and the excellent quality of the pictures. – *Michael M. Dodd, WA4HQW*

AN IC TUNE-UP DEVICE FOR THE BLIND AMATEURS

Several articles have been published concering tuning devices for blind amateurs. When a sightless friend got his Novice ticket, I decided to build such a circuit for him. After researching some of the published articles on the subject it became apparent that most of the circuit were unneccessarily complex and outdated, as compared with the availability of present-day intergrated circuits. The circuit, Fig. 1, was used in conjunction with the HW-16 transceiver, but can easily be adapted to almost any transmitter. It utilizes one monolithic integrated circuit which is available for $2.60.



This photograph shows how small the unit is.

How It Works

The unit provides an output tone whose frequency is proportional to the meter deflection on the HW-16. Thus, it can be used to dip the final or peak the relative output power. In addition, a reference frequency is provided which is set to give that frequency which corresponds to the plate current for 75-watts input power. The operator can resonate the final, then adjust the power level for 75-watts input.

The IC is a dual-voltage controlled multivibrator (VCM) which is intended for use in a phase-locked loop. It lends itself ideally to this application. The multivibrator provides a square-wave output whose frequency is proportional to the dc voltage applied to its input. The output stage of the device is a TTL driver which can be short circuited indefinitely without damage to the device. Thus, a loudspeaker may be connected directly to the output and sufficient volume is obtained without the need for an additional audio amplifier. Although the output is a square wave, the tone is quite acceptable.

The 0.1-μF capacitor, C4, is used to set the output frequency range of the oscillator; in this case it is approximately 1000 to 4000 Hertz (the center of the human hearing range). Since the HW-16 has no built-in loudspeaker, it was decided to use the same speaker for both the receiver and tuning circuit. A dpdt switch performs the necessary switching for the speaker and also applies power to the circuit. When switch S2 is in the REF (reference) position, the input of the oscillator is connected to the wiper arm of a 10-kΩ potentiometer (actually, any value between 5-kΩ and 100-kΩ will do). This provides a variable dc voltage which in turn is used to set the oscillator frequency to any value within its 1- to 4-kHz range. When the switch is in the XMTR position, the input of the oscillator is connected to the meter in the transmitter. A 3 mA, 1000-ohm meter is used in the HW-16 and therefore develops a voltage drop across it of 3 volts at full scale. The voltage-controlled multivibrator, however, is insensitive to input voltages between 0 and 2 volts, and actually delivers its full output frequency range for input voltages between 2 and 5 volts. The combination of diodes CR1, CR2, and CR3 and the 100-kΩ resistor provide a level shift caused by the voltage drop across the diodes. The junction of the diode and resistor varies from 2 to 5 volts for inputs of 0 to 3 volts and is thus within the desired range for VCM. C1, C2, and C3 bypass ȧny rf which may have been picked up in the interconnecting wiring. These should be placed as close to the IC as possible. It was found that on 15 meters a considerable

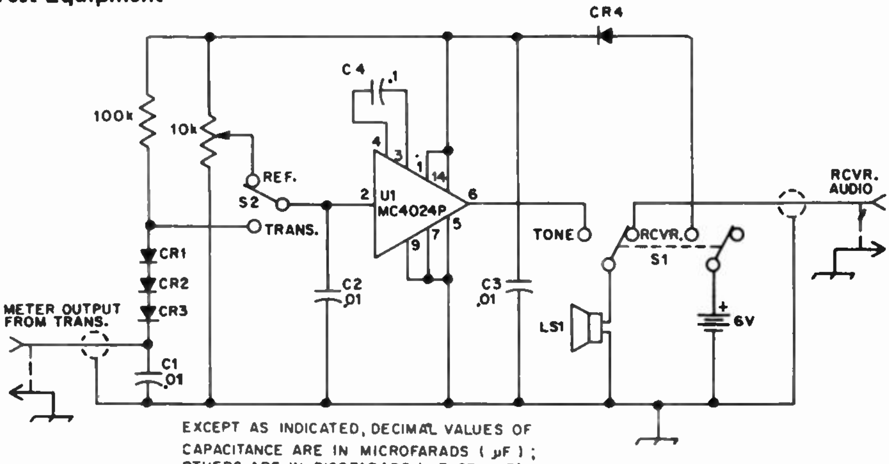


Fig. 1 — Circuit diagram of the tuning aid.
BT1 — 6-volt battery.
C1, C2, C3 — .01-μF disk ceramic, 1000 V.
CR1, CR2, CR3, CR4 — 1N914 or equiv.
R1 — 100-kΩ 1/2-watt carbon resistor.
R2 — 10-kΩ potentiometer, preferably multiturn trimmer.
S1 — Dpdt toggle or slide switch.
S2 — Spdt toggle or slide switch.
U1 — Integrated circuit, Motorola MC4024P.

amount of rf was getting on the power leads and dc input to the oscillator, adversely affecting its operation. Addition of the bypass capacitors corrected the problem.

Power is obtained from a 6-volt battery and it is suggested that battery operation be used. Diode CR4 drops about 0.75 volts thus delivering about 5.25 volts to the circuit. Power consumption is on the order of 30 mA. Since the unit draws so little power and is in operation only a small amount of time, battery life is quite high. The first battery used was a small mercury cell which lasted a year. Four C or D cells should last in excess of a year.

One attempt was made to power the circuit from the 6.3-V ac accessory output of the transceiver. A full-wave rectifier, capacitor filter and Zener diode regulator were used. However, the small amount of ripple on the power supply showed up as a 120-Hz modulation on the oscillator output. Rather than incorporate an elaborate voltage regulator, it seemed easier and more economical to use batteries, which has proven quite successful.

HW-16 Changes

Only one small addition is required on the transceiver. This is to provide a means of getting access to the meter circuitry. Connect a piece of hookup wire from the positive terminal of the meter, through a grommet in the chassis, and to an unused pin on the accessory socket. In addition, connect a .01-μF disk ceramic capacitor from the pin on the socket to chassis ground.

Calibration

Calibration must be done by a sighted amateur and should be checked about every six months. Battery degradation causes a change in the reference frequency. However, this change is not as great as one might expect because the output frequency is not dependent on the absolute input voltage to the oscillator but is more closely related to the ratio between the input and power-supply voltages. Since this ratio is fixed by the potentiometer, the frequency change is very small. Also, the frequency change is in a negative direction so that as the battery gets weaker, the reference frequency would correspond to a lower input power level. This prevents damage to the final and guarantees that the Novice regulation of 75 watts maximum input is not exceeded.

The transmitter should be tuned up in a normal fashion into a dummy load. The POWER-LEVEL control is then set to give a plate current reading of exactly 125 mA (red mark on meter scale) which corresponds to 75 watts input. Key the transmitter and leave it on. Turn the tuning circuit on and

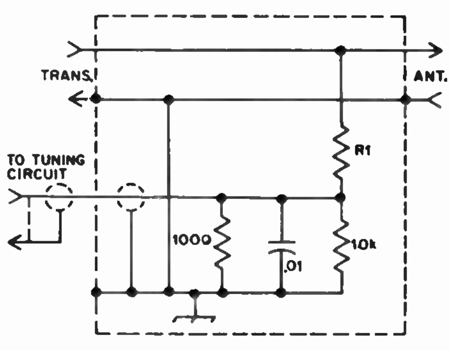


Fig. 2 — Circuit for use with tuning unit for relative output indication.

slowly adjust the setting of the reference potentiometer while switching S2 back and forth. When the same tone is heard with S2 in either position shut the tuning circuit off and release the key on the transmitter. The circuit is now calibrated and ready for operation.

Operation

Operation is quite simple and straightforward. The tuning circuit is turned on with S2 in the XMTR position. Set the meter switch to PLATE and the POWER LEVEL control to minimum. Key the transmitter and adjust the TUNE control for minimum pitch (plate current dip). The POWER LEVEL is then increased slowly while switching S2 back and forth. When the two tones are equal, release the transmitter key and shut the tuning circuit off. The transmitter is now tuned up to a final input power of 75 watts.

The unit will also monitor relative output power by setting the meter switch to that position. The reference frequency of course has no bearing when using the unit in this fashion, and the TUNE control is adjusted to give the highest output pitch.

The circuit is not limited to use with the HW-16 transceiver, and can be used with almost any transmitter. If the meter circuitry is similar to that of the HW-16 (i.e., the negative terminal of the meter is grounded and the meter provides approximately 3 V full scale) the unit can be used as is. If not, a suitable resistor can be placed in the cathode circuit of the final to develop a voltage drop of approximately 3 volts for full-scale deflection of the existing meter.

In any case, if it is not practical to modify an existing transmitter, the unit may be used to monitor relative output power. In this case the reference potentiometer and switch S2 are not required. The circuit at Fig. 2 may be used in conjunction with the tuner for that purpose.

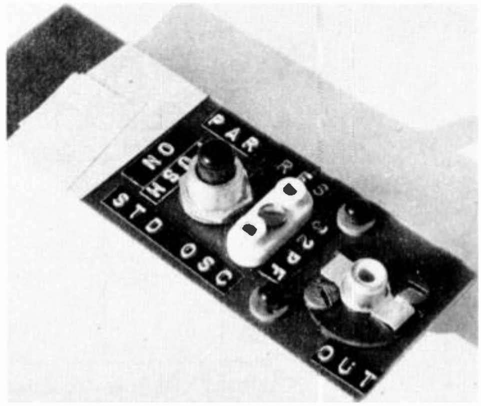
A special note of thanks goes to John Pavao, WA1LPM, for whom I designed the circuit and who encouraged me to write this article so that other sightless hams may benefit from it. – *Thomas P. Riley, WA1BYM*

A CRYSTAL TEST OSCILLATOR

There is a need for a good, portable crystal oscillator and especially one that is constructed for crystals with typical values. The author has been attempting to specify and purchase inexpensive but repeatable crystal units for channelized amateur communications. In the vhf range this problem becomes especially acute for two reasons. One, a given frequency percentage-tolerance represents a large number of kilohertz. Two, it is most difficult to obtain fundamental (as contrasted to 3rd, 5th and 7th overtone) units at frequencies above 20 MHz. A crystal operating in its overtone mode cannot simply be pulled to frequency by any appreciable extent.

In an attempt to find a manufacturer of low-cost crystal units, the experimenter soon realizes that only one electrical specification will produce satisfactory results – that is 32-pF parallel (or antiresonant) units. It is assumed that the reason is that the standard military test set, *TS 683/TSM* can be used by the manufacturer. Going to other specifications often produces unsatisfactory results when dealing with less talented suppliers, thus increasing markedly the cost.

A standard, untuned oscillator is described which will work with the 32-pF, antiresonant units. Crystals from 100 kHz to hundreds of MHz will oscillate. Some CT and DT miniature If crystals prove low on activity since these units are specifically cut for series resonance and exhibit a very low parallel resonant impedance. Vhf crystals so marked will oscillate on the fundamental mode only; that is either 1/3, 1/5, or 1/7 of the designated frequency.



Top view of the test oscillator.

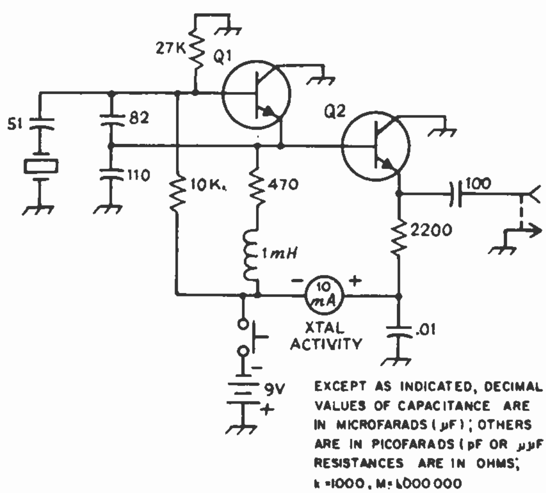
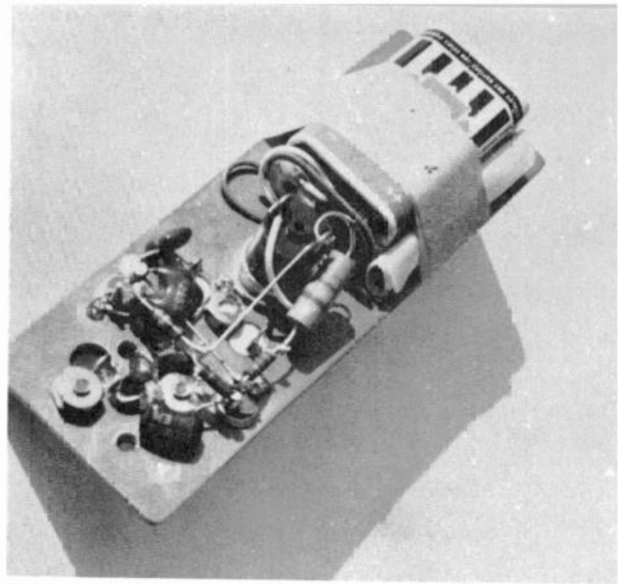


Fig. 1 – Schematic diagram of the crystal test oscillator. Resistors are 1/4- or 1/2-watt composition and capacitors are dipped mica. Some suggested transistors for Q1 and Q2 are: 2N706, HEP 56, 40237, or 2N2222.

Bottom view of the test oscillator.



Note that it does not matter what type crystal holder is being used. They all exhibit approximately 7-pF of internal capacitance when mounted in a standard crystal socket. In this test circuit do not wire more than one socket in parallel as this will change the 7-pF value of capacitance. The type of transistor used is relatively unimportant and any suitable small-signal npn bipolar transistor can be used.

Relative crystal activity can be measured by placing a meter (0-10 mA) in the −9-V lead to the Class C emitter-follower output stage. *For fundamental-mode blanks,* the higher the current the more active the crystal unit. The emitter follower produces an output that is very rich in harmonic energy and harmonics from 8-MHz crystals can be heard on 2 meters with ease.

It is possible to replace the 51-pF series capacitor with 0- to 100-pF trimmer to be certain a given crystal will "pull" to a desired channel frequency. Be sure, however, that the trimmer is replaced with 51 pF when returning to the 32-pF standard capacitance. No switching of this capacitor should be attempted because of the additional capacitance introduced by the switch.

A test circuit of this kind has proven extremely useful when a 32-pF antiresonant, parallel-mode crystal is desired. It has proven helpful when odd overtone units must be correlated. Construction of the unit has resulted in a miniature electrical and mechanical package such that correlation difficulties and cost have been minimized. – *Cliff Buttschardt, W6HDO*

A FET AND MOSFET TESTER

When working with transistor's it's always nice to know whether or not the semiconductor is good. While there are plenty of available devices to test bipolar transistors, there are no simple checkers for FETs. The unit shown in the photograph is designed to determine if a particular transistor is in proper working order. Although the checker won't test the gain of a transistor, nor indicate *positively* that a transistor is defective, it is quite useful as a "go-no-go" indicator for shorts or opens.

Circuit Details

The circuit shown in Fig. 1 consists of a common-gate rf oscillator stage with provision for selecting two oscillator frequencies. A 50-microampere meter, M1, is used to indicate the rectified rf voltage from CR1. S1 permits changing the oscillator frequency by selecting either L1 for 144 MHz, or L2 for 10 MHz. A 9-volt battery supplies the operating voltage.

Construction

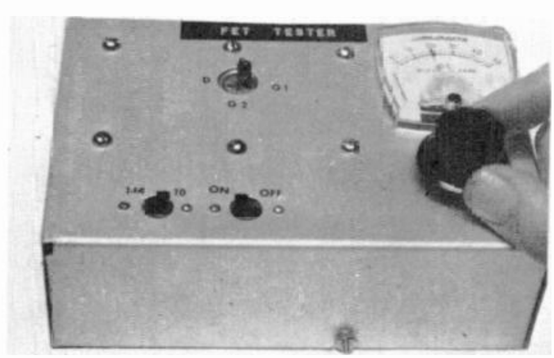
A 2 x 3-inch etched-circuit board is used for mounting most of the components. Fig. 2, a full size template, shows the proper placement of the various components on the board. A 2 x 4 x 6-inch aluminum chassis serves as a cabinet for the checker; however, any suitable container may be used.

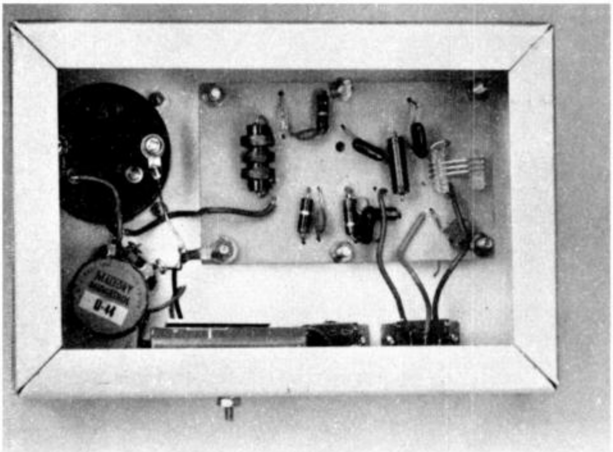
Using the Checker

It should be mentioned that the checker may be used to determine only if the transistor in question will function as an oscillator. If the circuit won't oscillate, it doesn't necessarily mean that the FET is defective. But, if it does oscillate, it's a good indication the device is at least in working order.

Checking a transistor is simple. Plug the FET into the transistor socket, turn S2 on, and adjust R5 for a reading on M1. If the transistor permits oscillation an indication will appear on M1, the amount of the indication being determined by the positioning of R5. If the needle on M1 stays on zero, there is a possibility of a bad transistor. The FET can be checked at either 10 MHz or 144 MHz, depending on the position of S1. Because it is an easy matter to destroy MOSFETs certain precautions should be observed. Static electricity can cause a puncture of the fragile dielectric gate material. It is a good idea to wind some thin, bare wire around the leads of a MOSFET before pulling it from it's shorting collar or socket. The wire should be removed only after placing the MOSFET

Here is the FET tester in use. The unit being tested is an MPF 103 and the meter reading indicates the transistor is oscillating at 10 MHz.





Bottom view of the transistor checker. The circuit board is mounted on 1/2-inch spacers. The 9-volt battery can be seen at the bottom left.

in the checker. When returning the transistor to the original circuit, the same procedure should be used.

Operation

Several types of transistors can be readily checked. Among the ones we checked were HEP-801s, HEP-802s, and some of the MPF102 through MPF107 series. When checking P-channel types, the battery polarity must be reversed. If it is expected that many P-channel types will be checked, it might be convenient to add a polarity-reversing switch to your checker. – *W1ICP*

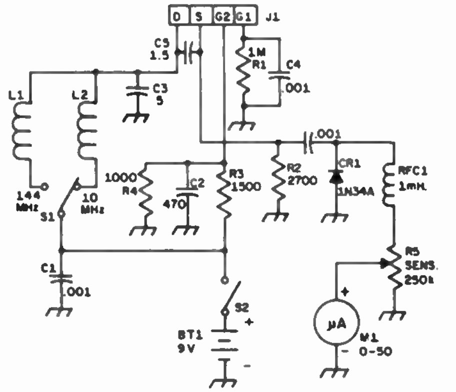


Fig. 1 — Circuit diagram of the transistor checker. All .001-uF capacitors are disk ceramic. Other capacitors are dipped silver micas. All resistors are 1/2 watt. Parts designations not listed below are so labeled for parts placement in Fig. 2.

J1 — Transistor socket.
L1 — 3 turns, 1/2-inch dia., 16 turns per inch, No. 20 (B&W Miniductor 3003).
L2 — 8.2-uH rf choke (Millen 34300-8.2).
M1 — 0 to 50-uA meter.
R5 — 250,000-ohm control, linear taper.

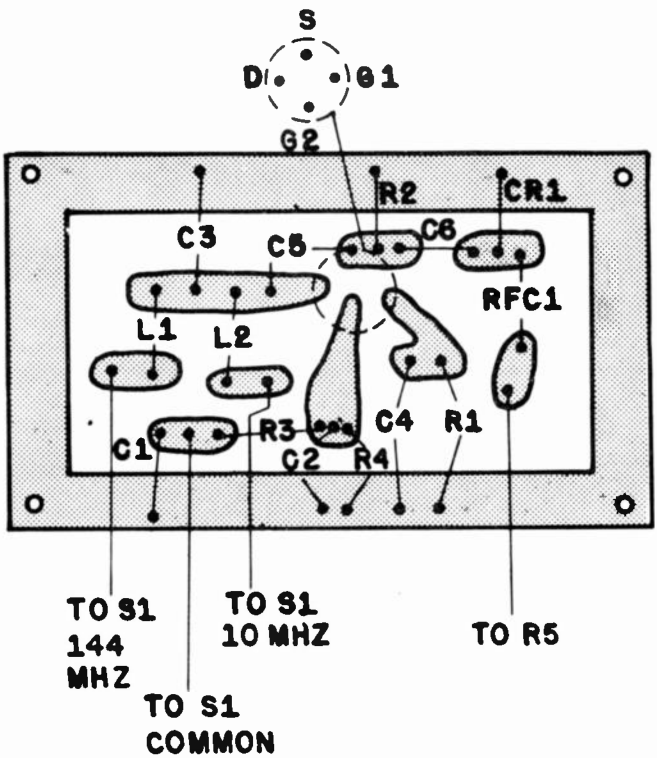


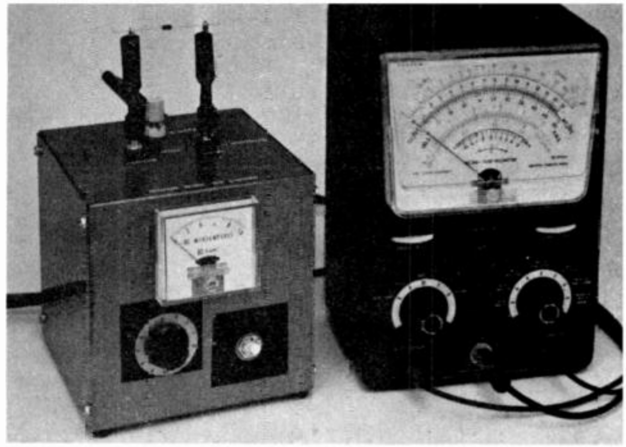
Fig. 2 — Circuit-board layout for The FET Tester.

A SILICON-DIODE PIV CHECKER

Because surplus silicon diodes can be purchased at a very low price, they are a very good buy even if a high percentage of them are defective. The dealer from whom I purchase diodes is very reliable, but occasionally I receive defective or substandard units. The time to spot these diodes is *before* they are assembled into a rectifier string, not after voltage is applied and the string breaks down.

Fig. 1 is the circuit diagram of the diode checker. R12, a rheostat in the primary circuit of T1, is used to control the output of a voltage doubler. M1, a 0-1-mA meter in series with the output of the power supply and the diode to be tested, indicates reverse current through the diode. An external voltmeter is used to measure the voltage at which the diode reverse current starts to avalanche. The accuracy of the measurement is determined primarily by the accuracy of the voltmeter used with the gadget. Because T1 has a 600-volt secondary, PIV ratings up to about 1700 volts can be checked with the tester.

Since no more than a milliampere or so of current is ever demanded from T1, this transformer can be the smallest 600-volt job you can find. Although your junk box may not contain the oil-filled capacitors suggested for C7 and C8, I do not recommend the substitution of strings of electrolytics for these two capacitors. A voltage-equalizing resistor is required across each electrolytic when several capacitors are connected in series, and additional current is drawn from the transformer. In R12 this current increase is multiplied approximately by the turns ratio of the transformer and might tax the current-handling capabilities of the potentiometer. However, the capacitance ratings of C7 and C8 may be reduced considerably without a serious sacrifice of output voltage, since the normal load on the supply is quite light.



Diode tester and VTVM setup to check the PIV rating of a silicon diode.

The bleeder resistors, R8 through R11, may be omitted if a 1000-ohms-per-volt voltmeter is used. These resistors are included only to quickly discharge C7 and C8 when R12 is turned to zero output. In any event, when employing the PIV checker, it is wise to use caution when connecting or disconnecting a diode. A 1-uF capacitor, charged up to a thousand volts or more, can be dangerous.

Construction

Referring to the photographs, the silicon diode PIV checker is built in a 6 x 6 x 6-inch aluminum utility cabinet (Bud AU1039HG). As shown in Fig.

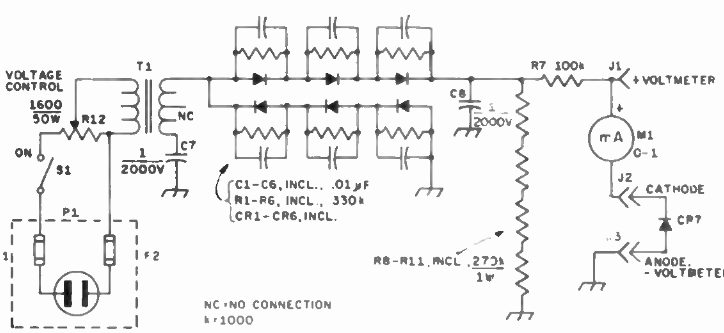
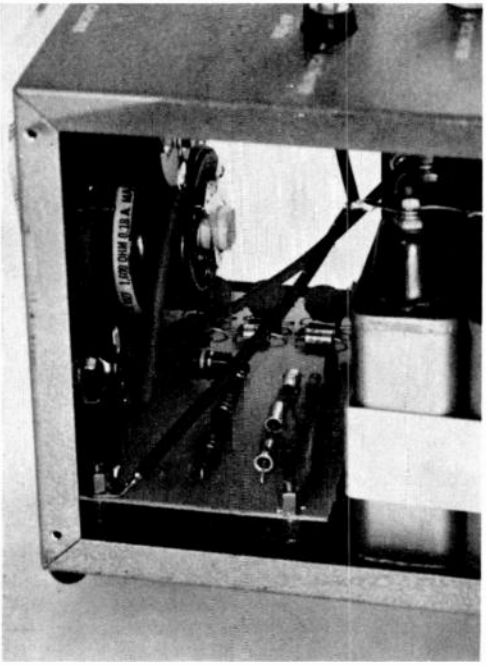


Fig. 1 — Schematic diagram of the silicon-diode PIV checker. Except as indicated, fixed resistors are ½-watt composition. Capacitance values are in uF.

C1-C6, inc. — 1000-volt-disk ceramic.
C7, C8 — 2000-volt oil-filled capacitor (Fair Radio Sales Co.).
CR1-CR6, inc. — 800-PIV silicon diode (1N3196).
CR7 — Silicon diode to be checked.
F1, F2 — ¼-ampere fuse.
J1 — White binding post (E. F. Johnson 111-301).
J2 — Red binding post (E. F. Johnson 111-302).
J3 — Back binding post (E. F. Johnson 111-303).
M1 — 0-1 dc milliammeter.
P1 — fused plug.
R12 — 50-watt rheostat (Ohmite 0327).
S1 — Spst toggle.
T1 — Power transformer: 600 volts, center tapped, current rating unimportant (Knight: Allied Radio 54 A 3704).



A side view of the silicon-diode PIV checker. The bracket used to mount the capacitors at the right is homemade from a piece of scrap aluminum.

2, most of the smaller components used in the tester are mounted on a 3 x 4 3/4-inch etched circuit board. One-half-inch threaded spacers are used to raise T1 and the circuit board above the floor of the cabinet. T1 is mounted in this fashion because the leads of the transformer used exit from the bottom of the transformer case. A homemade bracket is used to hold C7 and C8 in place. A sheet of spongy material between the capacitor nearest the back of the cabinet and the rear wall of the cabinet insures a snug mounting.

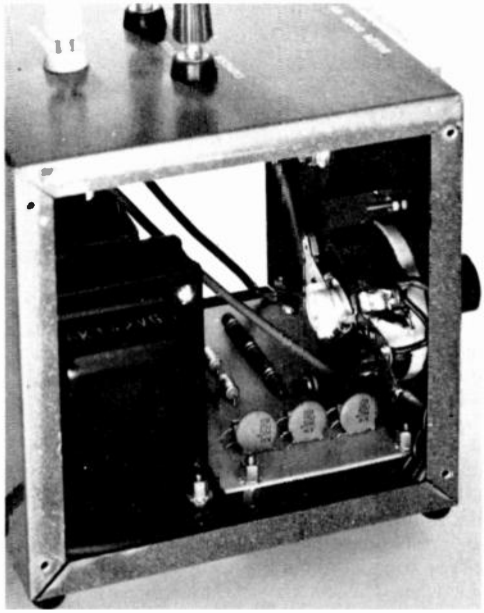
Operation

To use the checker, turn R12 to its zero voltage position and connect a voltmeter as indicated in Fig. 1. Of course, the voltage range of the voltmeter should be greater than the assumed PIV rating of the diode to be checked. When connecting the diode (CR7) to the checker, be sure the anode of the diode goes to the *negative* (chassis) side of the output. Otherwise, the checker will indicate that the diode is a dud.

Now slowly advance R12 until M1 just starts to indicate current flow. You can then read the avalanche voltage of the diode on the voltmeter. The PIV rating of the diode is slightly lower than this value.

The pointed end of the bullet-shaped capsule encasing an epoxy diode usually indicates the cathode terminal. However, these diodes are sometimes supplied with the polarity reversed. Therefore, if the checker should indicate that an epoxy rectifier – or any other type, for that matter – is a dud, reverse the connections to the diode. More often than not, the diode will be found to be good.

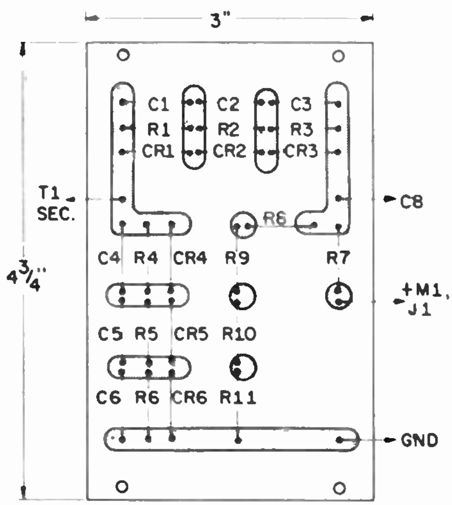
The cost-per-volt of diodes rises sharply with PIV ratings greater than 1000 volts. Furthermore,



A look at some of the innards of the diode tester. The rheostat at the right may seem to have a much higher wattage rating than the checker circuit requires. It doesn't though; R12 is the lowest-wattage unit that can be used without having its power rating exceeded when the control arm is near the maximum output setting of the rheostat.

high-voltage diodes require high-voltage shunt capacitors. I have found that the most economical rectifier string can be assembled from diodes having an 800-PIV rating. Therefore, the secondary of T1 can be as low as 450 volts, and you will still be able to check PIV ratings in excess of 1000 volts. This also lowers the required voltage ratings of C7 and C8 to about 1500 volts. – *Wilson Doty, WA4DID*

Fig. 2 – Circuit board layout. See Fig. 1 for component values.



FOIL SIDE SHOWN.
NON-ETCHED AREA SHADED.
COPPER STRIPS ARE 1/4" WIDE.
DWG. IS 1/2 SCALE.

A SIMPLE FET DIPPER

Most solid-state dippers use a diode to rectify the rf energy present at the collector or drain terminal of the oscillator. The rectified rf is used to drive a dc amplifier, and the amplifier operates a meter. This technique is fine provided the dipper is not coupled too tightly to the circuit under test, a condition which can cause the rf voltage to fall below the conduction point of the diode – approximately 0.4 volt for a germanium diode, and 0.6 volt for a silicon diode. When the diode no longer conducts, the meter indication falls to zero, thereby preventing one from obtaining a reading.

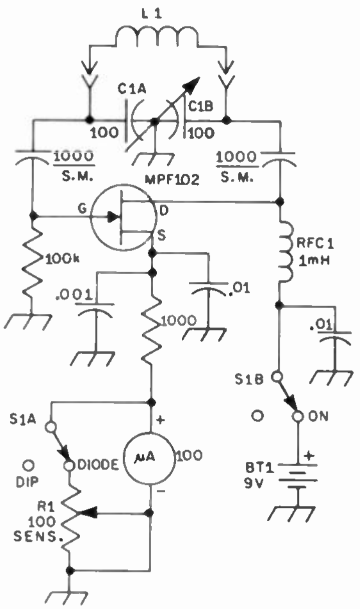


Fig. 1 – Schematic diagram of the FET dipper. Fixed-value capacitors are disk ceramic unless otherwise noted. SM = silver mica. Capacitance is in pF except decimal values which are in μF. Resistance is in ohms. K = 1000. Fixed-value resistors are 1/2-watt carbon types.
BT1 – Small 9-volt transistor-radio battery.
C1 – 100-pF per section miniature air-variable.

The circuit shown was tried, and the performance was good. There are no dead spots in the tuning range, and a pronounced dip in meter reading can be obtained without experiencing diode "dropout." Changes in drain current are observed on a 100-μA meter. When S1 is placed in the DIODE position, the instrument can be used as an indicating wavemeter. In this mode the source-gate junction rectifies the sampled rf to provide an indication on the meter.

Keep all leads as short as possible to assure proper frequency coverage at the upper end of the operating range. James Millen GDO plug-in coils can be used if purchased as blanks and wound to the specifications given in the coil table. – *WICER.*

COIL DATA

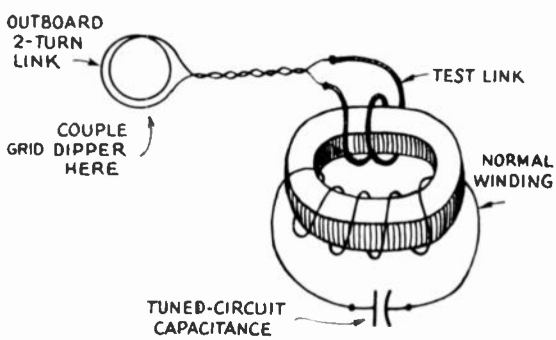
Freq. Range (MHz)	*L1 (μH)*	*Turns*	*Enam. Wire Guage*
1.5-3.4	220	214	No. 34
2.7-6.0	70	125	No. 34
4.8-10.2	22	58	No. 30
8.7-19.0	7	34	No. 22
18.0-40	1.6	16	No. 18
35-80	0.4	8	No. 18
70-160	0.1	hairpin 5/8 × 2"	No. 10

Coils for the FET dipper (except 70-160-MHz inductor) are wound on 5/8-inch-diameter polystyrene tubing. James Millen 74012 forms (blanks for the coils used with the Millen dipper) are available from the company by ordering direct – 150 Exchange St., Malden, MA 02148. The plug-in forms are 5/8-in. diameter and are 2 1/2 inches long. The two low-band coils have windings which occupy 1 1/2 inches (close-wound). All others (except the high-band hairpin) occupy 1 inch on the form, turns spaced where applicable.

GRID-DIPPING TOROIDAL-WOUND INDUCTORS

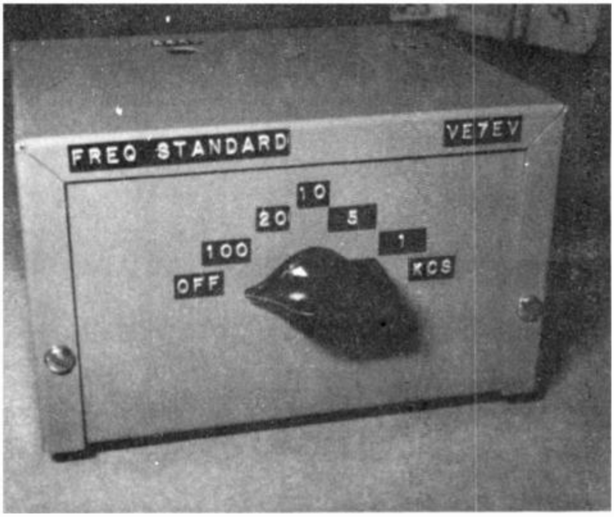
Because of the self-shielding properties of toroid coils, it is either difficult or impossible to check for resonant frequencies with a "dipper." In some instances it may be possible to obtain a reading on the dipper by virtue of stray capacitive coupling, but the dip will be rather broad and difficult to discern. The accompanying drawing shows a simple way to check tuned-circuit resonance when working with toroidal inductors.

The toroid coil under test is connected to its circuit points, and whatever series or parallel *C* it is used with should be included in the circuit. A one- or two-turn link is looped through the toroid core, then connected to an outboard link of the same number of turns. The dipper is then coupled to the outboard link to obtain a resonance check. – *WICER.*



A SECONDARY FREQUENCY STANDARD

The unit described here, and the alternative less complex circuits, are the result of a search for an inexpensive secondary frequency standard. Many



The deluxe frequency standard has the minimum of controls. One switch applies power and selects the desired output. The hole which is just visible at the top of the box is for the adjustment of the crystal to one of the WWV frequencies.

frequency standard circuits have been presented in trade periodicals, but none, to the author's knowledge, has made use of the low-cost Fairchild MSI Integrated Circuits. Most circuits have made use of a multiplicity of *J-K* flip-flops, and in order to obtain a 1-kHz marker something on the order of nine chips usually were required. Compare this with the Fairchild TTNL/MSI 9350 which in one chip gives a choice of a divide by two, divide by five, or a divide by ten counter. Put two units in series and drive them from a 100 kHz multivibrator crystal oscillator, and you have a frequency standard giving 1-kHz markers at an average cost of $3.30 (Canadian) per decade circuit! Contrast this with the final cost of a similar unit employing individual *J-K* flip-flops and you will soon appreciate the simpler, less expensive approach.

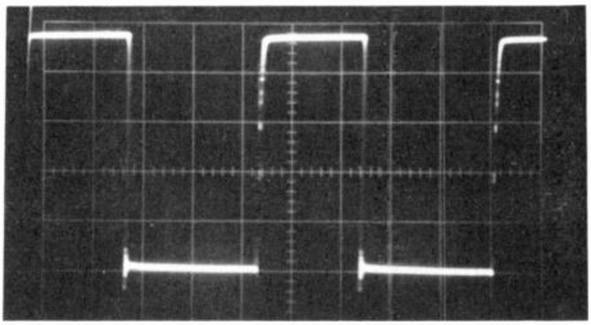
The unit described here provides strong marker signals at 100-, 20-, 10-, 5- and 1-kHz intervals well into the hf range. By a wiring change to the decade connections (see Fig. 2), the unit will easily provide alternative output ranges of 100, 50, 10, 5, 1 or 100, 50, 10, 2 and 1 kHz. Using the divider circuits of Fig. 2, and employing only a single decade divider with a crystal oscillator, one may construct an extremely simple standard. By using a switch in the deluxe unit to select the external decade connections, one could provide an even greater choice of markers, including all points already mentioned.

Circuit Descriptions and Construction

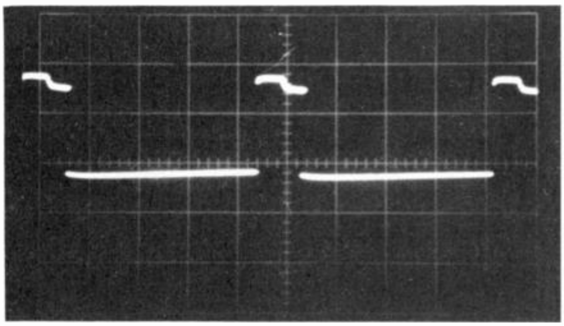
The unit in Fig. 1 employs a pair of Fairchild decade dividers driven by a multivibrator type 100-kHz crystal oscillator using an International Rectifier 2-input quad NOR gate. This oscillator could just as easily have been a Fairchild 9914 two-input gate or a Motorola HEP580. The IR brand IC was already available, therefore it was used. It also offers the advantage of having two extra gates, one of which has been grounded to provide isolation between the oscillator and the first decade divider. The 4-pole, 6-position switch was made up from spare wafers already on hand. Ready-made units are available, but too expensive to buy. I recommend that a multipole switch be employed to disable the idle decades, as they draw approximately 20 milliamperes each when they are activated, though not used.

The unit was built into a Hammond 1411L Handy Case having the dimensions HWD 5 × 4 × 3 inches. A Bud CU-2105-A is the same size.

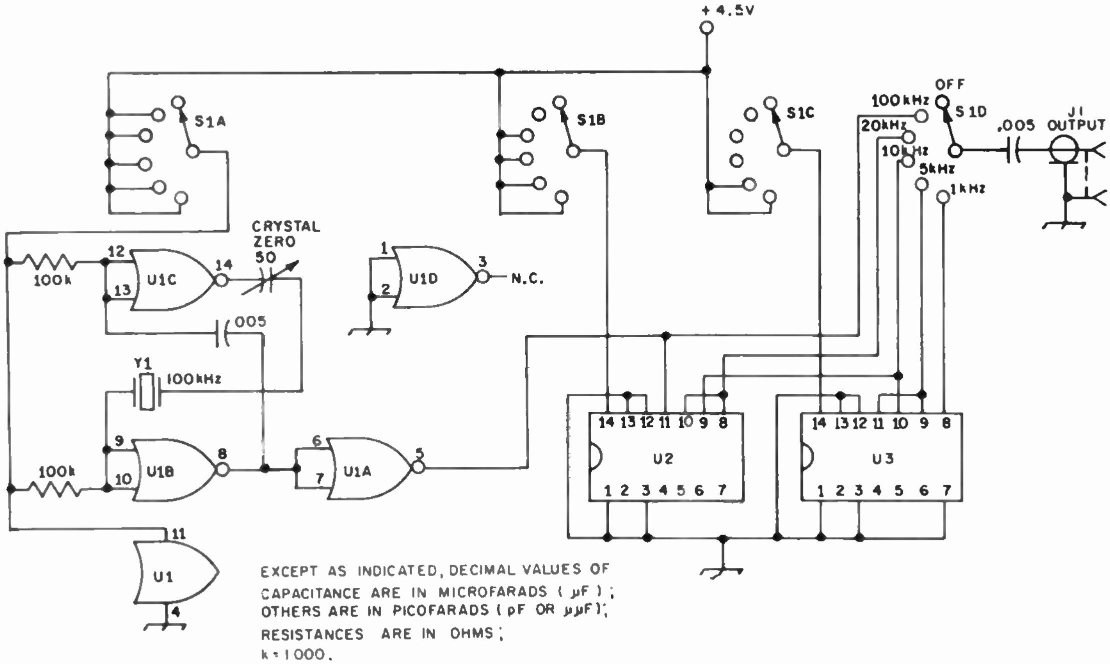
The three ICs, the trimmer capacitor, and the crystal socket were mounted on a perforated board, 3 × 3 inches, with plated holes. IC sockets were mounted on the board by cutting two thin slits with a motor tool and fine cutter. The slits are just wide enough to accept the pins of the IC sockets on a press-fit basis and are anchored firmly in place by the point-to-point wiring. The board is mounted on the bottom of the containing box using 4-40 screws which allows just enough clearance for the wiring. The holder for three penlight cells is mounted in the lid of the box. The general construction should be clear from the photographs. Hammond 1421T3 self-adhesive rubber feet were affixed to the bottom of the box to prevent scratching of the operating



The 100-kHz square-wave output signal from the standard.



The 1-kHz output of the frequency standard.



▲ Fig. 1 — The circuit for the deluxe frequency standard shows the advantage of using ICs, which requires a minimum of components. S1 selects the desired output marker while energizing the necessary portions of the dividing chain.

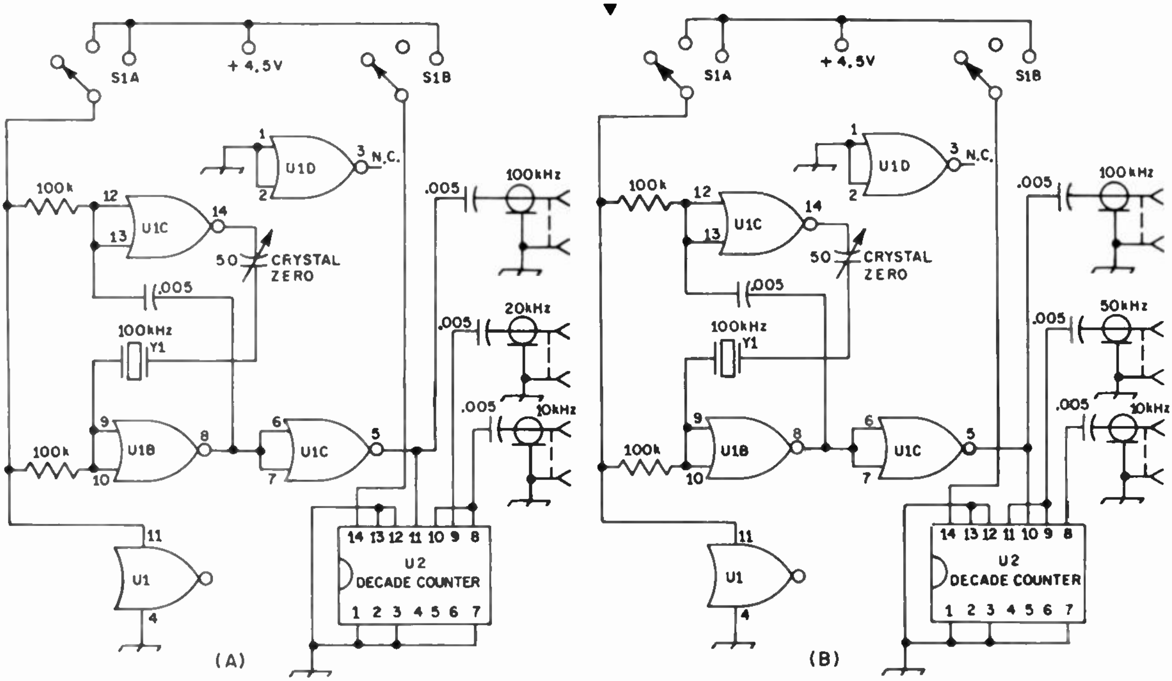
U1 — Quad 2-input NOR gate (International Rectifier IC724-C or equiv.).

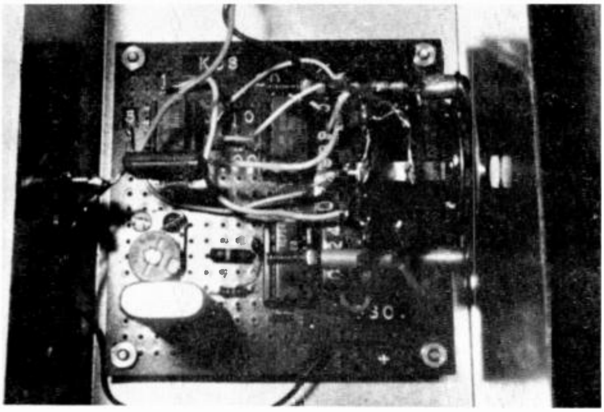
U2, U3 — Decade counter (Fairchild MSI9350 or equiv.).

S1 — 4-pole, 6-position rotary, nonshorting (Centralab PSA-211 or equiv.).

Y1 — 100-kHz frequency-standard crystal (Peterson Radio Z-6A or equiv.).

Fig. 2 — Alternative connections for a frequency standard if the 5- and 1-kHz outputs are not desired. One IC has been eliminated, and a 4-pole 6-position switch for S1 is not used, further reducing the cost of the inexpensive standard. ▼





A top view of the frequency standard shows the placement of parts. The 100-kHz crystal and its trimmer are located at the lower left. The frequency selection switch is at the center, right.

table. An access hole in the top of the box permits adjustment of the standard to WWV frequencies.

Economy Circuits

Figs. 2A and 2B show two economy versions of the standard. Fig. 2A provides 100-, 50-, and 10-kHz markers, while Fig. 2B provides 100-, 20- and 10-kHz calibration points. Construction of either unit should follow the more deluxe model, except that economy in these units is maintained by bringing the output markers to separate jacks, rather than using an expensive multipole switch.

A word of advice: the decades will not switch with less than 3 volts, but no attempt should be made to feed them with a voltage greater than 5 volts. Three penlight cells perform the task admirably.

I would like to acknowledge the assistance of Albert Harskamp and Brian Ounsted of Total Electronics, who assisted in my search for the correct IC units, and to Darrell Greenwood who took the photographs. – *A.C. Beresford, VE7EV*

THE COMPACT-A-TEST[1]

Many test instruments ahve been designed for radio amateurs use, and if all were to be built a great deal of expense would bee incurred, particularly for meters in things which are only used occasionally. Individual units take up a fair amount of space in the shack. In view of these considerations a basic design was drawn to find how many functions would be practicable in a compact switchable instrument.

Having an 8 1/2 X 4 3/4 X 3-inch box available, all that remained was to find out just what could be fitted into it. A 6-position, 8-pole, 4-section switch, S1, was used as a means of function selection. (See Fig. 1.) A field-strength meter with a-m phone-monitor facilities was the first unit built. A transistor-radio type telescopic antenna was added for making more distant measurements. Apart from using the coil L1 as a pickup medium, a link was connected to a coaxial socket so that a probe could also be used. Construction information for the probe is shown in Fig. 2.

The second unit built was a grid-dip meter. This oscillator also drives the third unit, an antenna impedance bridge. A tube oscillator is used. (A transistor oscillator would perhaps have been more convenient but would not have provided sufficient drive.) The coil, L1, is wound to suit the frequency to be covered, and is tapped at 1/7 of the total turns from the cold end to provide a cathode tap for the 6C4 tube. The tap can be used to feed the diode of the field-strength meter in place of the link, L2, which is shown in Fig. 1. The probe output and telescopic antenna are switch-connected to the circuit to widen its use.

The third function is that of an antenna impedance bridge. The bridge is driven by the GDO by means of the probe link coil, L2. The circuit whose impedance is to be measured is connected at J3. The bridge may be calibrated by means of known-value composition resistors placed across this jack, and the range is approximately 10 to 500 ohms. The meter is driven to full scale by advancing the GDO gain control, R1, and when the bridge knob is turned, a null or dip in meter reading will be noted. The impedance is read off against the calibration. The 150-pF differential capacitor must be insulated from the chassis and also shielded from the rest of the circuit.

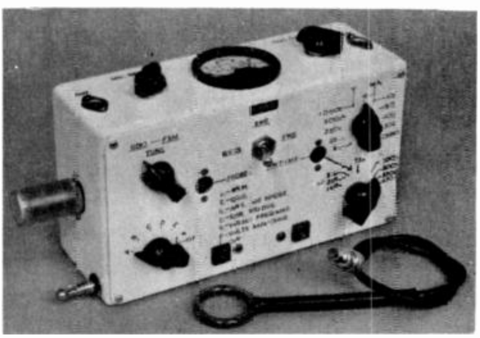
SWR Indicator, Frequency Marker

The fourth function is that of a standing-wave-ratio indicator. This circuit is built into the top 8 1/2 X 3-inch face which contains the SWR-meter gain control and GDO gain control, together with the input and output coaxial sockets for the SWR indicator. The FORWARD/REVERSE switch is on the front panel. SWR is determined by the following ratio:

$$\frac{FWD + REF}{FWD - REF}$$

First, drive the meter to full scale by adjusting the gain control, R2, using the FORWARD position of

[1]Adapted from *The G5PP Compact-A-Test*, published by the Midland Amateur Radio Society.



The Compact-A-Test, a device which performs many functions while using a single meter. The probe is seen in the foreground, and the telescoping antenna and probe-link coil are seen on the left end of the instrument.

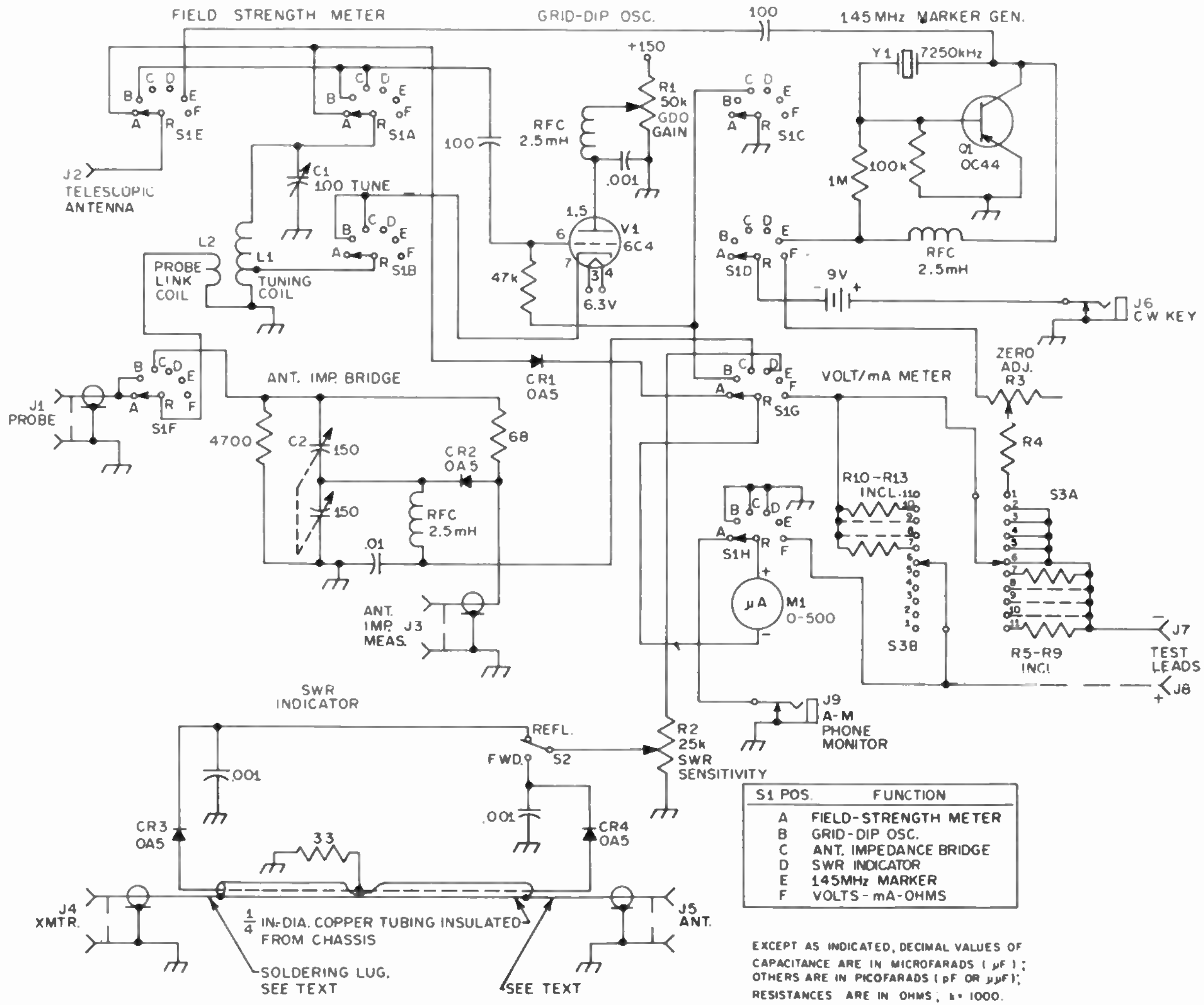


Fig. 1 — Schematic diagram of the Compact-A-Test. No connections are made to those terminals of S1 and S3 which show no connecting wires. Components not listed below are for text reference.

CR1 CR4 incl. – Small-signal germanium diode (OA5 or 1N34A).

J1, J3, J4, J5 — Uhf coaxial receptacle, type SO-239.

J2, J7, J8 — Single-contact receptacle.

J6, J9 — Phone jack, single-circuit, shorting.

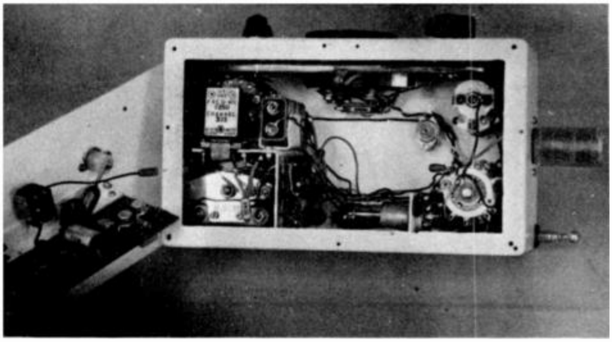
L1 — Wound to suit desired frequency coverage (see text). Winding form is 3/4-inch dia., 1 3/4-inch long. Tap connected 1/7 of total turns from "cold" end.

L2 — 10-turn link, wound over L1.

Q1 — Germanium npn rf transistor (OC44 or Motorola HEP 640).

R1, R2 — Linear-taper composition, low wattage.

S2 — Spdt.



The interior of the Compact-A-Test. In this view S1 is visible in the lower-right corner of the enclosure, with C1 positioned just above it. In the lower-left corner is the 145-MHz marker generator circuit, and partially hidden by the crystal, is S3. The copper tubing in the SWR-indicator circuit is seen along the top edge of the enclosure. The two-tone oscillator board is visible on the side panel.

the switch. This value will be read as 1. A second reading is now taken with the switch in the REVERSE position. If this was, say, 0.2, then using the formula, the SWR would be:

$$\frac{1 + 0.2}{1 - 0.2} = \frac{1.2}{0.8}$$

or a ratio of 1.5 to 1.

The reflectometer pickup line is made from 1/4-inch OD copper tubing approximately 9 inches long. A solder lug is attached to each end of the tubing. The hole in each lug fits over the center conductor of the coax sockets, and is soldered there. The tube is bent to fit between the box flange and the meter. At the exact center of the tube the metal is filed away on one side to form a slot in the wall of the tubing. The inner core of a length of 1/4-inch coax is now fed through the tube from each end and brought our via the slot in the center. The center of this coax inner conductor is returned to the chassis through a 33-ohm resistor. The far ends of this conductor connect to the diodes.

The fifth unit is a 145-MHz frequency marker. This consists of an OC44 transistor oscillator, with its 20th harmonic falling at 145 MHz. The signal is quite readable on this frequency and is also usable in the 70-cm band. The telescopic rod is used to radiate the low-level signal. By keying the battery lead, cw is obtained for Morse code practice and is receivable on 7250 kHz, or at any harmonic thereof.

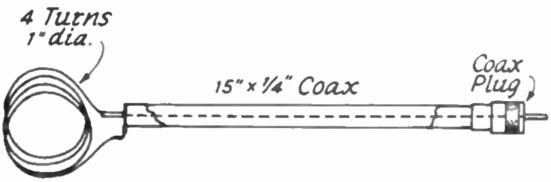


Fig. 2 — The probe is constructed from 1/4-inch diameter coaxial line such as RG-58/U. The shield is stripped from the coax and the center conductor is used to form the four turns.

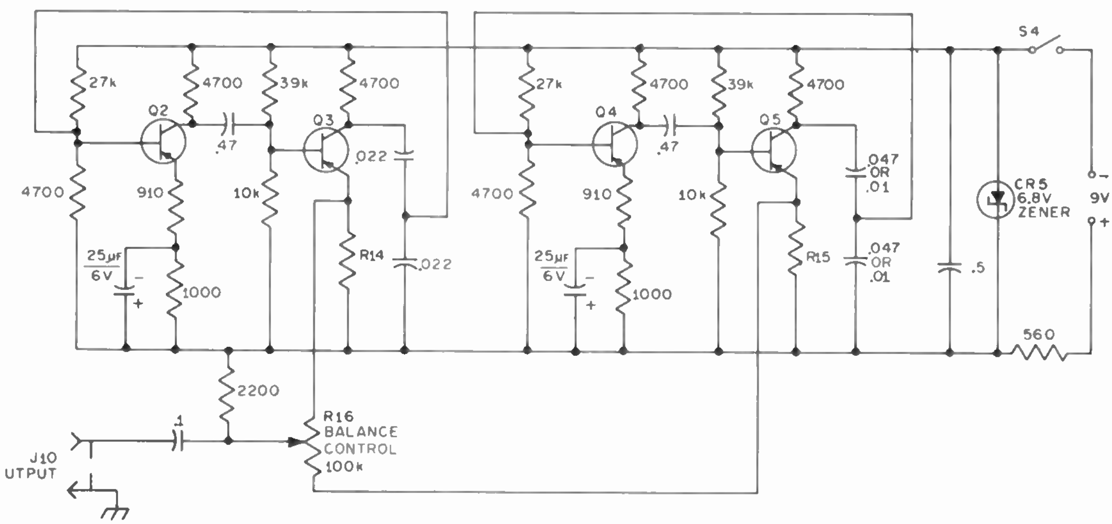


Fig. 3 — Two-tone oscillator.
J10 — Phono jack.
Q1 — Q5 incl. — Silicon pnp audio or rf transistor (BCY30 or 2N4059).
R14, R15 — Approximately 3000 ohms. Determine value experimentally to give sine-wave output.
S4 — Spst.

The last unit controlled by the 6-position switch is a voltmeter/milliameter and short-circuit tester. This could be calibrated for ohms, if required. The voltmeter series resistors and the current-metering shunt resistors can be calibrated by Ohm's law to individual requirements, taking into account the resistance of the meter itself.

Having completed the units and checked that they worked, it was found that a large vacant space remained in the middle of the box. At the suggestion of G3OVQ, who kindly supplied the circuit, a two-tone oscillator was incorporated and made to fit into this space. See Fig. 3. This all-transistor unit is powered from the internal 9-volt battery, the negative lead being picked up with a small plug and socket, and fed through an ON/OFF switch.

Switch Functions

Perhaps the easy way to understand the wiring is to follow the switching functions which are next described.

Position A: FIELD-STRENGTH METER AND A-M PHONE MONITOR: The coil and tuning capacitor are connected to the OA5 diode, then through the meter and closed-circuit jack to ground. The probe circuit is energized from the link coil and the telescopic antenna is connected.

Position B: GRID-DIP OSCILLATOR: The coil and tuning capacitor are now connected to the 6C4 grid capacitor. The coil tap is connected to the cathode. The grid lead is returned to ground via the meter, whose positive terminal is grounded. The probe circuit is energized from the link coil, and the antenna is connected.

Position C: ANTENNA IMPEDANCE BRIDGE: The meter is switched to the output of the bridge diode. The 6C4 grid resistor is returned directly to ground. Output from the GDO (which remains operative in this switch position) is used to drive the bridge, again using the link coil which feeds the probe in positions A and B. The connection to the bridge for measuring the antenna impedance is made at J3. The impedance value is read on the calibrated dial associated with C2. The drive to the bridge is controlled by the GDO gain control, R1.

Position D: STANDING-WAVE-RATIO INDICATOR: The meter is transferred to the output of the two rectifiers, CR3 and CR4. The transmitter and station antenna are connected together by means of coaxial sockets, J4 and J5. Full-scale deflection in the FORWARD position is obtained by advancing the SWR sensitivity control, R2. The SWR is determined as outlined previously.

Position E: 145-MHZ FREQUENCY MARKER: The meter is not used in this circuit. The collector of Q1 is connected to the telescopic antenna, the 9-volt battery is switched on, and the key is plugged into the closed-circuit jack in the battery lead.

Position F: VOLTS - MILLIAMPERES AND SHORT-CIRCUIT TEST: The meter is transferred to the voltmeter-control switch.

The negative battery terminal is connected in the short-circuit test position (ohms).

Conclusion

Having set out to save money by doing away with the extra meters that would be required for separate instruments and using only one for the complete set, it seems logical to isolate the meter completely from the other functions. In this way it may be used for any other purpose which may come along. This is done by moving the selector switch to position F and the mA switch to position 6. The meter is thus available at the test leads. – *Bob Palmer, G5PP*

A SIMPLE TRANSISTOR CHECKER

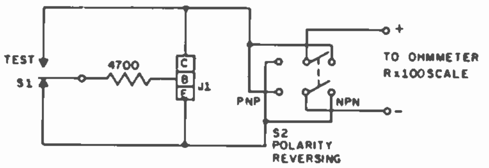
A quick and easy check of bipolar transistors can be made with an ohmmeter, using the device shown in the photo. The check will reveal whether the transistor is an npn or a pnp type, determine if it is germanium or silicon, and show that it is shorted, open, or "good." The checker may be used with either a VOM or a VTVM type of ohmmeter.

The voltage polarity at the ohmmeter terminals must be known, and connected as shown in the schematic. If the polarity is reversible by a switch on the ohmmeter itself, S2 may be eliminated from the checker.

This checker was constructed on an etched circuit board, with banana plugs spaced to mate directly with the ohmmeter terminals of the VOM. A polarity-reversing switch is contained on the meter, so none is required on the plug-in tester.

To check a transistor, simply plug it into the test socket, or else use clip-lead connections. Set the ohmmeter on the R x 100 scale, and set the polarity-reversing switch for the highest meter reading in ohms. This reading will be in the order of megohms for a good small transistor. The polarity setting now indicates the type of transistor, pnp or npn. To test the forward-biased condition of the transistor, depress S1, and again note the resistance. A good small silicon transistor will read in the range between 800 and 1000 ohms, germanium between 150 and 250 ohms. Power transistors will generally provide slightly lower readings than these.

If you're uncertain as to whether the transistor is a bipolar or an FET, this difference can also be



The transistor checker. J1 – Transistor socket. S1 – Spst momentary push. S2 – Dpdt slide or toggle; not required if voltage polarity may be reversed at ohmmeter.

detected. First of all, the "forward conduction" test of an FET will give a reading of several thousand ohms. With the transistor still connected for the test, reverse the polarity of the voltage as applied from the ohmmeter. The meter will normally read between 2000 and 10,000 ohms for a silicon transistor, and between 600 and 1000 ohms for germanium. Again depress the test switch. If the transistor is bipolar, the reading will go to megohms; an FET will give an almost unchanged reading.

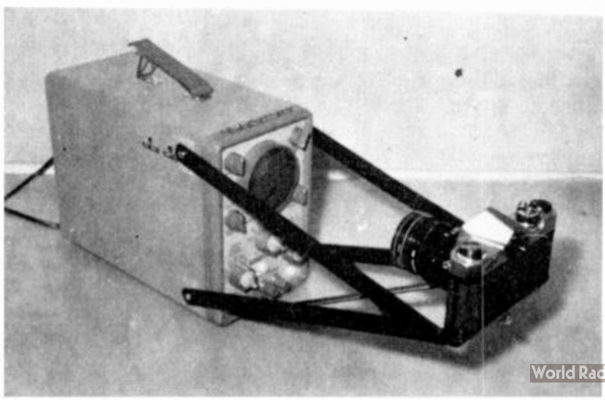
For a simple device, this one is quite handy for checking those surplus or junk-box transistors. – *K1PLP.*

AN OSCILLOSCOPE CAMERA ADAPTER

Do you need an adapter to fasten your camera to a scope? Here's one of welded steel strap for attaching a Pentax SP-500 35-mm camera to an EICO Model 435, 3-inch scope.

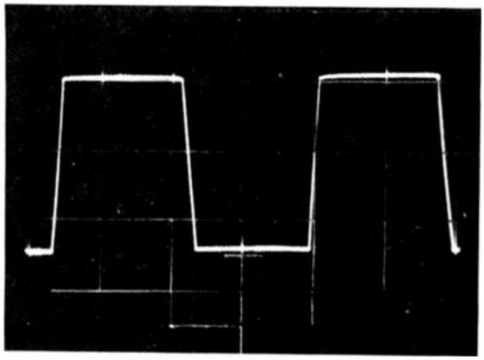
The adapter, made from 3/4 × 1/8-inch steel strap, is attached to the scope case by four 10-32 screws. The screws enter drilled and tapped plates which are mounted permanently in the scope case by pop-rivets. The camera rests on the adapter cross bar, a 1-inch-wide steel strap, and is attached by a 1/4-20 short wing-nut assembly. The attaching devices permit rapid assembly and disassembly as the need occurs.

View of the scope-to-camera adapter in place on the EICO oscilloscope.



The author (after experimenting with different close-up lenses) uses a +2 close-up lens mounted by a retaining ring and lens hood at the front of the camera's 55-mm lens. The +2 lens enables reasonable camera-to-scope distance while permitting maximum scope image size on 35-mm format. In this case, the 3-inch scope bezel's outer surface is just visible on the film. Good photos have been obtained with the following settings:

Scope brilliance control:	Visible waveshape to just below blooming.
Lens opening:	f/2.
Shutter speed:	1/8 second.
Film:	Plus-X (ASA-125).
Developing:	D-76 (diluted 1:1) 6 min. at 72 degrees Fahrenheit. Kodak variable contrast paper (No. 3-1/2 filter at 6 seconds).



Photographic results of camera and adapter properly built and focused.

These settings are approximate, but do represent a starting point.

If bright light is not permitted to fall on the front of the scope, a light-excluding tube from the scope bezel to the camera lens is not necessary for good photos. On the other hand, excessive scope brilliance that causes blooming will cause rather poor exposures.

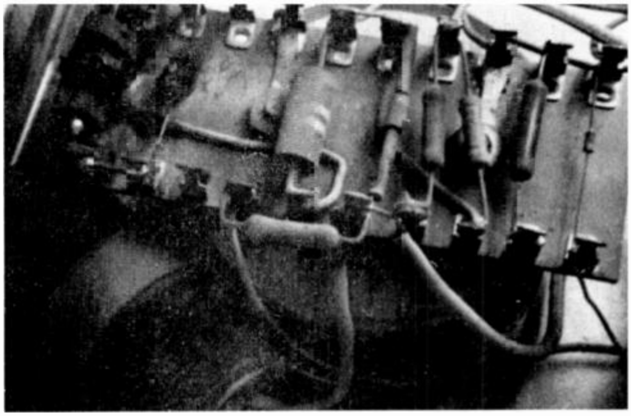
Different cameras, films, and scopes will require slightly different design approaches. For any particular application, the design and use should emphasize low cost, rigidity, reasonable size, avoidance of stray light, minimum usable scope brilliance, and proper exposure obtained by experiment. In addition, the adapter should be designed so that the optical axis of the camera is centered on the scope tube and the camera-to-tube distance is such that a little focusing ability remains in the camera lens (don't rack the lens all the way in or out when establishing lens-to-scope distance).

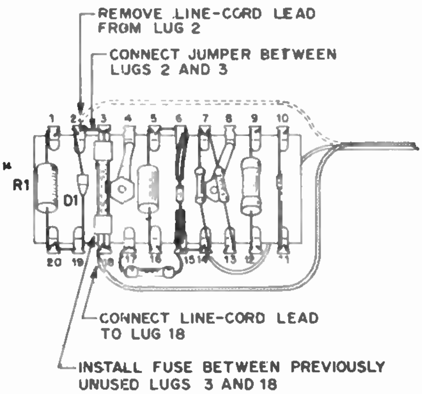
For your adapter, mock it up on a bench, check image size, take a few photos, check dimensions, then design and build it. Lots of luck. – *C. A. Stiles, Jr., ex-K5MRK* for Test Equipment

FUSE PROTECTION FOR THE HEATH LINE-VOLTAGE MONITOR

Most equipment which is connected to the 117-V ac power line for operation is fused for protection against damage which may otherwise result if an internal short develops. The Heath[1] IM-103 line voltage monitor has no such protection. (The basic diagram of the circuit appears in *QST* for September, 1972, p. 55.) The accompanying photograph shows what the inside of my monitor looked like after a short developed in the rectifier diode, D1. The 100-ohm, 2-W resistor, R1, shown at the left of the terminal strip in the photo, is charred, and soot is depositied over everything else inside the enclosure. Surprisingly, all other components were undamaged except the terminal strip itself, which was burned away beneath R1.

R1, D1, and the terminal strip were replaced, and all other parts were stripped from the monitor and thoroughly cleaned before the assembly was rebuilt. I decided I didn't want to repeat that tedious task if a similar short should reoccur, so I found a simple solution. A fuse may be added to the terminal strip and only one wire need be moved to complete the modification. The accompanying sketch shows how the fuse may be installed. A pig-tail fuse may be used, but I removed the clips from an old fuse-clip assembly and soldered them directly to the lugs of the terminal strip. The spacing between the lugs is more than adequate to install the standard-size 1-1/4-inch glass fuse. I used an AGC-type 1/4-A fuse, but an MDL (slow-blow) 1/4-A size would be better. For highest accuracy of the monitor indication, it should be recalibrated after the fuse is installed, as low-current fuses have inherent resistance. – *K1PLP*





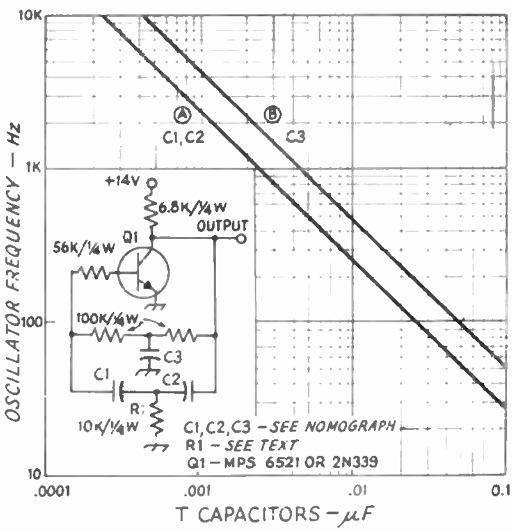
Modification to install fuse in Heath IM-103 Line Voltage Monitor.

A SIMPLE AND STABLE TRANSISTOR AUDIO OSCILLATOR

In this day of remote control, autopatches, and repeaters, there is a need every once in a while for a simple, stable, audio oscillator. The design for such an audio oscillator was drawn up based on articles written by Maynard, "Twin-T Oscillator," *Electronics World*, August, 1968, and Antanaitis, "A Simple Two-Transistor A.F.S.K. Generator," *QST*, September, 1969. The criteria for the oscillator was that it should be small, and that a number of them could be interchanged quickly from a given connector. The audio oscillator was built on a circuit board designed so that it could be plugged into an Amphenol 143-006-01 circuit-board socket (see photograph).

The circuit is shown in the figure, and the attached nomogram is used to help choose the design frequency which depends upon the chosen values of C1, C2, and C3. Several transistors were tried and the choice of transistor did not seem critical. Of those that were tried, the 2N339 appeared to be a good substitute for the MPS6521.

Several audio units were built. The frequency of each was checked with a frequency counter. It was found that their frequencies would vary approximately 0.1 Hz around the design frequency. If R1 were replaced with a 50,000-ohm control, the oscillator would tune as much as 1500 Hz from the design frequency. – *Bob Tarone, WB6ZBX, and Dean W. Larson, W6HAB.*



[1] Late models have a fuse included.

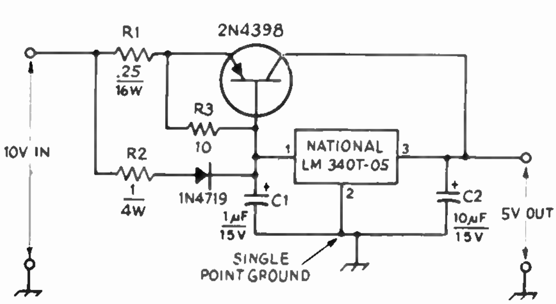
for the Power Supply

IMPROVED REGULATOR CIRCUIT

While many amateurs are now using integrated-circuit voltage regulators, an external current-boosting transistor is usually required to increase the regulator current capacity. Normal current-boosting schemes, however, require additional active devices to duplicate some of the worthwhile regulator safety features (short-circuit protection, safe-operating area protection, and thermal shut-down). Here is a regulator circuit which retains these safety features through a current-sharing design. This regulator, intended for TTL circuits, has an output of 5 volts at 5 amperes, and a typical load regulation of 1.4 percent.

R1 and R2 provide the necessary current division (assuming the transistor base-emitter voltage equals the diode drop). The voltage drops across R1 and R2 are equal, and the currents through R1 and R2 are inversely proportional to their resistances. In this circuit, R1 has four times the current flow of R2. For reasonable values of beta, the transistor emitter current will approximately equal its collector current, while the current through R2 will equal the current through the regulator. Under overload or short-circuit conditions, the protection circuitry of the regulator not only limits its own output current, but that of the external pass transistor too.

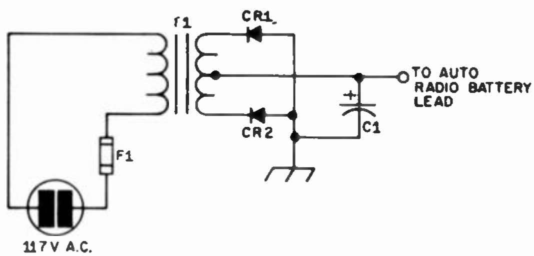
Thermal overload protection is extended to the external pass transistor when its heat sink has at least four times the capacity of the regulator (this is because both devices have almost the same input and output voltage and share the load current in a 4:1 ratio). For optimum current sharing between the regulator and transistor as temperature changes, the diode should be located physically near the pass transistor so its heat-sinking arrangement keeps it at the same temperature.



If the National LM340T regulator is used and mounted on the same heat sink as the transistor, the regulator should be electrically isolated from the heat sink as its case (pin 3) is grounded while the case (collector) of the transistor is at the regulator output potential. C1 prevents unwanted oscillations, while C2 improves the output impedance of the overall circuit. R3 is used to unload the excessive charge in the base region of the pass transistor when the regulator suddenly goes from full load to no load. The single-point ground system allows the regulator sense terminals (pins 2 and 3) to monitor load voltage directly rather than at some point along a possibly resistive ground-return path carrying up to 5 A of load current. – *William R. Clabo, K9ASL/8*

117-VAC OPERATION FOR CAR RADIOS

A simple power supply can be constructed and installed permanently in the car to allow operation of the radio on either 117 Vac or 12 Vdc. No switching is necessary. Just plug in the ac cord when 117-volt operation is desired. – *W1NPG*



Schematic diagram of a simple power supply for operating a car radio on 117-Vac. The output of the supply can be permanently attached to the battery lead connection on the radio.

C1 – 500-µF, 50-V electrolytic.
CR1,CR2 – 100 PRV, 2.5-A diode.
F1 – 2-A fuse.
T1 – 25.2-V, 2-A filament transformer (Triad F-41X).

INSULATION FOR HOMEMADE TRANSFORMERS

For insulation between layers of turns in a homemade transformer, the plastic bags used for roasting meats, manufactured by Reynolds Metals Company, work well. The trade name is "Brown-In-Bag" and the material is slightly over .001 inch thick. Of course, the material will withstand high temperatures. No tests have been made to determine the voltage breakdown point, but I have used this material successfully with transformers up to 750 volts rms. – *W. Vollkommer, W2HO*

INCREASING PLATE VOLTAGE

A "smoke test" recently led to disastrous results in one of my power supplies. Among other things, the plate transformer burned up. The closest replacement I could locate was 100 volts short of what I needed. As it happened, though, I had available a 50-VA isolation transformer which, when connected as shown in the diagram, provided the needed voltage. The bridge rectifier assured that the voltage from T2 added to the high voltage from T1. CR1 through CR4 are 200-PRV, 1-A, silicon diodes. The .01-μF capacitor is necessary to prevent switching transients from damaging the components.

No doubt this same arrangement could be used to advantage with other transformer voltages. Care should be taken, however, not to exceed the ratings of the main filter capacitor or other components. – *F. V. Kohl, W4NM*

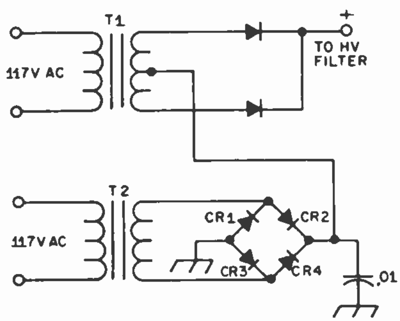


Diagram of the booster arrangement. Component designations are for text reference.

PREVENTING TRANSISTOR FAILURE IN THE COLLINS MP-1 MOBILE POWER SUPPLY

MP-1 mobile power supply owners are requested to make the following modifications to *Power Switching Relay K1*, in order to prevent ruining one or both of the oscillator transistors, because of high-voltage, short-duration, pulses generated by this relay. This modification applies to all supplies with the serial numbers *below 30332.*

Select a solid-state diode having at least a 200 PIV rating, with a forward- current rating of 400 mA or more. Then proceed with the following steps:

1) Remove the four cover screws, lift the cover and slide it back along the power cable.

Caution: When installing a diode, carefully observe proper polarity. To prevent heat damage, use a heat sink on the leads while soldering the diode in place.

2) Locate relay K1. Solder a diode (such as a 1N645 or equivalent) across the relay coil (cathode to the grey wire, anode to the yellow wire). Check that the cathode of the new diode, and the cathode of CR1 are wired together. In some power supplies, CR1 is a stud mounted type 1N1115 located next to fuse F1, in other supplies, CR1 is a small 1N4005 soldered between the coil and a contact on K1.

3) Add the modification to the MP-1 Mobile Power Supply schematic diagram.

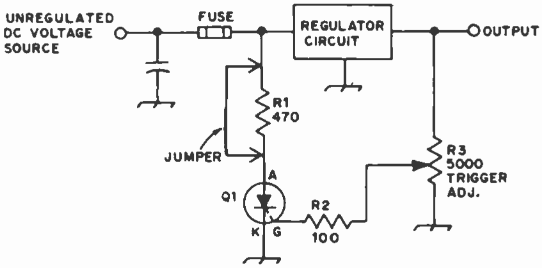
4) Replace the cover, and cover screws.

This information is being published in order to reach owners of the MP-1, who might not be on the records at the Collins Radio Co. – *Arnold Verdow, WØLIJ, Collins Radio Co.*

A CROWBAR CIRCUIT FOR POWER SUPPLIES

Much of the equipment being constructed today that uses solid-state devices requires a regulated supply voltage. Many of the more simple regulators are quite adequate, and the "on-card" regulators are becoming increasingly popular.

However, these simple regulators have one major problem area – if the series element shorts, the entire output from the rectifier will appear on the supply line feeding the equipment. Few of the ICs and transistors which are popular today will withstand such abuse.



SCR "crowbar circuit" for regulated power supplies. The device used at Q1 will depend upon voltage and current requirements. SCRs such as the HEP300, 302, or 304 are recommended.

The circuit shown will detect such an overvoltage condition and shut down the supply by blowing the fuse between the rectifiers and the regulator. Operation is quite simple; when the voltage at the output of the regulator reaches a value that will trigger the SCR, the SCR conducts heavily and the fuse opens. This configuration has the advantage of not overloading the regulator circuit if the SCR should fire because of some temporary condition. Such would not be the case if the SCR obtained anode voltage from the output side of the regulator.

To adjust the trip point of the crowbar, the jumper should be removed from across R1 and a voltmeter connected in its place. The regulator circuit should be adjusted until the output voltage is at the maximum value that is desired. If the regulator is of the nonadjustable type, substitute a voltage from another source, such as several flashlight batteries connected across a 25,000-ohm potentiometer. If the substitute method is used, R3 should be disconnected from the regulator output. When the voltage is of the desired maximum value, R3 should be adjusted until the SCR fires, as indicated by a sudden large increase in the voltage across R1. Check the setting several times. Note that you must remove power from the circuit to restore the SCR to the nonconducting state. When the adjustment of R3 is correct, place the jumper across R1, and connect R3 to the output of the regulator. The fuse should be of a value that is 50 to 75 percent higher than the maximum that will be furnished by the regulator. Note that the filter capacitor must be ahead of the fuse; otherwise the charging surge of current will blow the fuse when the supply is turned on. – *W1SL*

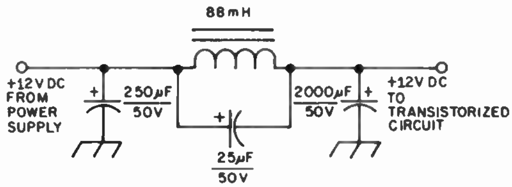
INCREASED VOLTAGE FOR TV-TYPE POWER SUPPLIES

Novice operator WN4SCF was running 40 watts with a junk-box rig consisting of a 6AG7 and an 807. The power supply used a TV transformer and a 5U4 rectifier. Since we wanted a Novice gallon, keeping within the tradition of building from the junk box, we decided to install a series of diodes in a bridge circuit across the 5U4 plate terminals on the tube socket. The addition of the diodes increased the plate voltage to 900 without a load, so a choke was installed to keep the capacitors from charging to the peak voltage supplied by the transformer. Using a 2-H choke, we reduced the voltage to 760. The modified power supply allowed us to load the amplifier stage to 75 watts input. – *Gerald L. Collins, W8BQE, and Frank Kendall, WN4SCF*

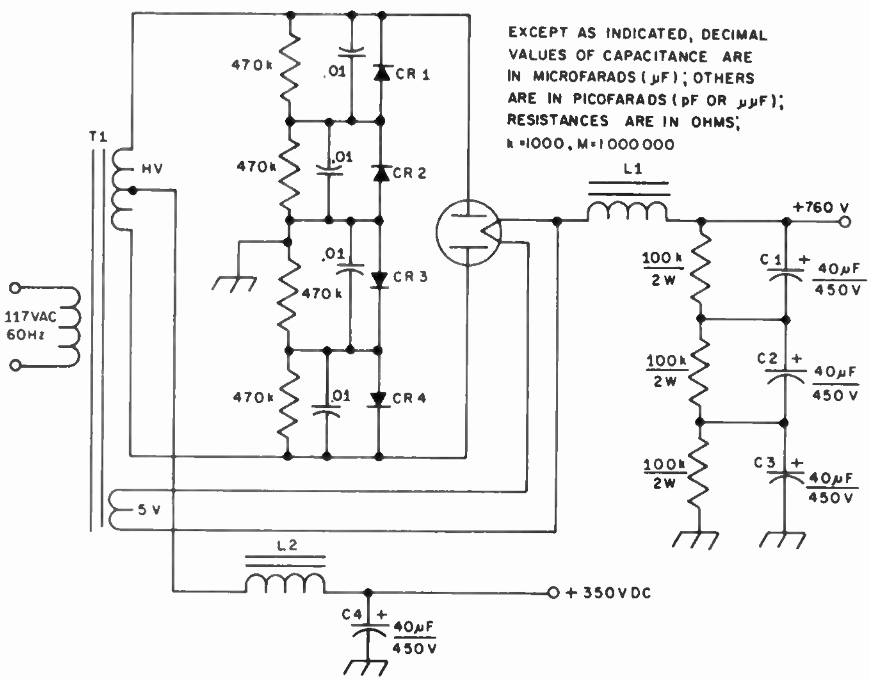
Circuit diagram for increasing the voltage of a tube-type full-wave rectifier power supply.
C1-C4, incl. – 40-µF, 450-V, electrolytic.
CR1-CR4, incl. – 600-PRV, 1-A silicon rectifier.
L1, L2 – 2-H filter choke, TV replacement type.
T1 – TV transformer.

REDUCING RIPPLE IN MINIATURE POWER SUPPLIES

When working with transistors, miniaturization is usually the keyword. For this reason you will seldom see a smoothing choke in the power supply of transistorized gear. Instead a resistor is substituted. This technique is fine for low current demands, but for higher values of current, the resistor degrades the regulation and causes a significant voltage drop. A simple cure is to use a tuned choke. An 88-mH toroid in parallel with a 25-µF capacitor presents a high impedance at 120 Hz, has an internal resistance of only 10 ohms, and can handle up to 200 mA of current. The component values given in the diagram have a resonant frequency of 106 Hz. With an audio oscillator and an oscilloscope or VTVM, the resonant frequency could be increased to that of the ac ripple by removing turns on the toroid. The filter values given reduce the ripple by a factor of 10 as compared to a filter using a 10-ohm series resistor. – *Richard M. Matteis, W4YAA*



The filter circuit.



CHARGING NICKEL-CADMIUM BATTERIES

Any advantage that a Nicad (nickel-cadmium) battery may have over other types can be lost through improper charging. Nicads can even be ruined on the *first* recharging cycle. If connected to a constant-voltage source, initial current may be quite high. Normally, no damage would result unless the battery voltage is low (fully discharged). Using a constant current for battery charging is permissible at the start of the charging cycle, however, as the battery reaches full charge, the voltage may rise to an excessive value.

The correct solution is a combination of the two methods. Any circuit used for charging Nicads should limit both the current and voltage, such as the one described here.

Some other precautions which should be observed while charging Nicads are:

1) Battery temperature should be between 40° and 80° F. It should never exceed 100° F.

2) Two or more batteries with the same voltage rating may be charged in parallel, but be sure that the charger has sufficient current capability.

3) Check the manufacturer's data sheet for the maximum allowable charging rate. A typical figure would be ten percent of the ampere-hour rating (a 10-ampere-hour battery would require a current of 1A).

4) Do not attempt to charge two batteries in series with a constant current unless the batteries are of the same type and capacity, and are in the same state of charge (voltage on one may be excessive).

5) To determine the approximate charging time, divide the ampere-hour rating by the charging current used, and multiply the resulting time by 1.25.

Suitable Charging Circuits

Figs. 1 and 2 show two versions of the same basic charging circuit. The circuit shown in Fig. 1 is used with 117 V ac, and the one in Fig. 2 can be used with the car battery. The latter circuit could be connected to the cigarette lighter, and is suitable for battery packs of up to 14 volts.

Two homemade walkie-talkies on top of their respective chargers. The batteries are left on charge continuously.

The dial lamp (DS1) is used to limit the current. One with a rating of 100 to 150 mA should work fine with most batteries. The voltage rating should be approximately that of the charging source (for example, two 12-V bulbs in series may be necessary if a 26-V supply is used).

The voltage-regulator shown in Fig. 3 is based on the fact that a forward-biased diode will not conduct until approximately 0.75 V dc is applied. By adding a suitable number of diodes in series as shown, a voltage regulator for the maximum

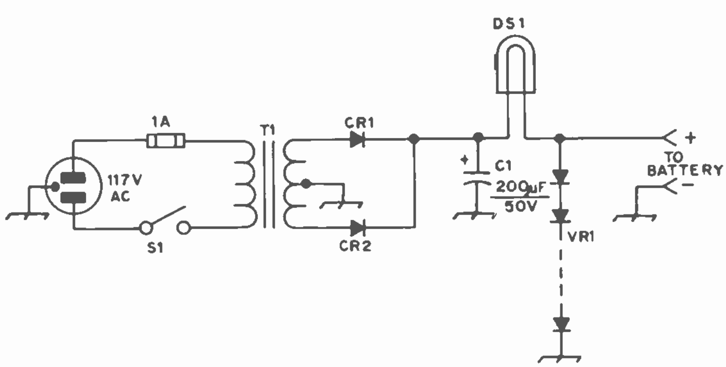
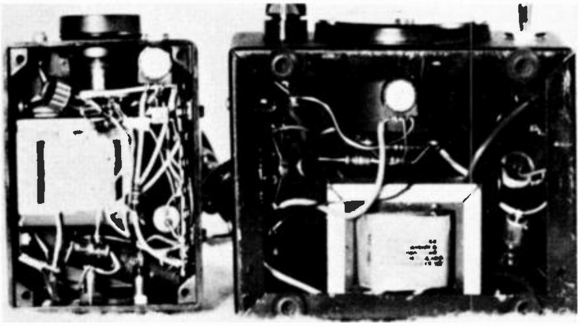


Fig. 1 — Schematic diagram of the 117-V ac charger.
C1 — Electrolytic.
CR1, CR2 — Silicon diodes, 100 PRV, 3 A.
DS1 — See text.
T1 — Primary 117 V ac, secondary 25.6 V at 500 mA. Calectro D1-752 (or equiv.).
VR1 — See text.



Bottom view of Nicad battery chargers.

battery voltage can be built easily. The circuit shown in Fig. 3 can be used in either Fig. 1 or 2, for VR1. It will draw little current until the battery voltage reaches a permissible value during charge. Once the voltage reaches a preset level, the diodes start to conduct and limit any further increases.

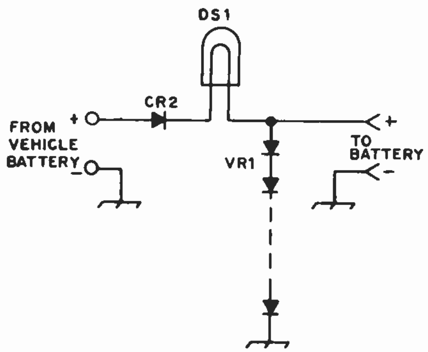


Fig. 2 – Schematic diagram of Nicad battery charger suitable for mobile use. See text for explanation of DS1 and VR1. CR2 protects the components in the event of accidental reversal of input leads. See Fig. 1 for CR2.

Initial Testing

After the circuit is wired and checked, apply power (without a battery connected for charging). The bulb should light to less than full brilliance. Measure the voltage across the regulator. It should be 3 to 8 percent above the rated voltage of the batteries to be charged. Adding and removing some diodes in VR1 may be necessary. Connect the discharged batteries and measure the charging current (either a built-in meter could be used as shown in the photograph, or a temporary one could be connected in series with the battery). The current should be typically 100 mA with partially discharged batteries. The current will decrease as the charging time increases, and a value of 5 mA indicates a fully charged condition. No damage will result if the batteries are left on charge continuously. – *Robert D. Shriner, WAØUZO*

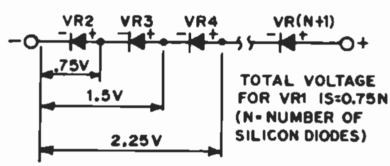


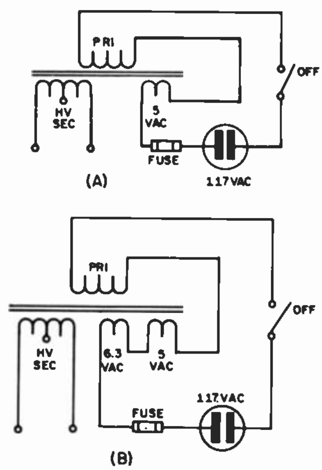
Fig. 3 – Schematic diagram of the voltage regulator (VR1, Figs. 1 and 2).

JUNK-BOX ZENERS

Recently I was in need of a low-voltage Zener diode and decided to check out all the transistors I had in my junk box. Some types worked fine; you even get two Zener voltages with one transistor as the Zener point of the base- collector junction is from the base-emitter junction. A handful of transistors will provide quite a range of Zener voltages, but on most types the current through the transistor can only be a small value. It should follow that the high-wattage transistors can be utilized in a like manner for high-wattage Zeners, but I have not tried them. – *Cal Enix, W8ZVC*

CHANGING THE OUTPUT VOLTAGE ON TV TRANSFORMERS

When using an old TV transformer in homemade equipment, the voltage may be somewhat higher than desired because of the increased efficiency of silicon-diode rectifiers, as compared with vacuum-tube recitifiers. Since there is usually a 5-volt winding not now being used, it can be wired into the primary circuit to either boost or buck the line voltage by 5 volts. The same thing can be done with an unused 6.3-volt winding. First, measure the secondary voltage of the power transformer with the 117-volt primary connected to the ac line. Then, connect the 5-volt winding in series with the primary. The output voltage will be approximately five percent higher or lower than before and if other than the desired condition exists, just reverse the 5-volt connections.



(A) The 5-volt winding in series with the primary.
(B) The 5- and 6-volt windings in series for added bucking or boosting.

Voltage boosting and bucking can be carried further by using the 6.3-volt winding with the 5-volt winding. First, after connecting the 5 and 6.3-volt windings in series, check the voltage to insure the two voltages are adding to approximately twelve volts. If the windings are bucking each other, the measured voltage will be about 1.3 volts and one winding should be reversed. The twelve-volt winding may now be used for bucking or boosting, as outlined above. – *Peter Stevenson, W4DUL.*

[EDITOR'S NOTE: When bucking or boosting the primary to change the secondary voltage, it should be noted that all secondary voltages change. If the builder is using filament or bias windings on the transformer for supplying operating voltage to the equipment, these voltages should be checked to insure they don't vary above or below the desired value.]

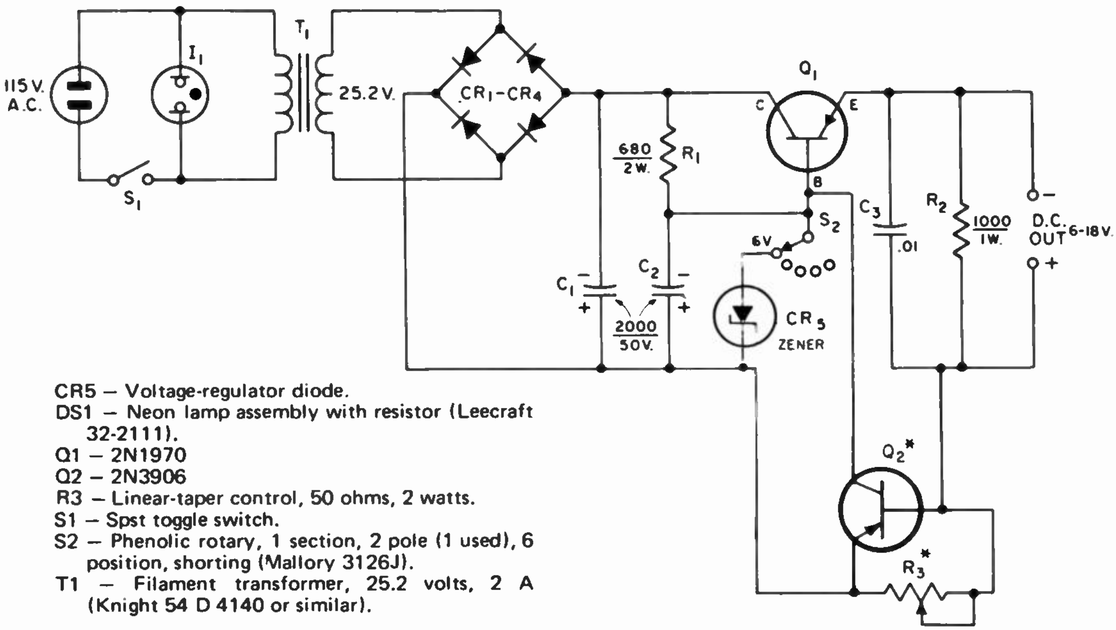
CURRENT LIMITING FOR A REGULATED LOW-VOLTAGE POWER SUPPLY

A current limiter, adjustable to no limiting at all, can be added easily to a simple series-transistor voltage regulator, such as the one shown in Fig. 12-24 of the 1970 *Radio Amateur's Handbook.* The arrangement shown in the diagram is particularly useful when trying new circuits, since it protects components in case of a wiring error. Additionally, it provides protection for the power supply. The experimenter should first determine what current drain is expected of a new circuit, and set the limiter about 20 percent greater than that value. Then, power can be applied with confidence.

The control dial can be calibrated by hooking a milliammeter directiy to the power-supply output and marking various values of short-circuit current. With the control set at 50 ohms, the short-circuit current will be about 10 mA. – *Julian M. Pike, WAØTCU*

Schematic diagram of the current-limiting power supply. Q2 and R3 are the two components added to the original circuit. Additional information concerning this design can be found in the power-supply chapter of either the 1969 or the 1970 *Radio Amateur's Handbook.* The unused positions of S2 can be used to select different values for CR5.

C1, C2 – 2000-μF, 50-volt electrolytic (Mallory CG23U5OC1).
C3 – .01-μF disk ceramic.
CR-1-CR4, incl. – 50 PRV, 3-A silicon diode.



CR5 – Voltage-regulator diode.
DS1 – Neon lamp assembly with resistor (Leecraft 32-2111).
Q1 – 2N1970
Q2 – 2N3906
R3 – Linear-taper control, 50 ohms, 2 watts.
S1 – Spst toggle switch.
S2 – Phenolic rotary, 1 section, 2 pole (1 used), 6 position, shorting (Mallory 3126J).
T1 – Filament transformer, 25.2 volts, 2 A (Knight 54 D 4140 or similar).

EXPERIMENTER's POWER SUPPLY

I've built an experimenter's power supply which someone may be interested in. It provides between 1 V dc and 31 V. dc in one-volt increments at 10 amperes with good regulation. The schematic diagram is shown in Fig. 1. T1 was made from an old TV transformer with approximately 350 watts capability. The secondary windings are wound with No. 14 enameled copper wire. The number of turns per dc volt output was determined experimentally, using the circuit of Fig. 2. The open-circuit voltage with ten turns was 5.4 volts dc yielding:

$$\frac{10.0 \text{ turns}}{5.4 \text{ V dc}} = 1.85 \text{ turns/volt dc}$$

Now the turns for each winding can be determined (see Table I). The necessary winding of fractional turns presented a minor problem that was easily overcome with a little planning.

The circuit provides no electronic regulation. Two facts ensure good load regulation. First, the

Fig. 1 — Schematic diagram of the experimenter's power supply.
CR1-CR4, incl. — Silicon diode, 55 A at 100 PRV.
S1-S5, incl. — 15-A dpdt toggle switch.
S6 — 5-A spst toggle switch.
T1 — See text.

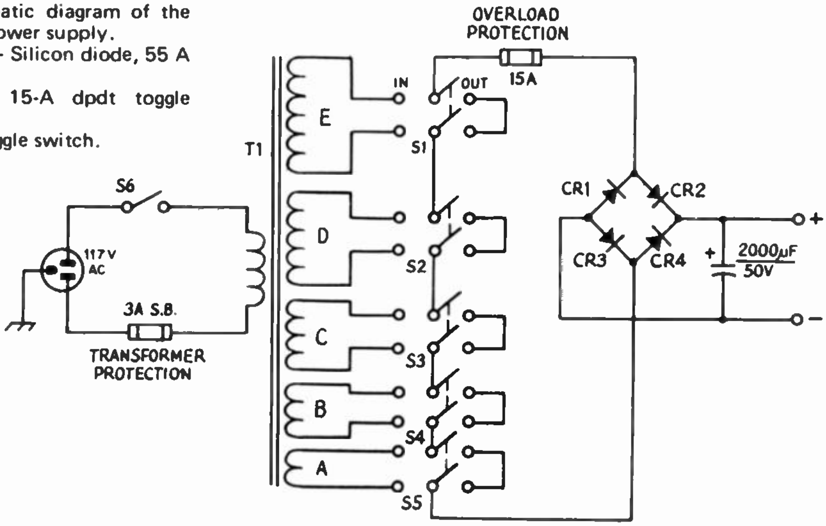
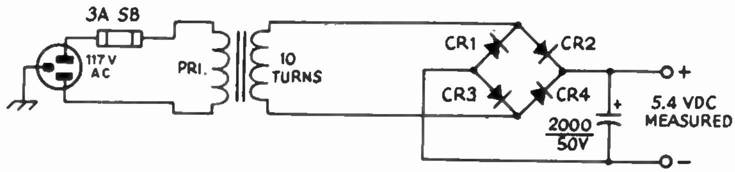


Fig. 2 — Schematic diagram of test circuit for determining turn-to-voltage ratio. CR1-CR4, incl., same as Fig. 1.



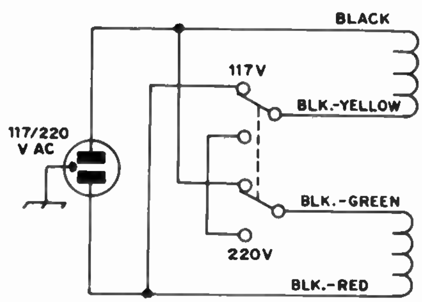
transformer impedance is low and secondly, 55-A diodes were used. Of course, the output is proportional to the line voltage, but most power lines today have good line regulation so this is not considered a significant problem. When tinkering with an oscillator circuit or other circuit requiring voltage stability, I use a small Zener-diode circuit that would be part of the finished circuit in any event. – *Steven W. Siter, WN1RFW*

Table I

Winding	*Output dc*	*Secondary Turns*
A	1.0	1.85
B	2.0	3.7
C	4.0	7.4
D	8.0	14.8
E	16.0	29.6

117/230-V SELECTOR SWITCH FOR HEATHKIT POWER SUPPLIES

In completing a Heathkit HW-101, the author wanted to do some alignments at the air base in England where he is stationed. Since the HP-23A power supply was wired for 230 V ac, which was the outlet voltage used at home, it had to be rewired for 117 V ac, which was used on the base. Rather than having to rewire the power supply each time, a dpdt switch was installed in the power supply as shown. For those who have to travel overseas, this may be a helpful addition where outlet voltages vary from place to place. – *Samuel E. Stimson, WN5ERL*

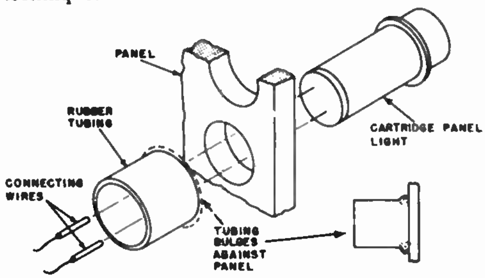


Hints and Kinks . . .

for the Builder

MOUNTING PANEL LAMPS

The use of rubber surgical tubing allows cartridge-type lamps to be mounted in close proximity to other lamps, and to be easily removed without damage. Such lamps can be mounted on digital displays, or other display panels, using this technique.



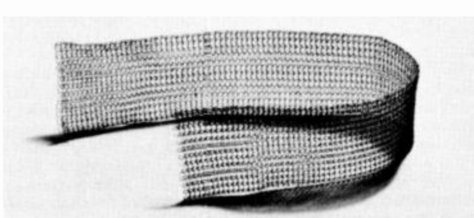
Shown is the method used to mount panel lamps as explained in the text.

A hole large enough to receive the cartridge lamp is drilled in the panel. The lamp is then inserted into the hole (see drawing). While pressure is applied to the outer portion of the lamp, a short piece of surgical tubing is slid over the part that extends through the hole. A slight bulging of the tubing at the panel secures the lamp and prevents vibrations.

The use of an insertion tool, made from a piece of metal tubing with an inside diameter slightly larger than the outside diameter of the lamp, is helpful in seating the rubber tubing. The lamp can be removed easily by withdrawing the rubber tubing and sliding the lamp from the panel. – *NASA SP-5906(03).*

INSTANT TUBE SHIELDS

Need an inexpensive tube shield? Scotch brand No. 24 electrical shielding tape is the answer. It is tinned copper, easy to cut to length, and will fit over most 7- and 9-pin miniature tubes. It may also be used to shield ignition wires. – *Alan Applegate, WBØBHE*



RIVETS IN PLACE OF SCREWS

While building an antenna tuning unit, I had trouble locating suitable hardware to install the two SO-239 coax connectors. To my surprise, a pop rivet tool and some 1/8-inch diameter rivets worked very nicely. The tool has many household uses and is inexpensive. The rivets are easily removed by drilling through their center holes. – *Eric C. Ellison, WB2CHT*

A SIMPLIFIED DIRECTION FINDER

From time to time I have seen articles on globe direction plotters of one kind or another. However, they all seemed somewhat complicated and would take too much time to construct. I like a simplified version that I saw at WA4BYR's shack. It can be put together in about thirty minutes and has been most satisfactory.

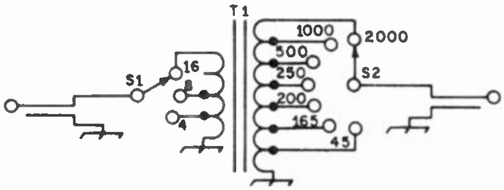
Take any suitable-size globe (the one I used was 9 inches in diameter) and remove it from its semicircular support. Drill a hole that will accept the support at your location on the globe, and another directly opposite the first hole. Then place the globe back on the supports. My support was graduated in degrees, with the zero at the equator. Using this zero, I drew in a new equator using a pen and India-ink, then placed approximate direction marks around this line to indicate the compass points.

To use, I place the location that I am interested in directly under the support arm. The approximate direction then is indicated on the new equator. – *Bob Davis, K4BRD*

Here is my simplified direction finder with the new equator and compass directions drawn on the globe. This takes the guess work out of finding the required beam headings.

AUDIO MATCH-MAKER

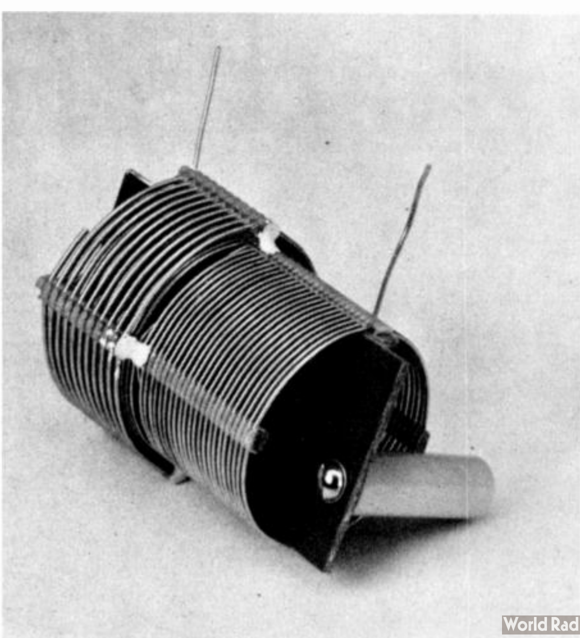
Over the years I have accumulated several headsets and loudspeakers. No two have the same impedances. Likewise, they rarely match the output impedance of my receiver. As a result the signal I hear is less than optimum. I solved my problem by using an audio transformer with multiple taps on the primary and secondary which I select by means of a rotary switch. I now hear the weak signals that eluded me because of this mismatch in receiver output to headphones. – *A. A. Gabriele, M.D., K3BZK*



Multi-tap audio transformer used to match a variety of impedances.
S1 – 1-pole, 3-position wafer switch.
S2 – 1-pole, 7-position wafer switch.
T1 – Line to voice coil transformer (Stancor A-8104).

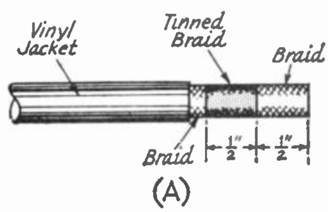
MOUNTING AIR-WOUND COILS

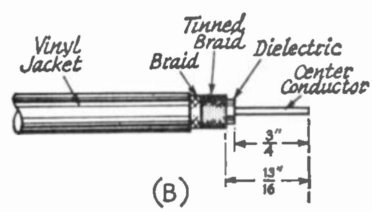
Mounting commercial air-wound coil stock can often times be a difficult task, especially if rigidity of the assembly is important. The photograph shows how a piece of insulating board or unclad circuit board can be snug-fit into the inside of a piece of coil stock. The board is installed just above or below opposite pairs of polystyrene ribs. A sufficient amount of the board is allowed to protrude from each end of the coil to permit steatite insulators to be used as mounting feet for the entire assembly. Epoxy cement can be used to secure the board in place. In the model shown, a link was made from larger-diameter coil stock than the main coil and cemented in place over one end of the inductor. – *W8HHS*



WIRING PL-259 PLUGS

Some hams do not tin the braid of RG-8/U when wiring 83-ISP (PL-259) plugs to the coax, because they find it hard to insert a tinned cable into the connector. The result can be poor shield-to-connector contact or a possible short circuit between the center conductor and stray wires of the braid. However, these problems don't need to occur, since there is a satisfactory way of preparing tinned braid. Remove 1-1/8 inches of the vinyl jacket, and tin the braid as shown (A). Then using a tube cutter, such as the type used to cut copper pipes, remove 13/16 inch of the braid (B). Next move the cutter toward the end of the coax and remove 3/4 inch of the dielectric. With this method, you can cut as deeply as you wish,[1] and the work can be inspected as you go along. To complete the installation, slide





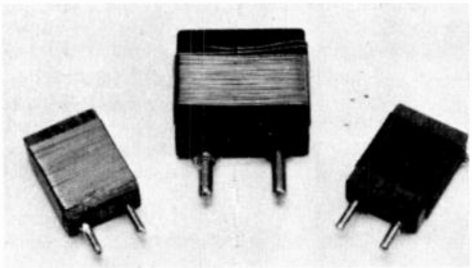
Steps for preparing RG-8/U for installation in 83-1SP connectors.

the coupling ring on the coax, insert the cable into the plug, solder the shield to the body, and solder the center conductor to the tip of the connector. – *Epps Griffin, W5HBD*

[EDITOR'S NOTE: When using this method or similar ones, avoid nicking the braid or center conductor in places where it is not meant to be cut. This weakens the metal considerably and it will break very easily at these points — a fact that can be used to advantage. For instance, rather than cutting the tinned portion of the braid all the way through with the pipe cutter, merely make a deep groove. Cut a slit along the braid up to the groove with a pair of diagonal cutters. The excess portion of the braid can then be peeled off with a pair of long-nosed pliers in a manner similar to that used in opening a key-type tin can.]

LOW-COST PLUG-IN COIL FORMS

Components for use in amateur construction projects are becoming very difficult to obtain. Few parts dealers are interested in stocking small items



for the single-lot purchaser. It is therefore a necessity that the radio enthusiast exercise his imagination as was the practice in the early days of amateur radio, when radio parts were scarce and expensive. In a recent search for suitable low-cost plug-in coil forms for a wavemeter, the writer stumbled upon a long-overlooked technique – modification of an existing radio part for use in a different application.

Many of yesteryear's builders used the bases of defunct radio tubes as coil forms, throwing away the glass envelopes and innards. That method is still a good one if you are fortunate enough to have a supply of the older tubes with phenolic or Bakelite bases. Since this writer long ago cast his old tubes to the winds of antiquity (somewhat wistfully) another source of coil forms became necessary. A look through the junk department of the workshop turned up what should have long ago been the "obvious" . . . old crystal holders with two-pin bases!

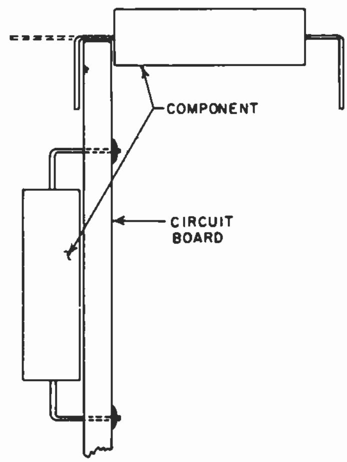
Two experimental inductors were wound on FT-243 crystal holders. Another was assembled while using one of the larger surplus holders. Both types are shown in the photograph. The metal front plates were removed and discarded. Similarly, the metal plates and quartz from the inside of the holders were cast aside. A new side plate was made from phenolic sheeting (stiff cardboard, Formica, or other insulating materials are also suitable) and later glued in place on the empty holder. Holes were drilled in the sides of the holders to allow the coil wires to be routed inside them, then down through the base pins where they were soldered in place. The illustration shows how this is done.

The inductors were checked on a Boonton 160-A *Q* meter. One FT-243 plug-in coil was wound full of No. 30 enameled wire. The unloaded *Q* was 100. The inductance was 42 μH. A similar inductor was wound using No. 26 enameled wire. It exhibited a *Q* of 105, and had an inductance of 14.4 μH. Not bad at all, and the fact that the winding is rectangular rather than circular has no significance! A circular coil from a well-known manufacturer's grid-dip meter (for the same inductance range) was compared to the homemade coil. The unloaded *Q* readings were nearly identical.

Those wishing to have longer coils can simply glue two crystal holders together, end to end, with epoxy cement. Or, if more than two terminals are needed, cement two holders together, back to back, and use a double crystal socket for the jack. If greater amounts of inductance are needed for low-frequency use, glue a slice of powdered-iron or ferrite material in the holder where the crystal once was. A piece of material cut from a flat bc-band ferrite antenna bar works very well for increasing the inductance of a coil. – *W1CER*

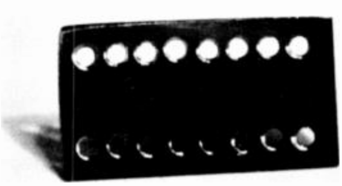
MOUNTING COMPONENTS ON PRINTED-CIRCUIT BOARDS

The spacing between holes on many commercially-made boards is approximately the length of the component plus twice the thickness of the board. When placing components on these boards, the edge of the board can be used as a form for bending the leads. I have found that this rule applies to about 8 out of 10 boards. – *David McClafferty, VE1ADH*



DIP-IC UNSOLDERING JIG

Here is a method for removing dual-in-line package IC's from pc boards. Use 0.1-inch perfboard as a guide and any convenient small drill. Drill the pin pattern of the IC in a piece of copper approximately 1/16-inch thick. Cut the copper to a



final dimension of 1/2 × 1 inch. Be sure that each pin of the IC is vertical to the base. The pins can be straightened by heating them with a small iron and then aligning them with a pair of long-nose pliers.

Lay the copper over the pins of the IC. Heat the copper with a large iron (100 to 200 watts). Gently apply pressure to the IC as the solder is melted around the pins, pulling the IC off as it is loosened from the solder. Heat will spread rapidly if the copper IC jig is tinned.– *Ralph V. Anderson, KØNL*

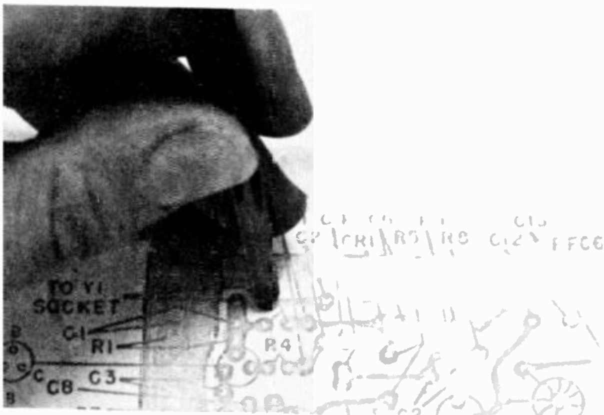


Fig. 1 – Locating holes for components with a center punch.

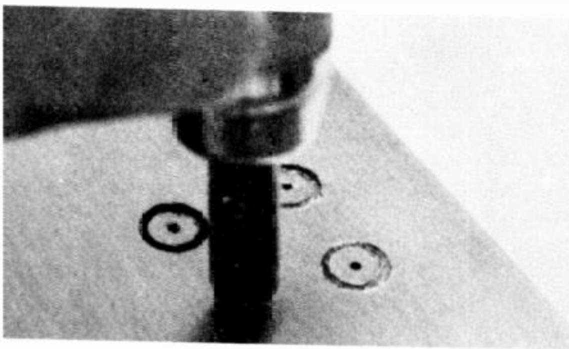


Fig. 2 – The isolated pads and the component holes can be made in one operation.

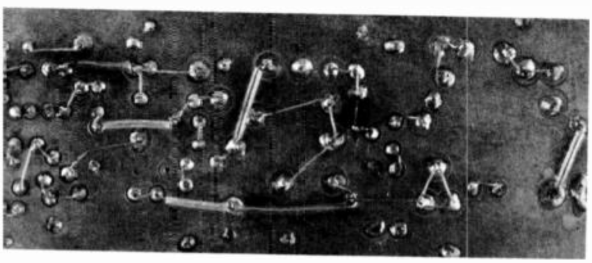


Fig. 3 – Bottom view of pc board (copper-clad side) showing method of wiring components.

Fig. 4 – Tool used in isolated-pad construction. Set screw allows removal of the No. 60 center drill. The shank will fit either an ordinary hand drill or certain push-type screwdrivers.

ISOLATED-PAD CIRCUIT-BOARD CONSTRUCTION

A problem often encountered by the amateur is how to lay out a single circuit board without an inordinate expenditure of labor and time. The isolated-pad method of circuit-board construction is well suited to instances where only a few boards are desired. Another advantage of the isolated-pad technique lies in the ease and simplicity of transferring artwork to the board surface. Fig. 1 shows an electrostatic copy of the artwork taped to a board and the hole centers being directly transferred to the copper by a center punch. Once this is done each of the holes is drilled and an isolated pad formed around the hole (Fig. 2). The components are then inserted, soldered, and excess leads trimmed. Normally, the molten solder will not bridge the gap of the isolated pad because of surface tension. The components are then electrically joined by using tinned wire soldered to the projecting wire stubs. The resulting isolated-pad circuit is shown in Fig. 3.

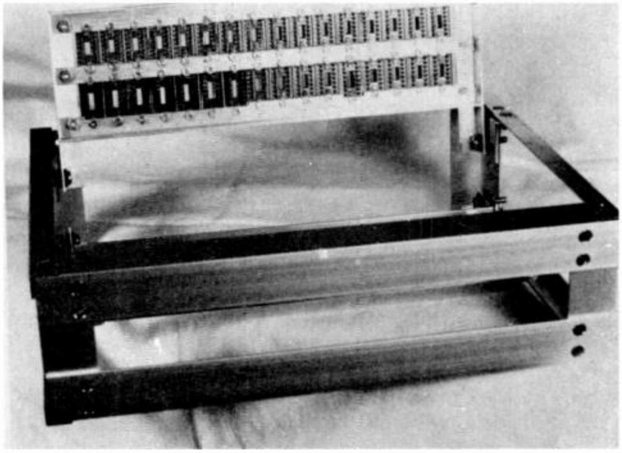
Use of the isolated-pad technique allows the builder to duplicate circuit templates with identical parts location and wiring layout. The component mounting is just as rugged as with etched pc-board construction.

An article by Ted Swift,[1] W6CMQ, suggested the basis for the construction technique described here. An improved version of the tool used in the Swift article was designed by the author. Improvements included a No. 60 drill as a center drill and adapting the shank to fit a Stanley Tools Co. Yankee screwdriver. Now the hole for the component wire and the isolated pad can be made simultaneously. The improved tool is shown in Fig. 4. These isolated-pad drills can be obtained from the author's son and a similar product is offered by Vector Electronics Co., parts No. P116 or P138. – *Alfred F. Stahler, W6AGX*

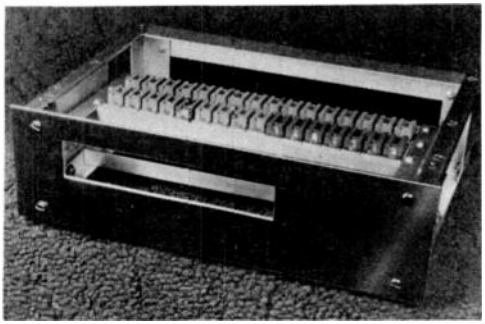
[1] Swift, "Low-Cost Instant Printed-Circuit Boards," *Ham Radio*, August, 1971, p. 44.

IC DUAL-FUNCTION CHASSIS

After trying several printed-circuit ideas for mounting ICs in experimental equipment, I decided that a completely new approach was necessary. What I needed was a breadboard layout having the appearance of a finished product. The dual-function chassis shown in the sketches and photographs serves both as a breadboard and a chassis, thereby reducing the overall cost of the project while allowing changes or repairs to be made easily. Anyone who has ever removed an IC from a circuit board will appreciate the advantages of sockets!



Shown above is the rear view of the author's frequency counter in its early stages. The swing-out mounting allows easy access to components and wiring.



IC sockets are available commercially, ranging in price from 40 cents to a dollar each. The problem is how to build a chassis for conveniently mounting them. My mechanical construction is shown in the photos, however this scheme can be altered to meet different requirements. The aluminum angle stock can be purchased at most hardware stores.

In addition to the more obvious benefits mentioned above, several other features make the dual-function chassis desirable. First, inexpensive, untested, or grab-bag ICs may be tested right in the unit. If you have a critical circuit requiring IC selection, this approach is ideal. Another important advantage is the ability to apply power (after making a modification) with the ICs removed. If an error is discovered, it can be corrected before reinstalling the integrated circuits. This can't be done easily with printed-circuit boards! In the time required for layout and construction of PC boards, a dual-function chassis can be built, wired, and tested. The job will be finished when the breadboard is completed. – *John Goegl, WA2LJK*

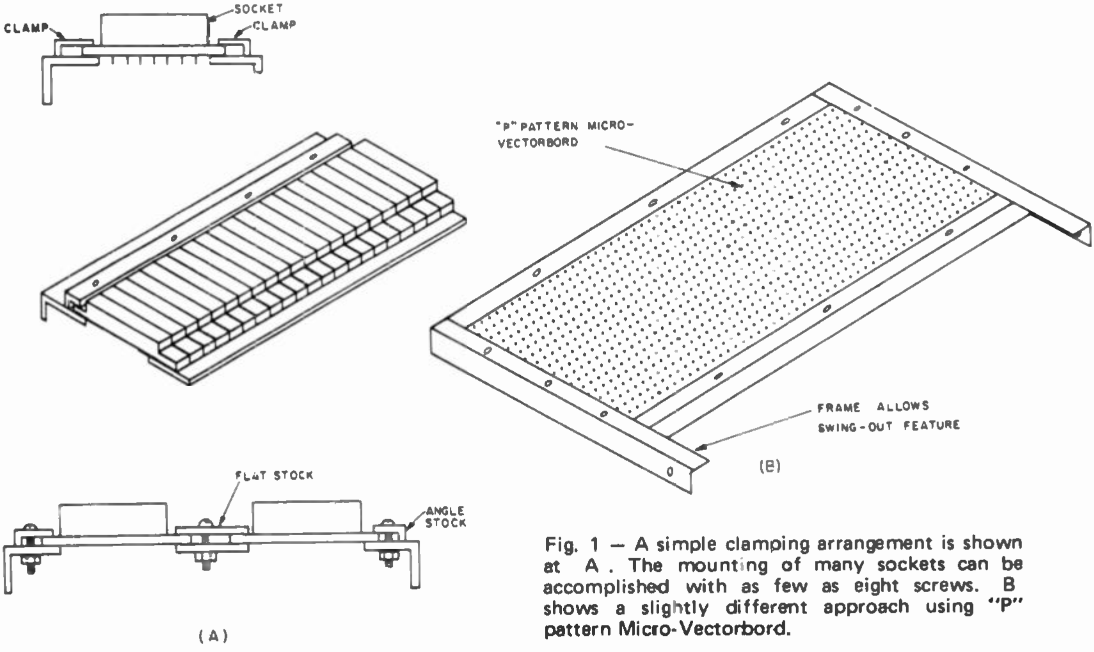


Fig. 1 – A simple clamping arrangement is shown at A. The mounting of many sockets can be accomplished with as few as eight screws. B shows a slightly different approach using "P" pattern Micro-Vectorbord.

PROTECTIVE FINISH FOR PANEL MARKINGS

Save the leftover coating material that comes with Polaroid film. This coating makes an excellent protective finish for transfer-type panel markings. The Polaroid applicator can be used to apply the print coater to the panel without the necessity of masking or spraying the entire panel. – *Albert D. Helfrick, K2BLA*

SIMPLE ONE-SHOT CIRCUIT BOARDS

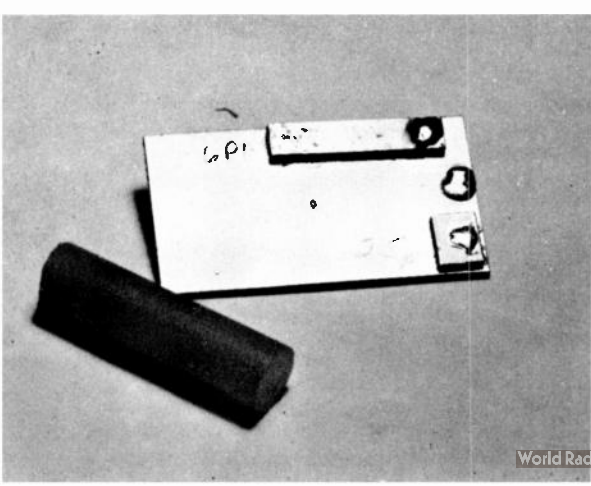
Solid-state breadboarding can take a variety of simple forms, but the technique discussed here is one of the most handy methods this writer has tried. The idea was supplied by Wes Hayward, W7ZOI, who learned of the technique from an associate, Gene Kauffman, K7OGG.

The main part of the experimental circuit board can be either single- or double-sided copper-clad material. Isolated pads can be cut to various sizes from scrap pieces of single- or double-clad pc board. The pads are glued to the main board by means of hot-melt glue. The latter is available in stick form from Sears Roebuck, and can be purchased at most hardware stores. The glue sticks are intended for use with hot-melt glue guns, the kind used by the workshop handyman.

Use a knife to cut thin slices of glue from the stick, place a chip of glue between the isolating pad and the main circuit board, heat the pad for a few seconds with the tip of a soldering iron, and the pad will adhere to the main board. It will be some 30 seconds before the glue sets. Make sure to heat the pad sufficiently to permit the glue to become completely solvent. If not, the pad will come loose under stress.

The pads and strips can be added as the breadboard progresses, stage by stage. Long strips can be used as voltage buses. Small pads are suitable for mounting component parts. The capacitance between the pads and the copper foil on the main board is helpful in assuring stability at vhf and uhf when designing dc, audio, and hf equipment. The writer measured the capacitance between the conductor of a 1/4 × 1-1/4-inch pad and the main board. The *RCL* bridge showed 6 pF. The amount of capacitance that exists will be dependent upon the dielectric constant of the insulating material of the circuit board, the board thickness, and the thickness of the layer of glue between the pad and the main board.

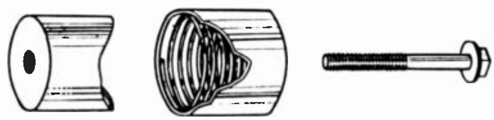
It is not recommended that this technique be used for finished products. However, if one wishes to keep the circuit for future use it is a simple task to place a bead of epoxy cement across each pad and affix it securely to the main board. – *W1CER*



The gray cylinder in the foreground is a stick of hot-melt glue. A package of several sticks costs approximately $1. A piece of circuit board is shown here with two isolating pads glued to it. A bead of solder has been placed on each pad and on the main board to illustrate the utility of this technique.

REMOVING SLUGS FROM GREENLEE PUNCHES

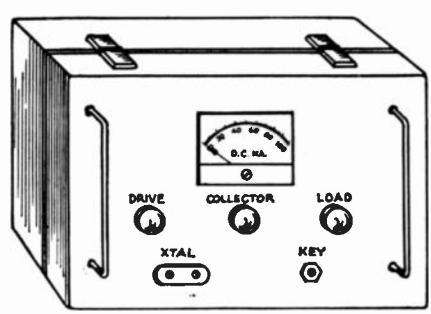
Prying the screw out of a Greenlee punch after is has been used is an exasperating job at best. A compression spring may be inserted in the die of the punch to facilitate ejection of the slug without the use of a screwdriver or other prying tool. – *NASA Technology Handbook SP-5010*



To facilitate the removal of the slug from a Greenlee punch after use, a spring is mounted inside the die.

EQUIPMENT CABINET

The next time you need a small cabinet for a portable or mobile rig, try a child's lunch box. To protect the components that protrude from the front of the container, handles can be installed as shown. In order to service the unit, it is only necessary to unsnap the fasteners on top of the box. – *Mike Bailey, WB4DCW*

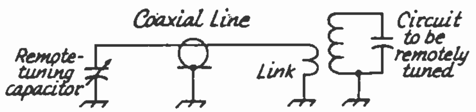


A child's lunch box used as a transmitter cabinet.

SIMPLE BANDSPREADING SYSTEM

The bandspreading scheme shown has been used in several applications at my station. It permits the remote tuning of resonant circuits. For example, I use the original dial mechanism and 350-pF tuning capacitor from a standard broadcast receiver to tune the high-frequency oscillator in my 6-meter receiver. In this case, a two-turn link gives a tuning range of 2 MHz.

Increasing the number of turns on the link, positioning the link closer to the coil, and increasing the value of the remote-tuning capacitor contribute to greater coverage. Low-capacitance line also helps to achieve this end.– *William L. North, W4GEB*



W4GEB's bandspreading system. Component values are discussed in the text.

AN INEXPENSIVE SUBSTITUTE FOR COIL FORMS

For low-power use, the plastic pill bottles available from any druggist or pharmacy make ideal coil forms. They come in a variety of sizes and diameters, and the smaller ones have a small enough ID to accept common-size ferrite rods. Male plugs (available in many pin configurations) can be cemented to the base of these bottles for plug-in coil use. Also, the coils can be cemented easily to a chassis or board by means of epoxy cement. – *George W. Smith, Jr., W5HIP/W5DPJ.*

HEAT SINKS FOR NUVISTOR TUBES

Transistor-type heat sinks make excellent heat dissipating radiators for Nuvistor tubes. Choose a high-emissivity black anodized finish if possible and use heat-sink compound (silicone grease) between the metal tube and the heat sink to reduce thermal resistance. – *Richard Mollentine, WAØKKC*

FINISHING ALUMINUM PANELS

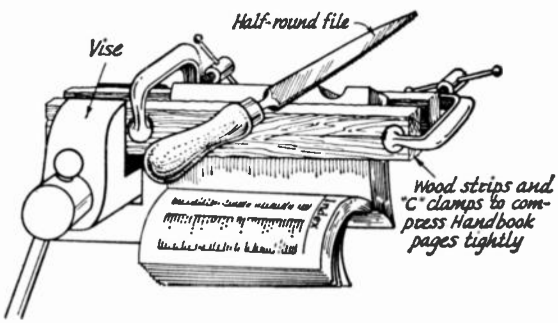
My junk box contained a few scratched panels which I wanted to use for my next 2-kW amplifier project. An orbital sander, fitted with a coarse grade of sandpaper, removed the scratches quite nicely and produced a velvet-like surface on the panels. Liquid dishwashing detergent and hot water were used to prepare the panels for painting. A double coat of clear glossy spray from a push-button can provided the panel with a remarkable finish. Lettering and numbers were applied in the usual manner. – *Sandy Morton, W6IAE*

A SOURCE OF HEAVY DUTY SWITCHES

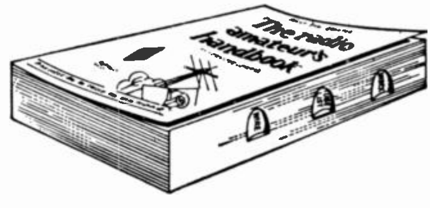
Most electric ranges have rotary switches that control the heater units. A common type has one position, *off*, with five heat-level positions. The switches could be used to place two transformer windings in series or parallel, from a 230- or 117-V source. Many other uses for these heavy-duty switches can be found around the shack. The ones described are quite adaptable. – *W. C. Holder, W4AAZ*

THUMB-GROOVE INDEXING THE HANDBOOK

Sections of the *Handbook* that are frequently used by the reader can be located quickly by filing thumb grooves in the *Handbook* pages as shown. As illustrated in the second sketch, I filed thumb grooves for only three subjects; the wire-size table, the tube index and the general index. These items seem to fill 99 percent of my general requirements. Other grooves can be added at any time, but usually the sections of the book they indicate are only of short-term use. – *Norm Cucuel, K1LFH*



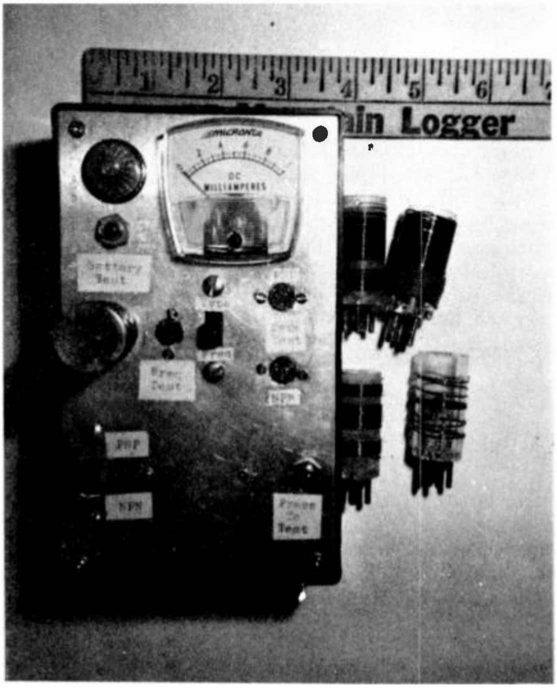
K1LFH's method of thumb-groove indexing the *Handbook*.



One method of labeling the thumb grooves.

CONNECTOR ADAPTER

Amateurs inconvenienced by type-N connectors on the rear of some commercially-made gear can solve the problem by purchasing an Amphenol 4400 adapter (UG-146/U). It is listed in catalogs under "between-series adapters." The price is under $4. – *Fred A. Hatfield, W8GUZ*



HOW HIGH WILL IT GO?

Readers with long memories may recall an article by the author entitled, "A Junk Box Transistor Tester," (*QST* for October, 1969). That article described the design and construction of a unit for testing various unknown transistors that hams acquire from time to time. In addition to a circuit for testing the dc beta (current-amplification factor) of a transistor, this unit contained a circuit for determining whether said transistor was npn or pnp.

However, the above tester left one big gap in our knowledge of the unknown transistor's capabilities. It could not determine the transistor's frequency limitations. This deficiency is corrected in the unit described below. Basically this new tester will do the following:

1) Test itself for run-down batteries.

2) Determine whether the transistor is an npn or pnp type.

3) See how high in frequency the unknown transistor can go and still maintain a reasonable current gain.

The complete circuit is shown in Fig. 1, but for simplicity's sake Fig. 2 shows each of the three above functions separately. The circuit in Fig. 2A shows the battery test feature, which merely taps a No. 47, 6-volt lamp across the battery. Since this lamp draws 150 mA from a 6-volt source (the usual transistor draws far less), you can assume that if the batteries light the lamp to full brilliance, they are live enough to handle the average small transistor. Fig. 2B shows the circuit for transistor-type testing. Its operation is based on the fact that the emitter-base junction (or for that matter, the base-collector junction) of a transistor is equivalent to a crystal diode, and hence will conduct current in one direction only. Which direction the current flows depends on the transistor type. In Fig. 2B, the two TYPE-TEST sockets are connected in parallel with each other, and in series with the meter and two current limiting resistors. If a pnp transistor is placed in the npn socket its emitter-base diode will be in the nonconducting direction and the meter should read zero. Placed in the pnp socket however, the transistor's diode will be in the conducting direction, and the meter should read a current. Similarly, an npn transistor would show current when placed in the npn socket, and would show none in the pnp socket. If you get a transistor that shows current in both sockets, you have a shorted (or at least a leaky) transistor. Better throw it out!

Fig. 2C shows the circuit for determining the frequency limitations of the transistor. Basically, it

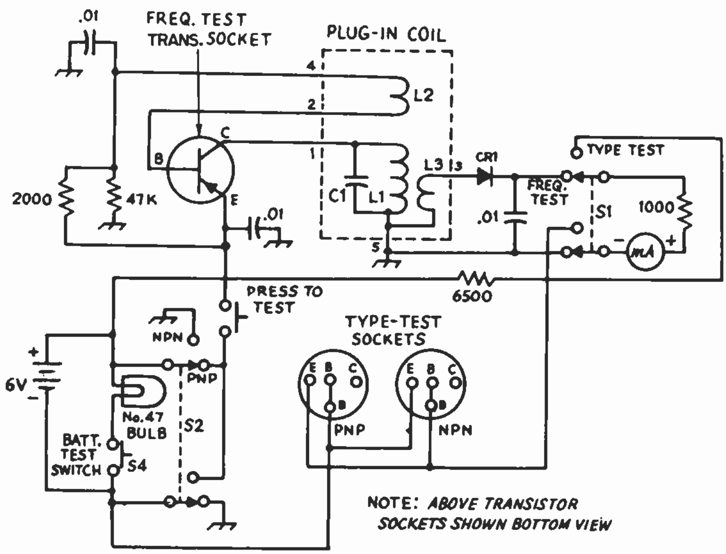


Fig. 1 — Schematic diagram of the transistor tester. Capacitors are disk ceramic and resistors are 1/2-watt composition.
CR1 — Germanium diode, 1N34A or equiv.
L1, L2, and L3 — See Table I. Different amounts of turns will have to be used for forms other than 3/4 inch.
S1, S2 — Dpdt slide switch.

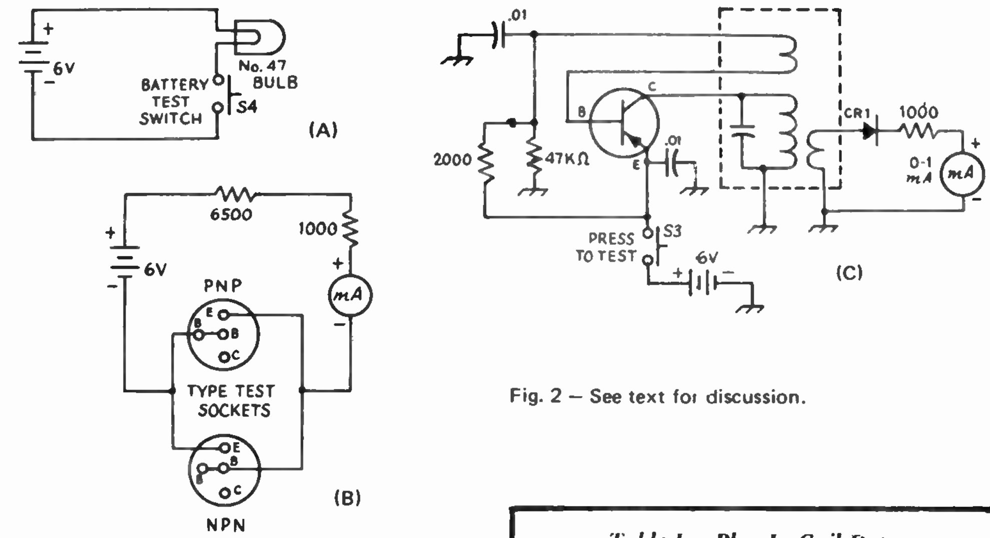


Fig. 2 – See text for discussion.

Table I – Plug-In Coil Data

Frequency (MHz)	L1 (Turns)	L2 (Turns)	L3 (Turns)	C1 (PE)
60	3	3	3	25
31	7	6	4	25
12	12	7	6	80
3	22	10	9	270
1	34	20	8	1000

Note: Above coils close-wound, 3/4-inch (19 mm) diameter.

amounts to a self-excited oscillator (tickler-coil type) with the frequency being determined by the plug-in coil used. If the transistor is capable of operating on the frequency of that particular plug-in coil it will oscillate. Some of the rf energy will be drawn off by coil L3, rectified by the diode CR1, and will actuate the meter. I used five plug-in coils, representing frequencies of 1, 3, 12, 31, and 60 MHz, respectively. These frequencies correspond to the labelings of the various compartments of my spare transistor tray. One that tests good on a dc beta checker, but will not actuate the meter on this checker with any of the coils is considered an audio transistor.

Operation of the unit is simplicity itself. To check a transistor type, set switch S1 to **TYPE-TEST** position, and plug the unknown transistor into each of the **TYPE-TEST** sockets in turn. To test frequency capabilities, set switch S1 to **FREQ TEST**. Set switch S2 to pnp or npn, depending on transistor type, and plug the transistor into the **FREQ TEST** socket. Plug in the highest frequency coil (in my case 60 MHz) and press test switch S3. If the meter reads, the transistor is capable of handling 60 MHz, and probably more. If the meter doesn't read, remove the plug-in coil and substitute the second highest frequency coil. Press switch S3 again, and check for meter indication. Continue to use lower and lower frequency coils until finally one is found that will cause the transistor to oscillate. You now know the approximate frequency limit of that particular transistor.

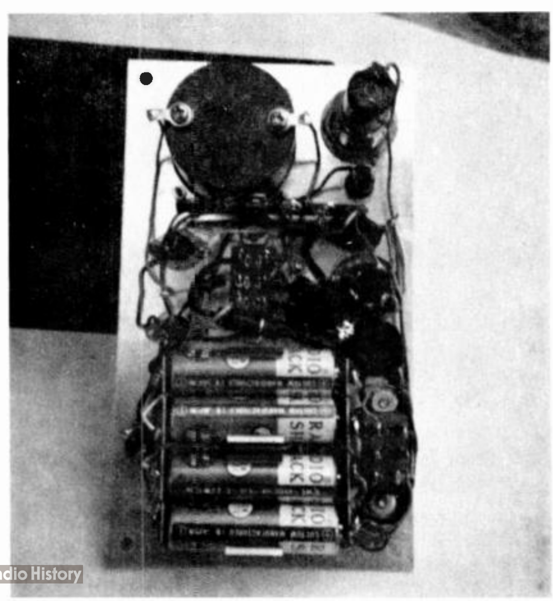
If you suspect weak batteries, merely press S4, the **BATTERY TEST** switch and check the lamp for full brilliance. This can be done regardless of the settings of the other three switches.

Construction

Construction of the unit should pose few problems. A hint on drilling the square holes for the slide switches – drill two holes with a 1/4-inch drill and file the corners with a small square file.

The parts layout is not critical and the one used by the writer need not be followed exactly. About the only requirement is to keep the **FREQ TEST** transistor socket close to the plug-in coil socket so as to allow short rf leads. It's also a good idea to locate S3 far enough from the coil-form socket that it can be pressed without getting the hand too close to the coils.

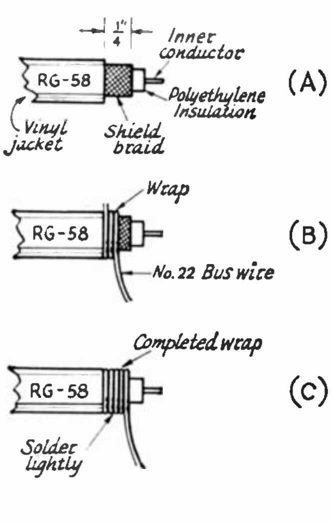
Construction of the tester.



The last item has to do with the tickler-coil windings (L2) on the coil forms. As any old-time ham from the regenerative receiver days is aware, the winding relationships are important. If the windings are phased right you get positive feedback and oscillation. If they are phased wrong you get negative feedback, and nothing. The best way to meet this problem is to make one coil as shown except leave the two ends of L2 unconnected. Plug in a transistor that you *know* will handle the frequency, and temporarily solder the ends of L2 to the pins. Plug the coil in, and press S3. (Make sure S1 and S2 are positioned properly.) If the meter reads, it indicates oscillation, and also indicates that you have L2 properly connected. Make the connections permanent. If the meter doesn't read you should reverse the two ends of L2 and try again. You should get a reading this time, but if you don't, check your connections carefully. You might also try another transistor. The diode, the meter, and S1 should also be checked out. Once you get one tickler coil wound correctly, you've got the problem solved. Just wind the coils on the other forms in the same direction. – *Howard Hanson, W7MRX*

NEAT COAXIAL SHIELD CONNECTIONS

When coaxial cable is to be used for inter-circuit wiring, where coaxial connectors are not employed, a neater-looking job will result by wrapping small-diameter bus wire over the shield braid of the cable as illustrated. The free end of the bus wire can be used to make the ground connection for the shield braid. A low-wattage soldering iron should be used to secure the bus wire to the braid, care being taken not to melt the polyethylene insulating material. This system works well with all types of coaxial cable and will dress up the appearance of shielded audio cable as well. – *8P6EV*

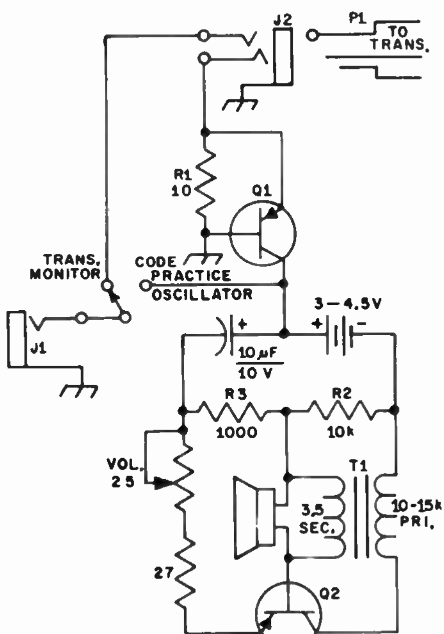


Steps in forming a neat coaxial shield connection.

CODE-PRACTICE OSCILLATOR AND MONITOR

Shown is the circuit of my code-practice oscillator which I modified to act as a transmitter monitor. Parts layout is not critical, but a three-wire jack will be necessary if the oscillator is built into a metal enclosure. R1 was chosen to give proper bias using the 150-mV keying circuit in my transmitter. R1 is 10 ohms, which is sufficient to forward bias Q1 and close the circuit to the code oscillator.

The oscillator requires 3 volts which can be supplied by two size-D cells, but provides increased volume when using a 4.5-volt supply. S1 provides code-practice-oscillator operation in one position, and both transmitter and oscillator in the other. I have used this scheme with three transmitters and find it satisfactory. – *Alex Bremner, Jr., WN7OQQ*



Circuit for a code-practice oscillator and transmitter monitor.
J1 – Two-circuit jack.
J2 – Three-circuit jack.
Q1, Q2 – Silicon transistor (Sylvania ECG-104 or General Electric GE-3).
R1 – See text.
T1 – Audio transformer 10,000- to 15,000-ohm primary, 3.5-ohm secondary.

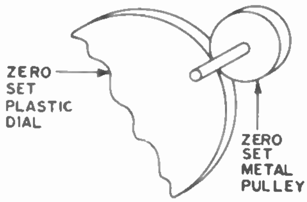
PROTECTIVE FINISH FOR PANEL MARKINGS

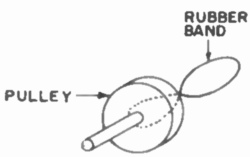
Save the leftover coating material that comes with Polaroid film. This coating makes an excellent protective finish for transfer-type panel markings. The Polaroid applicator can be used to apply the print coater to the panel without the necessity of masking or spraying the entire panel. – *Albert D. Helfrick, K2BLA*

INCREASING THE FRICTION IN WORN PULLEY GRIPS

In the Heath SB-301, and similar equipment, there is a split-ring pulley that moves a zero-set dial by means of friction. After a time, the pulley wears enough of the plastic from the dial that the oscillator cannot be set to zero for frequency calibration.

One way that I've found to remedy the situation cheaply and easily is to loop a rubber band around the inside of the pulley (several times) and build up the contact area so that the zero-set dial will make contact with the rubber on the pulley in place of rubbing on the metallic sides of the latter. I've made this change on all my equipment and find that it works very well. – *Dennis G. Eksten, W9DDL*



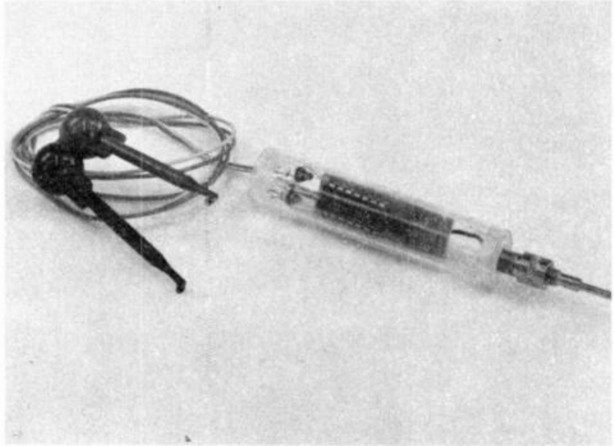


The rubber band is shown being looped around the pulley several times to build up the center so that it makes contact with the driven dial.

THE VEST-POCKET LOGIC PROBE†

I work at the National Bureau of Standards Institute for Basic Standards, where we design, build, and troubleshoot all instrumentation requested by the Cryogenics Division. The equipment is located in different buildings on our large grounds. In the past, we either had to tote an oscilloscope to these places or take the faulty equipment to our lab for troubleshooting. We developed this probe tester in July of 1969 to check out logic circuits and replace defective chips right in the operating area. It is very easy to use, and no more do we have to drag a scope with us to a test site.

This probe is a small, handy, and convenient instrument to troubleshoot circuits that operate in either the logic "one" (1) or "zero" (0) state. By attaching the power leads in the proper polarity to the logic 5-V power supply and touching the probe to an input, output, or intermediate pins of integrated circuits, the "one" indicator lamp or



"zero" indicator lamp will glow showing a "high" or "low" logic level respectively. An open circuit will not show any indication on either lamp. This

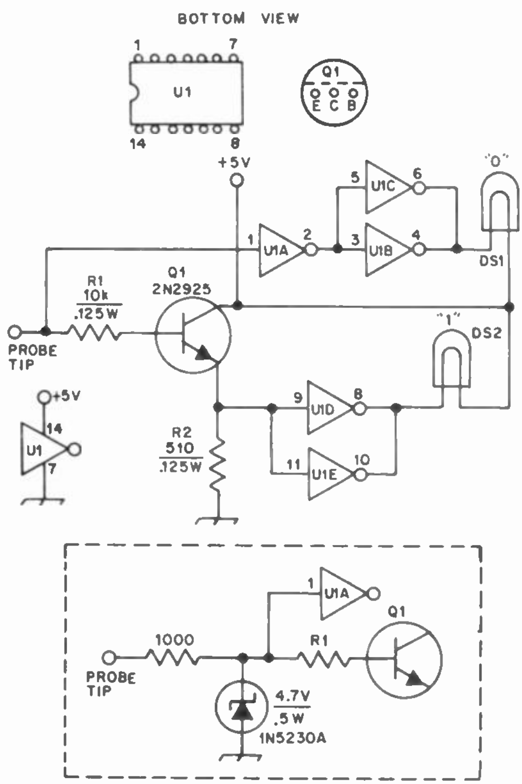
Fig. 1 – Schematic diagram of the vest-pocket logic probe. Resistances are in ohms, k = 1000. The probe must not be connected to a power supply yielding more than 5 volts or damage to the IC will result. However, an alternative input circuit, shown inside the dashed lines, may be used to *probe* voltages somewhat greater than +5 V. See Fig. 3 for mechanical information on parts.

DS1, DS2 – Incandescent, 3 V, 15 mA (Chicago Miniature No. 2158 or equiv.).

Q1 – Silicon npn audio transistor; 25 V, 200mW.

R1, R2 – 1/8-watt composition.

U1 – TTL hex inverter, dual in-line package, SN7404 or equiv.



† Developed at the National Bureau of Standards, Cryogenics Div., Metrology Section, Boulder, Colo.

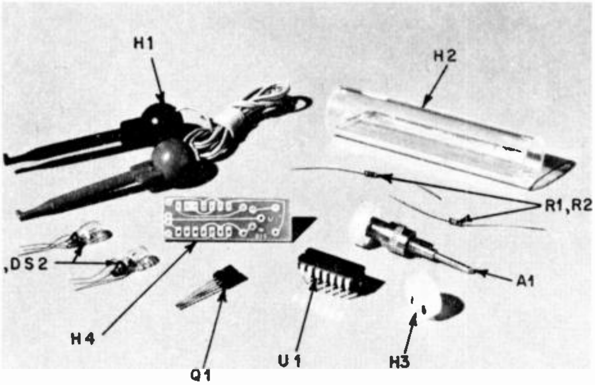


Fig. 3 — The parts used in making the probe assembly.

AI — Assembly of probe tip and end disk. Probe tip is standard phone tip (E.F. Johnson, H. H. Smith, or Keystone). End disk is 1/8-inch-thick piece of 1/2-inch-dia polystyrene rod, sanded, drilled and tapped to accept probe tip.
DS1 DS2 — See Fig. 1.
H1 — Power-connecting clips. The clips shown carry the designation X-100 and are manufactured by E-Z Hook, Division of Tektest, Inc., P. O. Box 1405, Arcadia, CA 91006. Small insulated alligator clips and flexible wire may be used instead.
H2 — 1/2-inch-ID polystyrene tubing, 2-1/2 inches long, used for body of probe.
H3 — End disk, 1/8-inch-thick piece of 1/2-inch-dia polystyrene rod, sanded, notched to pass power-connecting leads, and marked with "0" and "1" lamp identifications.
H4 — Etched circuit board, trimmed to dimensions 1/2 × 1-1/2 inches. See Fig. 2.
Q1 — See Fig. 1.
R1, R2 — See Fig. 1.
U1 — See Fig. 1.

probe is an indicator only and does not indicate a certain voltage at the probe. Fig. 1 shows the schematic diagram, and Fig. 2 shows the etching pattern for the circuit board. The photographs show how the probe is constructed. The probe should only be used with a 5-V power supply and is compatible only with TTL logic levels. A high voltage will harm or destroy the unit. — *E. H. Rogers, KØGKB*

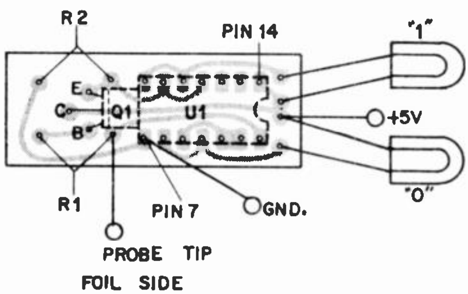


Fig. 2 — Circuit-board etching pattern and parts layout for the vest-pocket logic probe, actual size.

PANEL MATERIAL

Discarded washing machines, dryers, and other appliances are good sources for panel and chassis material. Scrap dealers are usually willing to let customers cut panels from these machines for a very reasonable price. The steel bends easily without breaking and can be cut with a sabre saw. An added feature is that one side is painted and this can serve as either the final finish or as a primer for another color. — *W. H. Moody. WA2RKU*

AN ATTRACTIVE FINISH FOR ALUMINUM

Homemade aluminum panels look bland, and here is a way to brighten them up a bit. If you have a bench-mounted drill press, get a short pencil with an eraser, and put it in the chuck with the eraser down. Just go along in rows until you have an attractive pattern of small circular decorations (jewel-case finish). Remember to change pencils before the eraser wears completely down, to prevent scratching by the meral casing that holds the eraser on the pencil. — *Gregg Pittenger, WN8JDJ*

[EDITOR'S NOTE: Steel wool affixed to the end of a drill or rod will provide similar results.]

Hints and Kinks . . . for CW Operation

Chapter 7

IC CLOCK FOR TTL KEYER

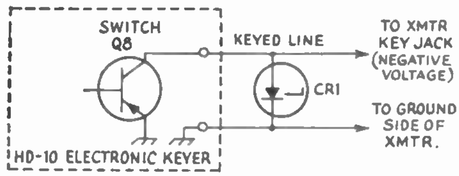
While designing a TTL keyer, I ran across a novel way to generate clock pulses very accurately and still say the keyer was built totally of integrated circuits (well, almost anyway). Later as the design of the keyer changed, the clock remained the same, with the exception of a few extra wires.

According to the way the keyer is designed, this clock may either be a free running or an instant start clock. The flexibility is obtained by using 2 SN74121 TTL ICs and some garden-variety capacitors and resistors. Refer to the diagram. Since the application called for instant-start operation, the ENABLE line was included. This is a Schmitt trigger input. If a free-running clock is needed, a momentary-contact normally-open push-button switch connected from ENABLE to ground should be added in the event that the initial state of the 74121 is unfired.

If the clock is used as the clock for a keyer where timing is critical, remember that there are two pulses to time. The one generated by U1 is of fixed length, and that from U2 is variable. The formula for pulse width is $t_p = 0.7C_TR_T$ (refer to the diagram for pulse widths with the values shown). The pulse width from U2 is varied by means of the potentiometer. With some power supply changes in the Micro-TO keyer shown in the *Handbook* for 1972, this circuit could replace the clock shown there. – *Bill Horger, WN4DWB*

PROTECTING THE TRANSISTOR SWITCH IN THE HD-10 KEYER

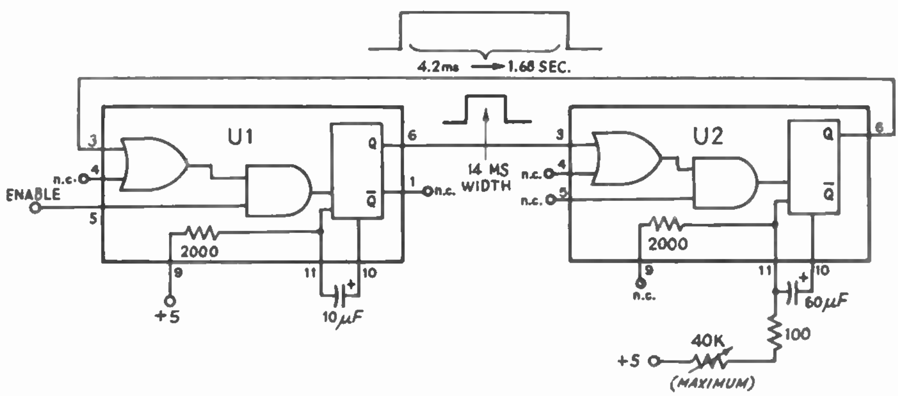
In the instruction manual for the Heath HD-10 electronic keyer, it states that the open circuit or spike voltage across the keyed line should never be allowed to exceed 105 volts, or the 2N398A transistor switch, Q_8, may be damaged. A simple and effective means of protecting Q_8 is shown. The installation of CR1, a 91-volt Zener, prevents the collector-to-emitter voltage rating of the 2N398A from being exceeded. – *Gilbert A. Herlich, W2AZG/6*



CR1 is a 91-volt Zener (1N3043 or equivalent) and Q_8 is a 2N398A.

DEACTIVATED-VOX CW OPERATION WITH THE HW-100

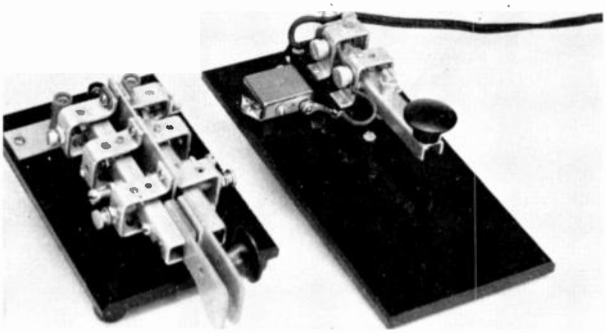
Many operators do not desire break-in operation on cw, especially when slower speeds are being used. Having the relays drop out between



Output may be taken from either pin 6 or pin 1 or either IC. Both ICs are SN74121 types (Texas Inst.). All capacitors are electrolytic. Internal nominal value is 2000 ohms.

characters because of short delay times can be quite annoying and increased delay may be unsuitable for ssb operation.

A simple method of overriding relay break-in during cw operation of the HW-100 is to utilize the lever-type switch found on most desk-type microphones. With the microphone connected and its switch activated, all relays remain energized and a carrier will be transmitted only when the key is depressed. – *Roy J. Durso, K4DJN*



Surplus straight key and twin-paddle key for keyer.

A TWIN-PADDLE KEY

The author came across some code practice sets at Fair Radio Co. here in Lima, Ohio. The set consisted of a little, funny looking, and simply constructed, key and buzzer mounted on a highly polished hard-rubber base. The unit sold for $1.50 at the time.

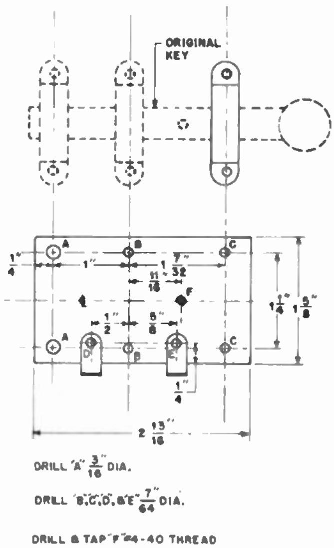


Fig. 1 – Aluminum mounting plate. Note angle brackets at "D" and "E."

Using three of these keys and simple tools, I was able to come up with a slick twin-paddle key for the trusty old 9TO keyer. This unit has good looks, fine contacts, bearings that need no adjusting, snappy feel, and the bearings are jumpered with braid. I have used the key for about four months and have had favorable comments from those who have seen it and who have heard the results. The total cost is approximately $6.50 using three keys, but the unit can be constructed using only two keys if you want to make your own backstop brackets.

Construction Details

Modification of the original keys and construction of the twin-paddle counterpart can be seen in the photograph and Fig. 1. The original keys should be disassembled, and the parts laid aside for use later in the construction of the new key. Some new parts will have to be fabricated, and these are:

1) An aluminum mounting plate as shown in Fig. 1. Either lay out the entire plate according to the plan shown in Fig. 1, or use the hard-rubber base of one of the original keys for a template for holes "A" and "B."

2) Four aluminum angle-brackets (1/2 inch on a leg, made from 3/8 × 1/16-inch aluminum stock).

3) A modified No. 4-40 nut, with a No. 4-40 round-head screw (Fig. 3). They are used to hold tension springs in place.

4) Insulating material and spacers for the brackets with the "hot-side" contacts.

5) 3/32-inch fiber glass board for paddles and spacers.

6) Lead or iron plate to increase weight of key.

It should be noted that the two original keys are used as they come with the exception of the following changes:

1) Since the original key was mounted on a base of insulating material, some means of insulating the contacts from the aluminum plate is

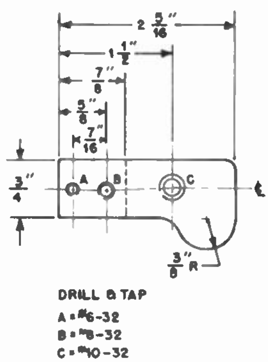


Fig. 2 – Pattern for paddles. Made from 3/32-inch fiber glass, with a 3/32-inch block cemented as shown by the dotted lines. Dimensions of the block are 3/4 × 7/8 inch.

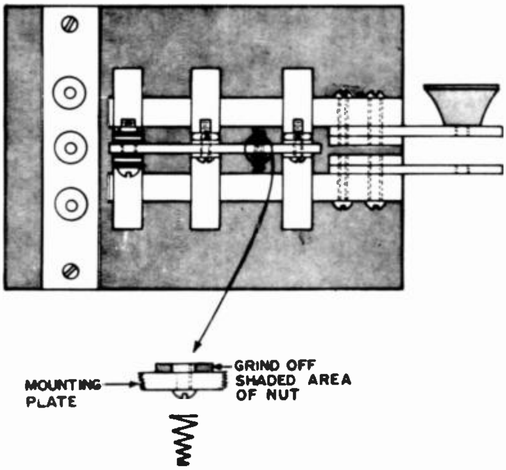


Fig. 3 — General layout. Note method of keeping tension springs in place.

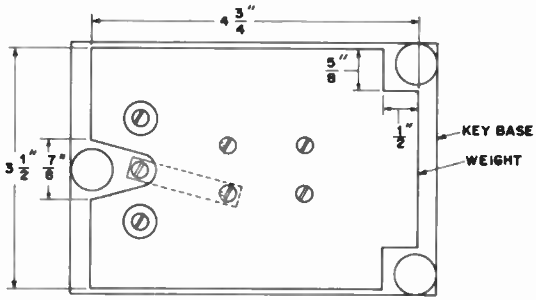


Fig. 4 — Key base showing mounting of optional feet and weight.

necessary. Use a strip of insulating material (such as fiber glass) under the brackets with the contacts, and use spacers under the screw heads and in the holes in such a manner as to prevent the brackets from shorting to the plate and the other bracket. After assembled, check with an ohmmeter.

2) An extra hole must be drilled in one of the lever arms in order to mount the new paddles. Use the pattern shown in Fig. 2, and cement a block of the fiber glass, preferably with epoxy cement, to the back of each of the paddles as shown in Fig. 3.

3) Some operators still prefer to have the knob on one of the paddles, and one of the original knobs can be cut down, or a suitable replacement obtained.

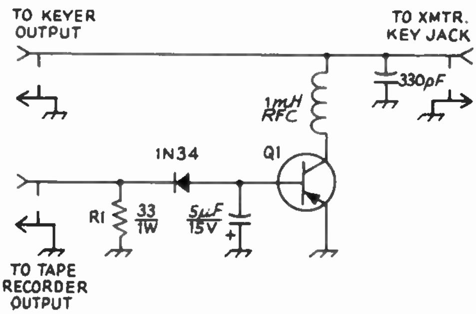
This completes the modification of the original keys, and an easy way of locating the hole "F" is as follows. Cut off the head of a No. 6-32 screw, and file a point on the remaining threaded portion. A drill chuck can be used as a vise to hold the screw. Thread the screw with the point down into one of the levers, and mark the plate with the pointed end. This locates hole "F."

Since the original key had another set of normally closed contacts for a backstop, another set of backstops will have to be made. Either the brackets from a third key could be used and modified, or a new set made out of 1/16-inch (or thicker) aluminum stock. Use No. 10-32 screws (with a No. 10-32 nut and lockwasher under them in order to lock them in place once the desired setting is made) threaded into the brackets as adjustments for the spacings on the dot and dash sides of the paddle.

This completes construction of the key, and the key is then mounted on a suitable base. One of the original key bases can be cut off as shown in the photograph and used. The key could then be bolted to the operating table, or extra weight added as shown in Fig. 4. — *Robert M. Mason, W8NN*

TAPE-RECORDER-DRIVEN SOLID-STATE KEYER

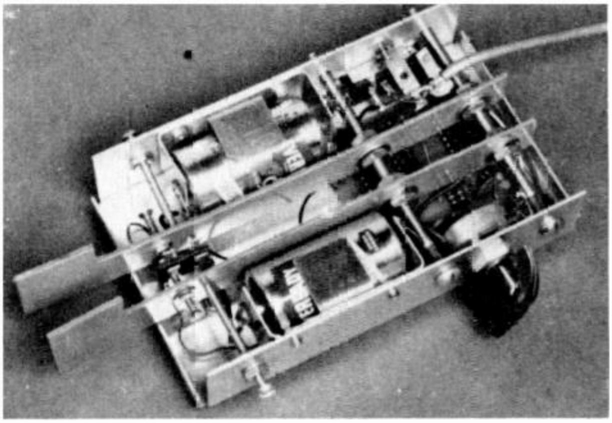
A while ago, a tape-recorder-driven relay keying device was described by WA2BCT in "Hints and Kinks," May, 1971, *QST*, which he used to replay W1AW Official Bulletins. An alternative to the relay-keying device is a solid-state keying circuit using a transistor to do the switching. The transistor should have a collector-to-emitter voltage rating in excess of the voltage across the terminals to be keyed.



A circuit for keying a transmitter with the audio output from a tape recorder.
Q1 — 2N4126. For keying over 40 volts use a 2N4888 or an SK3025 (RCA).
R1 — For text reference.

Component values shown in the diagram are not critical. Just make sure that the transistor is a pnp type when the voltage to be keyed has a negative polarity. This circuit can be used to key most transmitters as long as the current through the keyed circuit is within the collector-to-emitter rating of the switching transistor. R1 may be changed in order to provide a better impedance match between the output of the recorder and the input to the keying circuit. A transformer can also be used, if desired, in place of R1, to match impedances.

Once the keying circuit is connected as shown in the diagram, start the tape recorder. Increase the volume of the tape recorder until the transmitter keys correctly. — *Al Francisco, K7NVH/8*

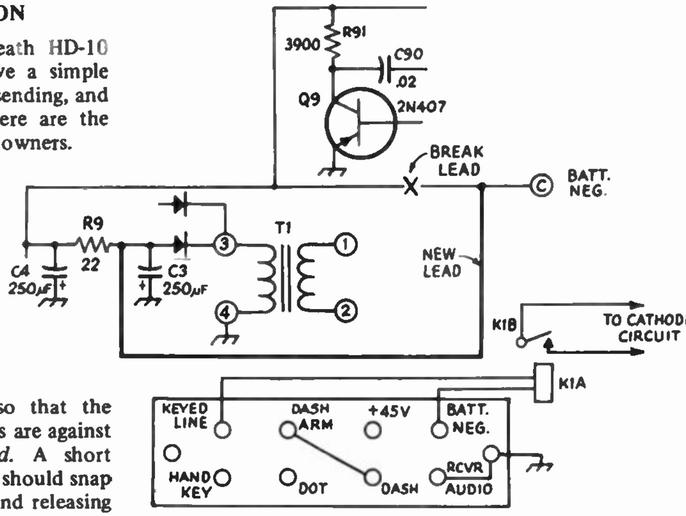


FORMICA KEYER PADDLE

An inexpensive electronic-keyer paddle can be made from a Minibox and two strips of Formica table-top covering. The Formica strips are flexible enough to give a feel similar to that of a bearing movement, yet have enough rigidity to be self-supporting. The mounting shown in the photo provides for adjustment of both tension and travel. I used a Minibox large enough to contain the batteries and electronic components. – *Richard Lamb, KØRJV*

HEATH HD-10 KEYER MODIFICATION

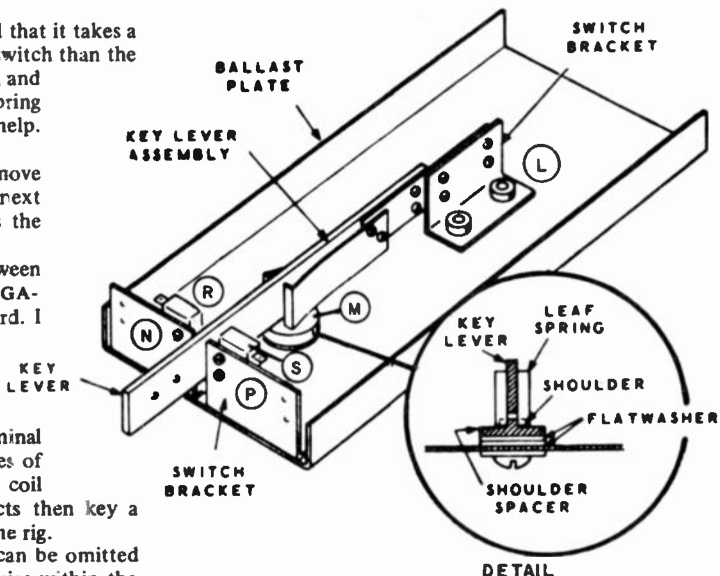
I have been using a modified Heath HD-10 keyer for several years now and have a simple modification which permits easy, fast sending, and also provides for cathode keying. Here are the details, which should help other HD-10 owners.



First, see p. 16 of the assembly manual. Then remove the leaf springs and the shoulder spacer. Center the key level in the center of the slot by adjustment of bracket L. Loosen the screws that hold L to the plate, adjust the bracket so that the level falls in the center of the slot and tighten the screws.

Next, adjust brackets N and P so that the operating buttons of the microswitches are against the key lever and *partly depressed.* A short movement of the lever toward one side should snap the microswitch on that side closed, and releasing the lever should allow it to reopen, which pushes the lever back to center. A little "fiddling" will get this adjustment just right.

When this is done, you may find that it takes a little more force to snap one microswitch than the other. If this bothers you, loosen L, and adjust it so that there is a little spring pressure on the side that needs help. Retighten L.



If cathode keying is desired, move the black lead from hole C to the next foil (the other side of R9). This is the only wiring change.

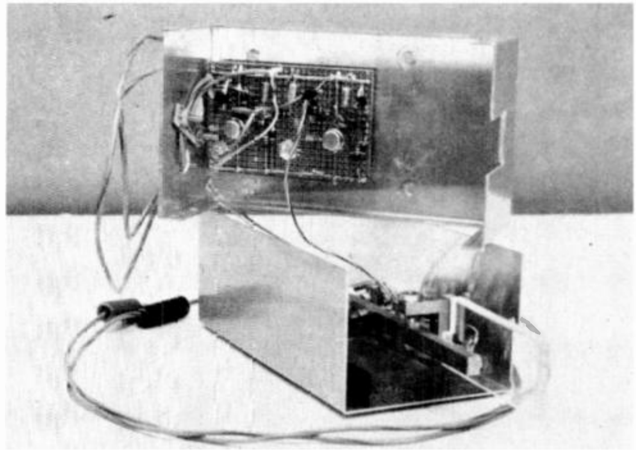
Connect the keying relay between KEYED LINE and BATTERY NEGATIVE on the external terminal board. I used a Magnecraft 132MPCX4 mercury-wetted reed relay with a 1000-ohm coil. (See the Allied Radio Industrial catalog.) I mounted this directly on the terminal board by means of two short pieces of No. 14 wire running from the relay coil to the terminals. The relay contacts then key a 50-watt buffer (in the cathode) on the rig.

The electrical change and relay can be omitted if you have only grid-block keyed rigs within the voltage limits of the keyer output transistor. The relay, of course, permits keying anything within the limits of the relay contacts. – *Albert B. Booth, W4SSM*

for CW Operation

AN IC QRP KEYER

For the better part of a decade, the author's major ham "hang-up" has been the construction and use of ultraportable battery-operated cw gear. Since this equipment is intended for use on mountaineering and hiking trips, power consumption is of more than academic interest. This article describes an electronic keyer which features variable speed and self-completing action while drawing a minimum of current. When operated from a 12-volt battery, the current required is only 10 mA. The keyer operates properly with a 9-volt battery, also.



The entire keyer is contained in a small Minibox. The paddle was built for the author by WA6EED.

The Circuit

The design, shown in Fig. 1, is based on a pair of inexpensive operational amplifiers, U1 and U2. In this application, however, the op amps are functioning without the usual negative feedback in a differential-comparator configuration. One input of each op amp is biased at a fixed voltage (about one-third of the supply voltage) while the other inputs are used to sense the voltage on the appropriate *RC* timing circuits. During key-up periods, the noninverting (+) input of U1 is held positive by R1 which keeps it saturated toward the positive supply. This keeps Q2 saturated. Similarly, the inverting (−) input of U2 is held positive by R2 keeping the output transistors cut off. A dot is initiated by discharging C2 through the collector of Q2. The output of U2 saturates positively which keys the transmitter. Simultaneously, Q1 saturates, and this action discharges C1. This turns off the output of U1 which allows Q2 to cut off. The dot capacitor, C2, is now free to charge through R2. When the voltage on the inverting input of U2 reaches the reference level on the noninverting input, the amplifier changes state with its output going nearly to ground potential. This terminates the dot and allows Q1 to cut off, which in turn allows the space-determining capacitor, C1, to charge. When C1 has charged to the same potential as the inverting input voltage on U1, this op amp changes state and Q2 goes into saturation again. If the paddle is still depressed, another element will be initiated. A dash is formed by discharging C3 in parallel with C2.

The network composed of R3, R4, and C4 introduces a subtle but essential delay into the cycle. This amounts to about 500 microseconds and occurs just after a dot or dash actuation. The timing capacitors, C2 and C3, are completely discharged for each element sent. The emitter follower, Q3, assures that the speed-control voltage remains stable during timing. Q3 could be eliminated if the voltage divider were much stiffer. However, this would increase the keyer current consumption. Two outputs are provided, Q4 being suitable for keying a positive voltage to ground (about 20 mA maximum) while Q5 is available for grid-block keying tube transmitters.

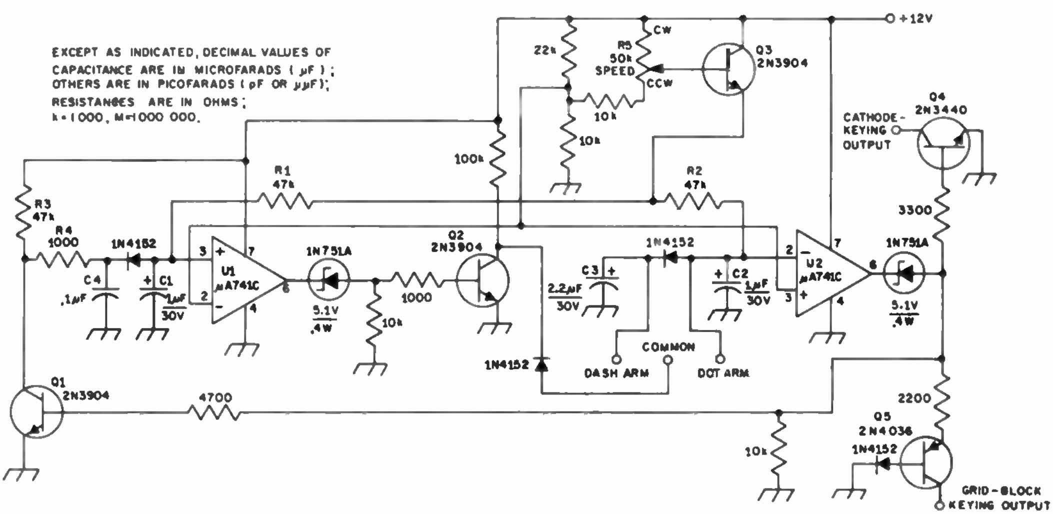


Fig. 1 — Circuit diagram of the keyer. Component designations are for text reference. Fixed-value resistors are 10 percent, composition; fixed-value capacitors are disk ceramic unless otherwise noted. R5 is a 50,000-ohm, linear-taper, composition control.

Construction and Operation

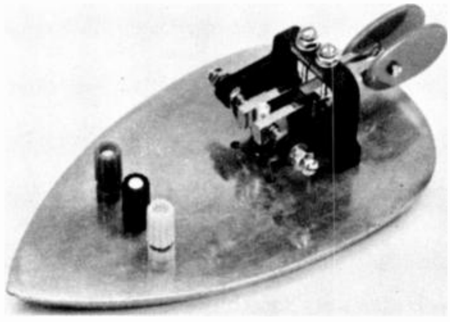
The construction of this unit is about as noncritical as any project can be. The author's unit was built on a small piece of Vectorbord. Building and testing can be completed in one evening. Ten-percent-tolerance tantalum capacitors were used at C1, C2, and C3. The Fairchild op amps are available from some *QST* advertisers. While intended for operation with a 12-volt supply, this keyer may be used with voltages up to 30. The speed is independent of the voltage used.

Although this device does not offer the precise timing of digital circuitry, the accuracy is more than adequate. The excellent performance, along with extreme simplicity and low power requirements, make the unit an ideal addition to the modern portable station. – *Wes Hayward, W7ZOI*

KEY BASE

Sick and tired of your key creeping all over the operating desk? One way to keep a key in one place is to mount it on a chunk of iron. And, an excellent base is the sole of an electric iron. The sole is made from cast iron, so it is easy to drill and machine.

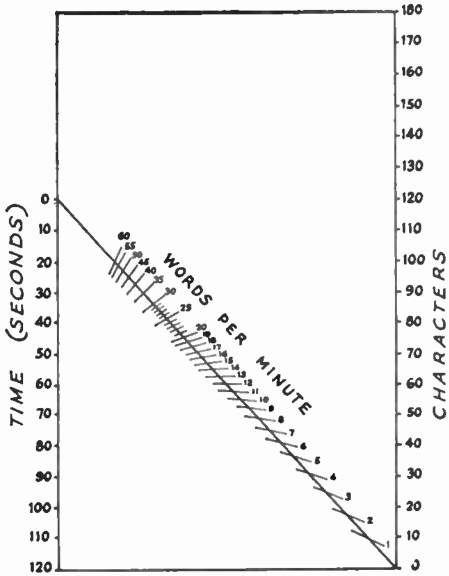
In the unit shown, a Brown Brothers paddle for an electronic bug is mounted at one end of the sole. At the other end are three E. F. Johnson insulated jack-top binding posts. Three rubber feet are mounted on the bottom. Depending on the size of the iron, almost any key or bug could be mounted on the sole. – *W1ICP*



A key base that will stay put.

CODE-SPEED NOMOGRAPH

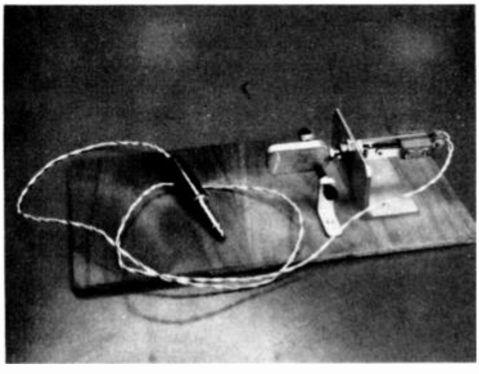
It's easy to determine one's code speed at a moment's glance by using the nomograph shown. Just place a ruler over the nomograph, with the left end of the ruler over the number of seconds required to transmit or copy the selected passage and the right end of the ruler over the number of characters in the text. The code speed is read directly from the intersection of the ruler and the middle scale. – *Lemuel D. Wright, WB2UYF*



Nomograph for determining code speed.

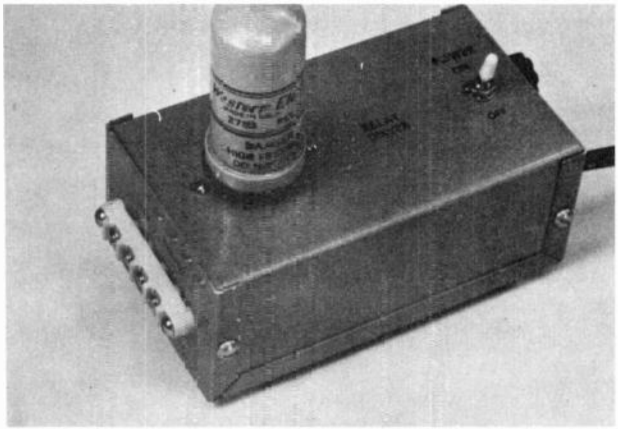
SIDE-SWIPE SPEED KEY

An inexpensive keyer paddle can be constructed easily. Shown here is a Switchcraft type 3006 switch used with a paddle to allow the operator to send straight-key cw with a side movement of the arm and fingers. The amount of effort required to send the higher speeds is greatly reduced.



for CW Operation

The switch was wired to key a transmitter by pushing the paddle in either direction. If desired, the wiring could be changed to allow keying an electronic keyer. I used an aluminum paddle which was screwed to the switch arm in place of the knob. A pair of guitar picks glued on the existing knob would serve the same purpose. Total cost of the unit is less than $4. – *Jim Mohr, WA7NYR*

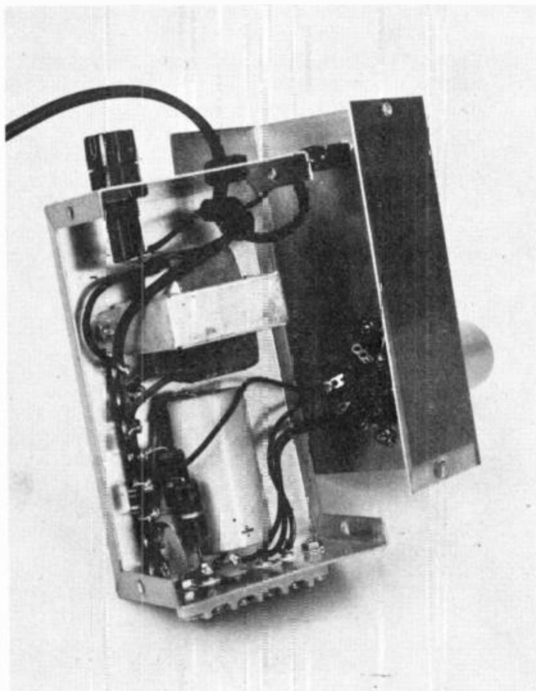


The relay driver as constructed by WA1CQW. The Western Electric 275B relay plugs into an octal socket.

A RELAY DRIVER FOR SOLID-STATE KEYERS

Some of today's transistorized electronic keyers will not operate with all transmitters because of the limitations of the transistor in the switching stage of the keyer. In many cases, voltages above 100 volts and currents greater than 30 to 40 mA will damage the switching transistor. One solution to this problem is the addition of an external circuit to actuate a keying relay, as shown in Fig. 1. The relay contacts then key the transmitter.

A medium-voltage power suppiy provides the current needed to operate the relay, K1. Relay keying is accomplished by closing the terminals connected to the relay coil. Keyed current is 8 mA, while the open-circuit voltage at the key-line terminals is less than 40 V – safe enough values for virtually any transistor-output keyer. And by observing the voltage polarity of the key-line terminals, the driver may be keyed with either an npn or a pnp transistor. The relay may also be keyed with a hand key connected to the key-line terminals. This would avoid contact arcing and the relatively high voltages which result across the open key terminals when a medium-power transmitter is cathode keyed. In addition, the relay driver may be used in conjunction with light-duty keying relays, such as reed relays often used in



This inside view shows the transformer mounted on the enclosure, and the rectifier and filter components mounted on a tie-point strip. The 4-lug screw-terminal strip for making external connections is ceramic, a Millen No. E-304; a phenolic strip may be used instead.

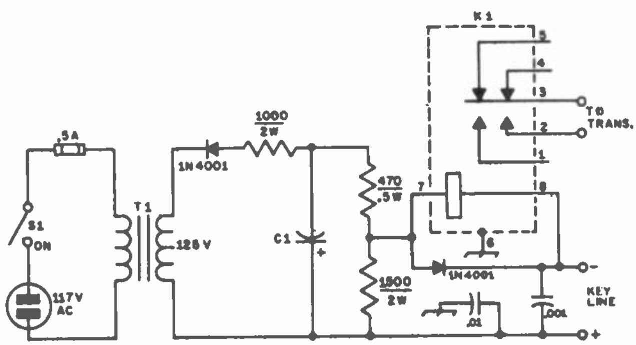


Fig. 1 – Schematic diagram of the relay driver. Resistances are in ohms.

C1 – Electrolytic; any value between 10 and 100 μF, 250- or 450-V rating.

K1 – Hermetically sealed relay, 4500-ohm, 8-mA operating current; mercury-wetted spdt contacts (Western Electric 275B or equiv.)

S1 – Spst toggle.

T1 – Plate-filament power transformer, 125-V, 15-mA and 6.3-V, 0.6-A secondaries; 6.3-V secondary unused (Stancor PS-8415 or equiv.).

solid-state electronic keyers, if it is desired to key large currents. The mercury-wetted contacts of K1 are fast acting with minimal bounce. This relay will have no problem following speeds of 50 or 60 wpm, and it is quiet in operation. For proper results, however, the relay must be operated in the vertical position. Otherwise the mercury pool will cause false closure of the contacts.

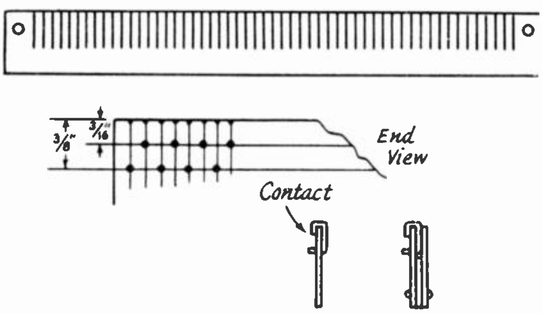
Construction

The relay driver shown in the photographs is built into a metal box measuring 2 1/8 × 3 × 5 1/4 inches. The power-supply portion of the circuit is contained completely inside the enclosure, to avoid having exposed voltages which could be dangerous to an operator. Although a 4-lug screw-terminal strip was used for making external connections to the instrument, phone or phono jacks could just as well have been used. Having all connections isolated from the metal enclosure offers advantages, though, if versatility regarding polarity of connections is desired – there need be no worry about negative- or positive-ground configurations.

Parts layout is not critical. Several types of relays having mercury-wetted contacts are available either new or on the surplus market,[1] and any having a dc coil resistance in the range of 4000 to 5000 ohms should work in this circuit. Be sure to take variations in pin connections into account. – *K1PLP*

MODIFICATION OF AN OLD TYPEWRITER FOR KEYBOARD USE

Here is a method for converting an old typewriter for use as a keyboard with an amateur keyer. Other than the typewriter, all that is needed is some copper wire for the contacts (No. 12) and a piece of plastic strip on which to mount them. The latter could be a piece of pc board with the foil removed.



When you turn over any typewriter you will notice that there is a metal spacer that separates the keys and ensures that they move up and down in a straight line. Here the back sides of the keys are all approximately the same height. It occurred to me that if I could make contact here, the keys would travel the same distance for all letters. As the keys are already grounded the letter contacts must be isolated on the contact board.

After removing the foil from the circuit board, take off the key-divider strip from the typewriter and place it on top of the board. Now mark the contact placement. Be sure the two are clamped together firmly for perfect alignment. Also leave space at both ends of the board for mounting to the typewriter frame. Now mark each keyway on the circuit board. Remove the divider strip and your board should be as shown.

Next draw two lines lengthwise, one 3/16 inch down from the marked edge and another 3/8 inch down. Take a small drill the size of the wire you will use for the contacts, drill alternate holes to give more space for soldering on the contact wires. To keep the wire from slipping out of place over the edge, I used a small three-cornered file and filed a notch in the edge of the board one half the thickness of the wire

Now you are ready to wire in the contacts. Cut a piece of No. 12 copper wire an inch long and bend in a 90-degree angle. Insert it in the hole and bend the wire over the edge of the circuit board in the notch. After wiring all 48 holes, cut off the excess leaving only enough for soldering.

The finished width and length of the board will depend upon the particular typewriter used. It is a good idea to glue another strip over the back of the board for greater strength. Clean off the back of the keys where they make contact and tin them with solder. This completes the modification. – *Jack F. Holt, W9RZI*

[1] Surplus W. E. 275B relays are available from Barry Electronics Corp., 512 Broadway, New York, NY 10012, under Catalog No. 20-145GA.

Hints and Kinks . . .

for VHF Gear

AUXILIARY SPEAKER FOR REGENCY HR-2

I have found that an auxiliary speaker sounds better than the built-in speaker of my HR-2. However, to connect an auxiliary speaker, disconnect the jumper wire on terminals 1 and 2 and fasten the speaker to the two screws on the rear terminal strip.

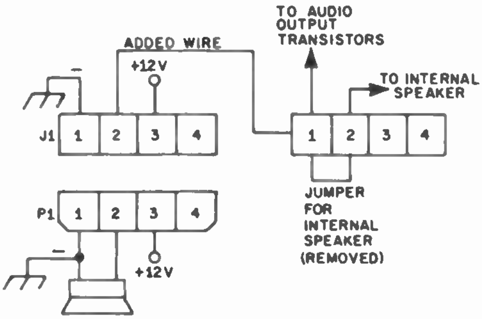


Diagram for the adding of an auxiliary speaker for the HR-2.

Since I use the transceiver both mobile and in the house, I found the best answer is to have a separate speaker at both locations, and to modify the power plug. The power plug has two unused pins on it. As shown in the drawing, connecting or disconnecting the power plug (and the antenna) is all that is required to shift the transceiver from car to house operation. – *Thomas W. Donohoe, W2NJS*

TENSIONING DEVICE FOR VHF TUNING MECHANISMS

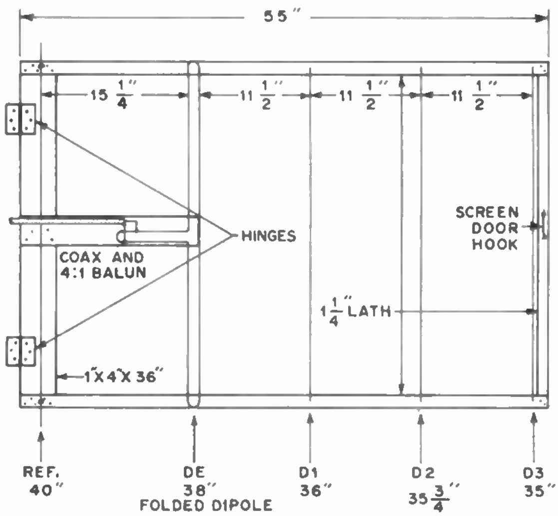
Homemade tuning capacitors and moveable vanes for vhf often exhibit erratic behavior because of lack of tension and consequent poor grounding and wobble. A simple tensioning device can be found in an old flashlight. Remove the large spring from the base of the flashlight and slip it over the tuning shaft. When the tuning knob is replaced, the spring is compressed between the front panel and the knob and keeps everything nice and tight. – *Michael Schmidendorff, WB8JXF*

2-METER GARDEN-GATE BEAM ANTENNA

In these times when many amateurs are moving to apartment type complexes, antennas, even in the vhf range, can present real problems. Many types of antennas are unsuitable because of their size and eye appeal to non-ham neighbors and landlords. One solution available to the 2-meter operator, living in an apartment having a balcony, might be my Garden-Gate Beam.

The antenna is constructed of light wood-lath material, 1 × 4-inch boards, two hinges, and No. 12 copper wire. The cost of this array is quite low. After construction of the gate, the wood should be sprayed with a clear varnish to seal it against moisture. The gate can then be mounted on the door frame to the balcony and a screen-door type hook and eye added to secure it to the wall when not in use. This will allow full use of the balcony for other purposes.

Matching the antenna for a minimum feed-line SWR is done by sliding a 4:1 balun along a quarter-wave matching stub and pruning of the driven element while monitoring a vhf SWR indicator or wattmeter. Spacing of the elements may be in any of many possible combinations; the ones used here are shown in the drawing. – *Jim McDonald, W4FBO/Ø*



The Garden-Gate Antenna was mounted on a frame 40 X 55 inches, made of 1 X 4-inch lath wood material. The element spacing in wavelengths was 0.2 between REFL and DE, 0.15 between DE and D1, 0.15 between D1 and D2, and D2 to D3.

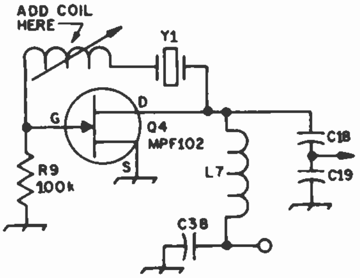
2-METER CONVERTER MODIFICATION

I had difficulty in getting the local-oscillator crystal on frequency after building the "High Performance 2-Meter Converter" from June, 1971, *QST*. The trimmer capacitor suggested in Fig. 1 (C36) did not have significant effect in my model.

In fact, my oscillator was operating 7 kHz higher than 58 MHz.

My cure for the problem was the addition of a small variable inductor in series with one leg of the crystal, as shown in the diagram. I used a 1/4-inch-diameter iron-core slug-tuned form with approximately 5 turns of wire wound over it.

I substituted Motorola HEP53s for the 40637s specified in the article. I was unable to get the 4 volts pk-pk output at the junction of C29 and C30 while using these transistors. The problem was solved by changing R13 to 100 ohms.

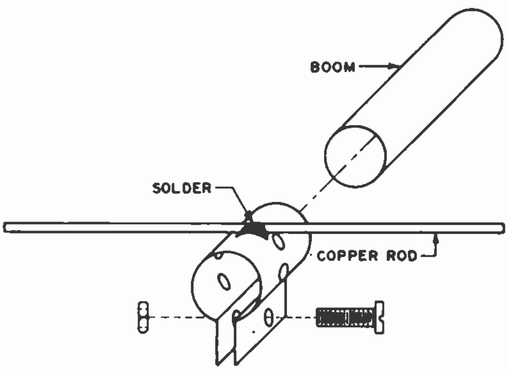


Modification of crystal oscillator showing addition of variable inductor in series with crystal.

Performance with this converter is outstanding! I'm hearing distant stations (60 miles or more away) while using a 19-inch ground-plane antenna 55 feet in the air. Others in Kansas City need beams to obtain equal reception! – *Bob Keplinger, KØCTK*

A UHF BOOM-TO-ELEMENT CLAMP

While building an experimental Yagi for 432 MHz I had need of a way to mount the elements to the boom without drilling holes in the latter, so that I could adjust the elements for proper performance. The best way that I could accomplish this was to make the elements of 1/8-inch copper rod and solder them to perforated steel tape of the kind stocked by many hardware and electrical supply stores.



To make the bracket, I cut a 4-inch piece of the tape and bend it around the boom, using a pair of pliers to get a tight fit. The perforated tape is actually a tin alloy and bends easily. It will take solder very well. The bracket was soldered to each clamp using a 50-watt soldering iron.

After optimum spacing is found a more permanent connection may be desired. All that is necessary is to drill the boom at this final setting and place a nut-and-bolt combination through a pair of the holes in the tape, which will prevent movement. – *Steve DiBartolomeo, WN6HOC*

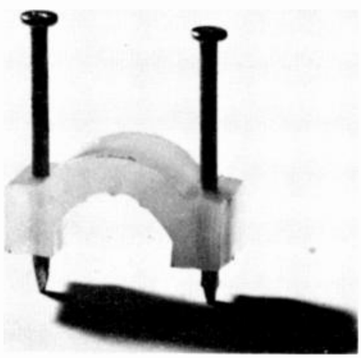
VHF GROUNDS

Securing short ground-return paths around tube sockets in vhf equipment can prove troublesome, when using aluminum chassis material. Brass rings can be fashioned from sheet shock by cutting out a circle of material with a socket punch. The diameter of the circle should be about one inch larger than the tube socket you intend to use. The inner hole can then be made with a socket punch of the correct diameter to allow the tube socket to pass through. Mounting holes are drilled so that the ring may be mounted below the chassis with the same bolts that hold the tube socket. It is then possible to make direct solder connections to the brass ring when returning bypass capacitors and related circuit elements to ground. – *W1CER*

A SOURCE FOR FEEDER SPREADERS

The plastic staples that are used to fasten electrical cables (such as Romex, BX, and UF) to the wooden interior parts of a building can also be used as feeder spreaders. The staple shown is made by the Madison Equipment Co., and costs 66 cents for a package of 50.

A very low-loss line with a characteristic impedance of 375 ohms can be made using the staples and No. 14 wire. Remove the nails that come with the staples and slide the staples over the wires. Since the fit is tight enough to prevent further movement once the staples are in place, no other means of fastening is required. – *Joseph Kilgore, W2EIF*



REDUCING OSCILLATOR DRIFT IN A 432-MHz TRANSMITTER

I was having drift problems with my 432-MHz transmitter as a result of the crystal oscillator being mounted on the transmitter main chassis. The drift would amount to 200 Hz or more during a half-hour schedule. I decided to rebuild and thermally isolate the crystal oscillator and first multiplier.

The circuit as shown in Fig. 1 consists of a JFET crystal oscillator and a bipolar transistor doubler. In order to adjust the crystal oscillator to the desired frequency and eliminate a capacitor shaft from coming out of the oscillator compartment, which would upset the thermal isolation, a varactor tuning diode was installed. A voltage divider using a fixed resistor, R1, and a ten-turn pot, R2, from a 9-volt regulated supply, was used to back-bias the varactor diode, CR1, and tune the crystal frequency.

With the values shown in Fig. 1, I was able to get about 40-kHz change in frequency at 432 MHz. If fm or frequency-shift keying is desired, the addition of an audio transformer, a three position switch, a pot and a key jack would be necessary.

To tune the oscillator initially, place the three-position switch, S1, in the cw position, the frequency control, R2, so that the arm is at ground, and the variable capacitor, C1, at mid-range. Connect the oscillator output to the transmitter, apply power and adjust L1 for maximum output power while observing the drive to some succeeding stage in the transmitter. Monitor the final transmitter frequency with a frequency meter or a calibrated receiver and adjust C1 for the desired frequency. This frequency will depend upon the values of C1 and CR1 and the characteristics of the particular crystal. Now set the frequency control, R2, to the opposite end of its travel (maximum voltage); the output frequency will now have increased. The value of R1 may be changed to obtain the desired upper frequency limit.

A 9-volt regulated power supply was used to operate this oscillator/multiplier and the output power was measured at 100 mW across a 50-ohm load. This was ample power for my transmitter.

A graph of bias voltage vs. frequency (F_o = 432 MHz) is shown in Fig. 2. The slope of the graph varies from approximately .08 volt/kHz at the lower end to 0.19 volt/kHz at the upper end of the curve. When using this circuitry for fm, the deviation will vary when changing the center frequency. There are various ways to circumvent this problem. However, I operate primarily on one frequency and therefore did not add the extra circuitry. If wide-band fm is used there will be some distortion because of the changing slope. The slope changes less toward the low end, so it would be best to set up the oscillator so that the desired frequency falls near the lower end. If the deviation is 10 kHz the frequency distortion will be near zero at the low end, increasing to 4 percent at the high end.

When using fm the peak af voltage should never be high enough to cause the varactor diode to conduct. When this happens severe distortion results. The varactor diode conducts when the

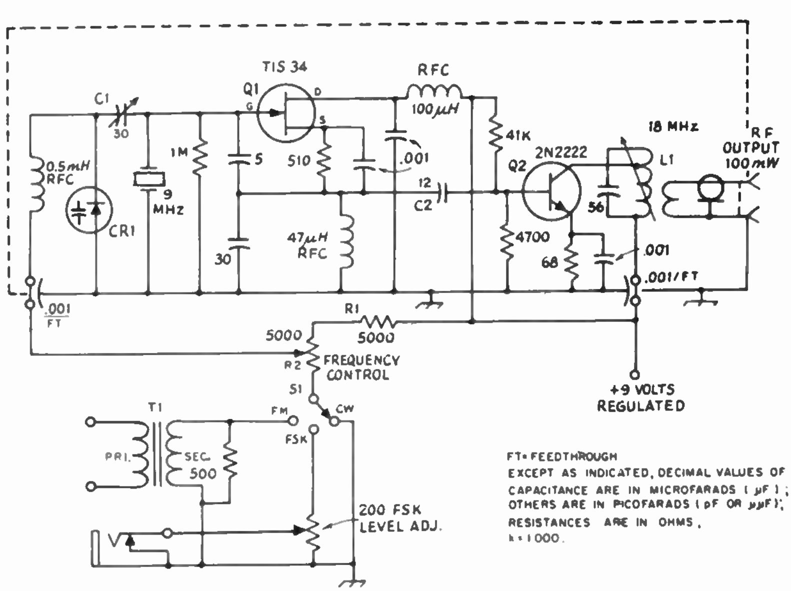


Fig. 1 — The schematic of the Varicap-controlled crystal oscillator used in a 432-MHz transmitter. C2 is selected to produce 20- to 25-mA collector current through Q2. CR1 is a 33-pF varactor diode (1N5146 or equiv.). L1 primary is wound with 20 turns of No. 27 enameled wire tapped at 9 turns from cold end on a 5/16-inch-diameter ceramic form. Secondary is 3 turns of No. 24 insulated wire placed over the cold end of L1. T1 is a line-to-line transformer.

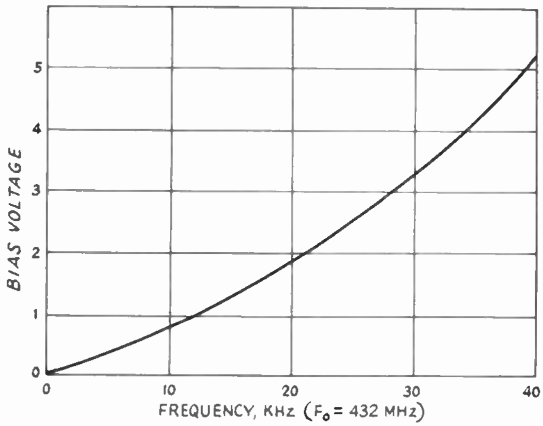


Fig. 2 — A graph of the bias voltage vs. frequency for the oscillator in the 432-MHz transmitter. C1 has been adjusted for about midrange of the tuning limits.

peak af voltage plus the bias voltage equals -0.7 volt. To be safe, never let the peak af voltage exceed the bias voltage.

In the fsk mode I was able to obtain up to 4-kHz shift at the low end of the curve and 800-Hz shift near the upper end of the curve.

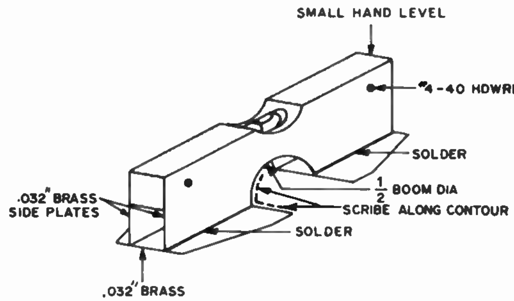
The circuit was built on a piece of single-sided copper-clad epoxy board and mounted in a 2 × 3 × 1/2-inch box. A second box with dimensions one inch larger than the oscillator/multiplier box was used as a thermal insulation holder. A block of expanded polystyrene was cut to fit inside of this box. The polystyrene block was cut in half and formed to fit around the oscillator/multiplier box. With the oscillator/multiplier box fitted in the polystyrene and clearance holes cut for the wires, the two polystyrene sections were glued together and placed in the larger box. Next, they were mounted on a rack panel along with the control pots, mode switch, af transformer and key jack. The completed unit was placed in a section of the rack where a minimum of heat and air movement existed.

This modification has greatly reduced the drift problem of my transmitter, and has made it much easier to get on frequency and stay there. — *C. E. Swedblom, WA6EXV.*

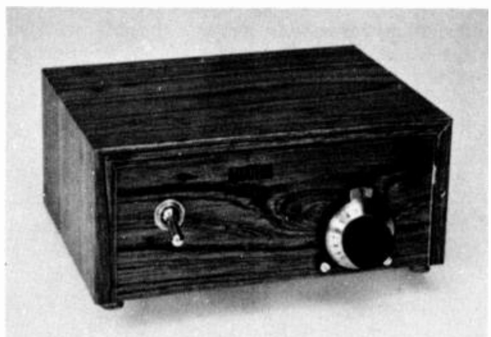
PRECISION ALIGNMENT ELEMENT-HOLE MARKING JIG

I recently ran into difficulty when trying to position holes in boom material for uhf beams. The attached sketch shows a jig which was built to accurately scribe marks on the boom. Constructed of .032-inch brass sheet, it can be made with hand tools. The two side plates are made together for accuracy and bolted to the small aluminum hand level. Then the horizontal bottom plates are soldered in place. A small long spring can be attached to the jig going under the boom which helps keep the jig in place.

First the boom is secured so as not to rotate. Scribe marks are then placed where the elements are to be located. Then the jig is placed on the boom and vertical and horizontal scribe marks are made. Accurately center punch each side of the boom where the scribe lines intersect. Working up in drill sizes to the desired hole diameter will result in a cleaner, rounder hole. Drill each side hole separately and do not drill completely through the boom. That is the cause of most misalignment problems. *E. R. Angle, WA6GUY*



Precision alignment jig. Clamp boom so as not to rotate. Assembly rests on boom in desired position and should be adjusted with the level so that scribe-mark centers are in a straight line.



A TUNER FOR ATV

Recently, a group of amateurs in the Springfield, Mass., area decided it was high time to get going on fast-scan amateur TV. Almost everyone in the group already possessed the necessary camera, so in this case half the battle was won. Surplus Motorola T-44 uhf transmitters, long retired from active duty in the two-way commercial field, were paired with the solid-state modulator described by WØMZL[1] to produce the high-resolution transmission system we desired. Several models of the 48-element collinear array presented in the *VHF Manual*[2] were mass

[1] McLeod, "ATV with the Motorola T44 UHF Transmitter," *QST* for December, 1972, and February, 1973.

[2] *The Radio Amateur's VHF Manual*, third edition, p. 213.

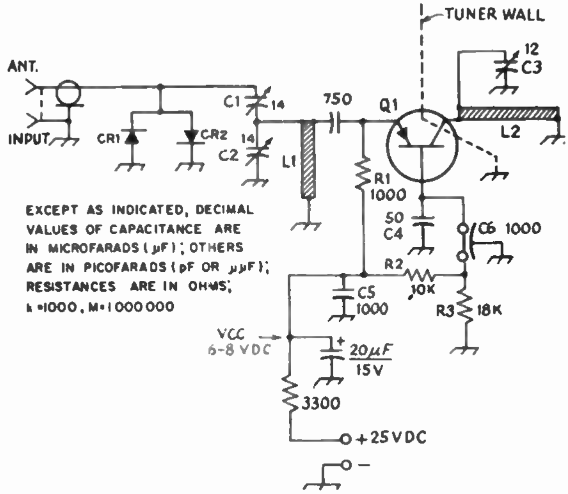


Fig. 1 — Schematic diagram of the 439-MHz preamp. Resistors are 1/4- and 1/2-watt composition.
C1, C2 — 14-pF trimmer, E. F. Johnson pc-type mount.
C3 — 12-pF glass trimmer.
C4 — 50-pF button mica.
C5 — .001-µF button mica.
C6 — .001-µF feed-through.
VR1, VR2 — 1N914. (May be eliminated in receive-only applications.)
Q1 — TIXM101. (See text.)
L1 — 1.5-inch (3.81 cm) length of No. 16 wire in a "U"-shaped coil.
L2 — 1.5-inch (3.81 cm) length of No. 14 wire. Antenna line in tuner rf cavity.

produced "antenna-bee fashion." These would give us the wideband, directive high-gain antennas required for strong, ghost-free pictures in our hilly and heavily wooded New England area.

The one remaining problem left to be solved was the receiving converter, needed to convert our 439.25-MHz signals down to a locally unused vhf TV channel for use with a common TV set. The use of 439.25 MHz, which is the national ATV channel, made it practical to consider the use of a modified uhf TV tuner for the heart of this portion of the system. The end result is described here, and represents the efforts of several evening's work by the author.

It is unfortunate that in the past many amateurs have modified uhf tuners for this purpose by simply padding down the three tuner lines. At best, this approach yields only mediocre performance, and has given modified uhf tuners the reputation of being a quick, but generally third-rate, method. This is unfortunate, for in our opinion with a little additional effort these tuners can be reworked to give outstanding performance. The basis for this modification comes from an earlier *QST* article by the author.[3] This article dealt with a tunable 440-MHz fm monitor receiver built around a uhf tuner front end.

Construction

A Sickles model 228 tuner construction was used, and these are readily obtained from discarded TV sets, or from various surplus outlets. The prospective builder should not despair if the exact tuner is not available. The majority of uhf tuners are enough alike in design and physical layout so as to give results similar to those obtained by the author.

The tuner to be used should be modified first according to the directions given in the author's *QST* article. The modified tuners provide around 12 MHz of coverage at 440 MHz. Unlike the tuner in the aforementioned article, in which an externally mounted preamplifier was used, the preamp used with the ATV version forms an integral part of the tuner assembly. The circuit diagram of the preamp is shown in Fig. 1. By using the antenna

[3] Bertini, "A Tunable 440-MHz FM Receiver," *QST* for July, 1971.

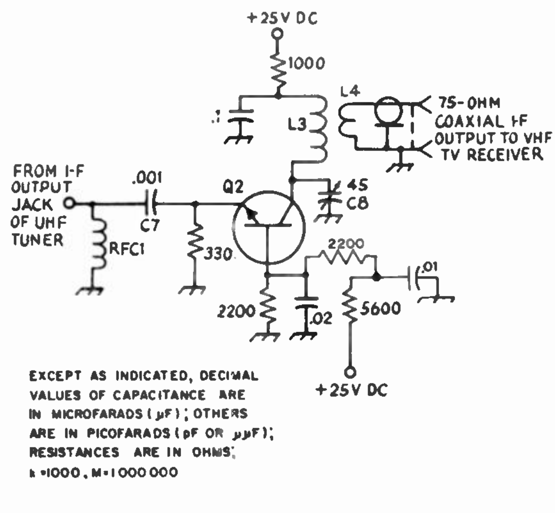
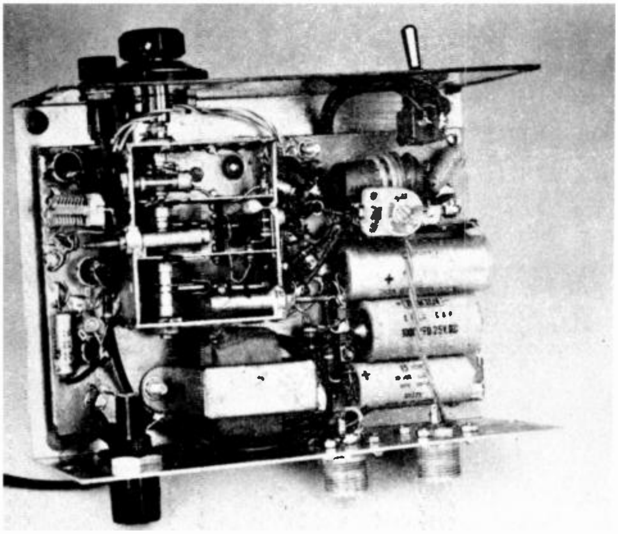


Fig. 2 — Schematic diagram of the i-f preamp. Resistors are 1/4- or 1/2-watt composition.
C7 — .001-µF disk ceramic.
C8 — 7 to 45-pF trimmer.
L3 — 5 turns No. 24 enameled wire on 0.5-inch (12.7 mm) OD toroid (red "E" core).
L4 — 3 turns No. 24 enam. over L3 cold end.
Q1 — 2N2222.
RFC1 — 330 µH.



Layout of the ATV tuner. The preamp compartment is visible in the upper left-hand portion of the photograph. Q1 is mounted in the side wall between the glass trimmer and the air trimmer. Leads to Q1 should be kept as short as possible.

line in the tuner as the collector output network for the preamp, a lower noise figure and increased sensitivity were realized over that of a remote preamp stage. With 14 dB of mixer noise being typical for these tuners, it is quite obvious *what* the rf stage is expected to overcome and improve upon!

Some of the later model 228 uhf tuners utilize biased hot-carrier diodes in the mixer. These are readily identifiable by the clear glass diode package which has a single black band, and by locating the resistor from the emitter of the local oscillator transistor, which provides the dc biasing for the diode. The lower noise figure of the hot-carrier diodes allowed these tuners to produce pictures with a better degree of "quieting," or less snow, at comparably lower signal levels than with tuners using the conventional germanium mixer diodes. These are generally 1N82 diodes in the Sickles tuners, and are identified by a clear glass diode package with a single gray and a single red band. The overall weak-signal detection ability was the same with both mixer types.

A slight improvement in sensitivity is possible by increasing the coupling between the mixer and antenna cavities of the tuner. The removal of the Faraday shield (if present) as described in the previous *QST* article, partially achieves this, and the coupling can be further improved by moving the antenna line closer to the coupling port. This is best done by the removal of the rigid line originally used, and by substituting an equal length of No. 14 bus wire in its place.

The preamp in this converter uses a Texas Instrument TIXM101 germanium uhf transistor, designed for low-noise amplifier applications up to 1200 MHz. They are, unfortunately, expensive and difficult to obtain, and were used only because several were residing in the junkbox at the time. However, any of the more common uhf pnp transistors will work equally well, with usually only a small change in base biasing being required.

The transistor body is mounted in a 3/8-inch (9.52 mm) hole drilled through the left side-wall of the antenna tuner cavity, just below the glass trimmer used to pad the antenna tuning line. This provides a convenient, ready-made shield for the preamp, and the shield lead of the transistor should be directly soldered to the tuner sidewall. For stable operation, the 50-pF base bypass capacitor is soldered as close to the transistor body (on the base lead) as is physically possible, and to the tuner wall, using extremely short leads. The collector lead is too short to reach the glass trimmer, and is lengthened with a short piece of 1/8-inch (3.18 mm) copper strap. It is possible for this rf stage to become regenerative under certain conditions of tuning in the presence of a reactive antenna load.

The tuner is mounted on a piece of heavy double-sided pc board. The tuner sidewall associated with the rf stage is seam soldered to the pc board where the two meet at right angles. The pc board surrounding the tuner case provides a convenient surface on which to build the remaining converter circuitry.

A noticeable improvement in overall performance was obtained with the inclusion of an i-f amplifier stage. The circuit diagram is shown in Fig. 2. A 2N2222 transistor was used as a grounded-base amplifier. The input to the i-f stage is untuned, and the purpose of the 330-μH choke is to provide a dc-return path for the mixer diode current. Any i-f between Channel 2 through 6 may be obtained, dependent upon the tuning of the i-f output and the operating frequency of the local oscillator. The coil information shown is for an i-f which corresponds to Channel 5. The i-f output is designed to feed an unbalanced 75-ohm line, and vhf TV sets equipped with only a 300-ohm input will require a 4:1 balun.

Conclusions

This article is written under the assumption that the reader has had some experience working with uhf circuitry. So far, six converters have been assembled with identical results, and the experienced builder should have little or no difficulty in making the necessary modifications.

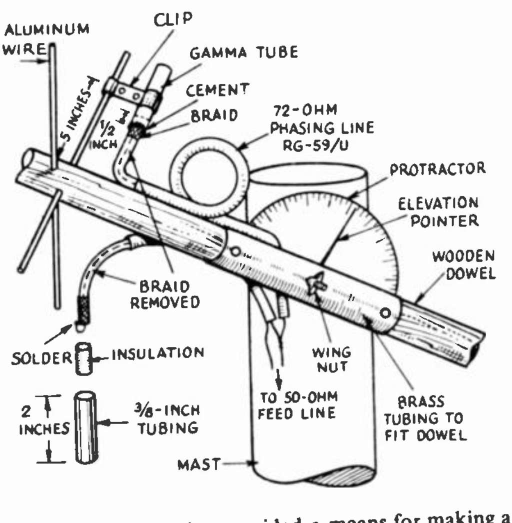
For a basis of comparison, several conventionally padded-down tuners were obtained. These were tried using the i-f amplifier, and with externally mounted preamplifiers. Both homemade and well known commercially made preamps were tried in these tests. The results showed that while some combinations could approach the performance of the author's unit, none could surpass it. Preamps tried in front of the author's converter gave varying results. Some caused little or no worthwhile improvement over the basic unit, while others actually caused a degradation in picture fidelity because of the increased selectivity.

These conclusions were drawn from on-the-air comparisons made with local ATV buffs, and by bench measurements using the author's Measurements Corp. model 84 signal generator. This tuner will provide a quick, practical and economical approach for the reception of ATV signals. – *Peter J. Bertini, K1ZJH*

INSTANT OSCAR ANTENNA

Field Day rule changes allowing credit for Oscar 6 contacts made a simple portable antenna system a necessity. Using KH6IJ's information on crossed-Yagi antennas (*QST*, January, 1973), engineers K1HTV and W1YNC came up with a suitable design. They then turned the whole thing over to chief technician, W1FTX to make it work. This he did and some of the ideas incorporated into the antenna may be of interest to other Oscar users.

The boom consisted of wooden-dowel stock approximately 3/4-inch in diameter. Two sections were used and were connected by inserting them into a short piece of brass pipe and then pinned.



The brass pipe also provided a means for making a good mechanical connection to the mast with a bolt and wing-nut combination. A pointer was attached to the boom in order to set the elevation on a protractor fastened to the mast. Wire elements of approximately 1/8-inch diameter then were inserted through holes in the boom at appropriate points for each 6-element Yagi.

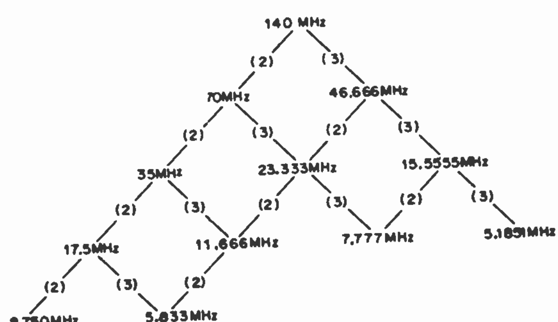
The gamma-matching section presented the most difficult problem since there were no elaborate shop facilities available. Details of the solution are shown in the drawing. A short section of braid is slipped over the dielectric of the cable and soldered to the inner conductor. This forms one plate of a coaxial-type capacitor. A thin layer of some suitable insulating material such as plastic tape is then placed over the braid and the assembly is inserted into a short section of aluminum tubing. It was found that only a short capacitor length (1/2 inch) was needed. This was cemented in place with silicone rubber sealer (bathtub caulking compound). The clip was positioned until a minimum SWR reading was found. The process was repeated for the other Yagi.

Performance of the antenna was adequate for its intended purpose. Little difficulty was encountered in working through the satellite and contacts were made during most passes, even some of the less favorable ones. – *W1YNC*

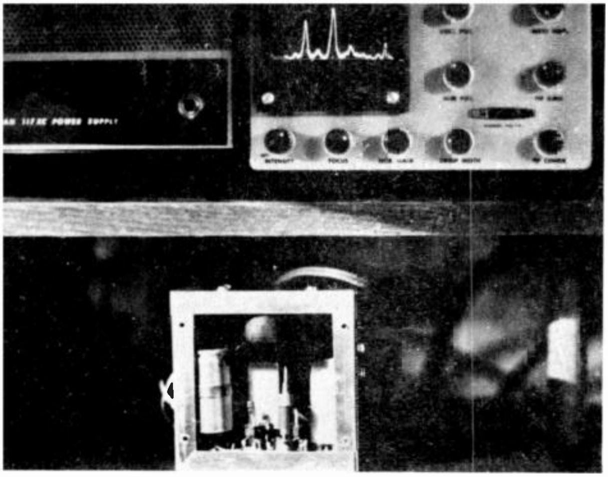
A SIMPLE FREQUENCY-MULTIPLIER CHART

Many times a vhf builder would like to see all the possible multiplication products to a given output frequency. This need most frequently comes up in planning receiver LOs (local oscillators) where the desired output frequencies are not as familiar as those of transmitter multiplier chains. The following simple chart allows one to see all possible choices at a glance. In the practical case shown here, an injection frequency on approximately 140 MHz was needed for converting a commercial fm receiver to two-meter operation.

The method assumes that only doublers and triplers are being used. The multiplication factors are shown across the chart. With the products thus displayed, the constructor can choose a frequency based on his own particular requirements. For example, one can see that starting at 8.750 MHz is not good from the standpoint of spurious products, but the cost of surplus crystals which could be etched or ground to this frequency is attractive. The spurious products could be attenuated by careful design and the use of more tuned circuits. The middle frequencies of 17.5 MHz, 11.666 MHz and 15.555 MHz look like especially good prospects. Most crystal manufacturers have a change in their price structure in this area, and you may be able to get on the low side of a price difference by proper frequency selection. With multichannel fm receivers it is easy to invest a fortune in crystals and using this chart could result in considerable savings. – *Ed Valmore, K2EVJ*



If only doublers or triplers are to be used, divide the desired output frequency by either 2 or 3. The locations of these numbers can be deduced from the example (second row). The multiplier factors are shown in parentheses. Divide the numbers obtained by the previous division and mark them down in the third row from the top. Continue the process until all the possible crystal frequencies are reached.



Panadaptor display and converter.

A LOW-COST I-F CONVERTER FOR SURPLUS PANADAPTORS

Contests and band openings in the vhf spectrum can be a challenge and great operating fun. During these events, it is a help to know where the activity is without wasting time tuning the band. With a spectrum analyzer or Panadaptor one can have an idea of band conditions at a quick glance.

There are quite a few surplus Panadaptors in the 25- to 45-dollar class, most of which have a 455-kHz i-f. Unfortunately, most ssb and fm transceivers do not have a 455-kHz i-f. This converter is intended for use with the Swan 250. However, the circuit will work with any i-f simply by changing its local oscillator frequency. The LO frequency is determined by the formula:

$$f_{LO} = f_{i\text{-}f} \pm 455$$

f_{LO} = Local oscillator frequency (kHz)
$f_{i\text{-}f}$ = First i-f in receiver (kHz)

The circuit consists of three stages: oscillator, mixer, and a broad-band amplifier. The 455-kHz amplifier consists of two standard i-f transformers. There are two 4.7-pF capacitors from primary to secondary on T1 and T2. These create an over-coupled stage, thus yielding greater bandwidth. The circuit layout is not particularly critical. However, it is a good idea to isolate the stages from each other to limit spurious responses.

Tune-up is fairly simply. First, a known frequency must be fed into the receiver and the receiver tuned to this frequency. L2 should then be adjusted so that the displayed signal is centered on the screen. Next the 4.7-pF capacitors, C8 and C9 should be disconnected (at point "X") and then T1 and T2 tuned for maximum signal output. Reconnect C8 and C9. Tune the upper slugs of T1 and T2, equalizing signals on the high-frequency side of the display and then tune the lower slugs for the low-frequency side of the display. It will take about three sets of adjustments to obtain a flat response. – *Warren Dyckman, WA2CAC*

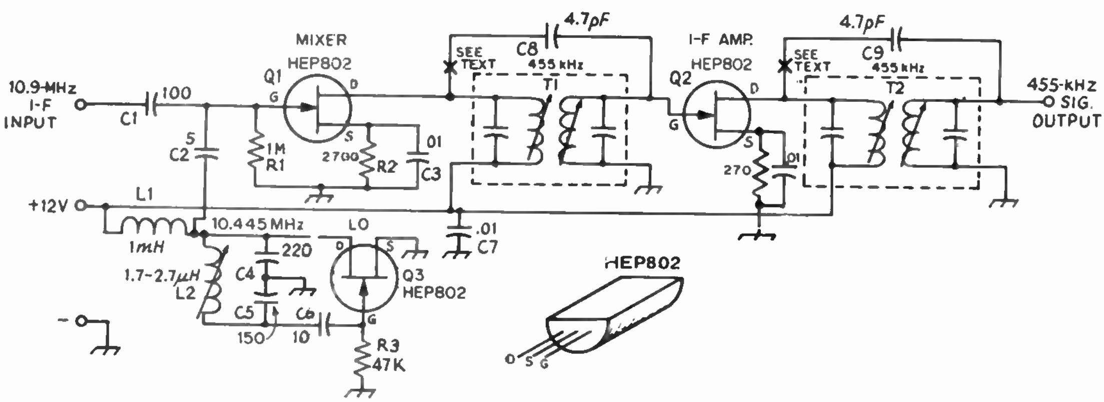
VXO FOR OSCAR 6

Here's an idea for Oscar 6 users who are "rockbound" with their two-meter rigs. Put a 3- to 30-pF trimmer across the crystal and you can swing its frequency quite nicely. I employ one of the Phillips trimmers (it uses concentric cups, one fixed and the other threaded) and adjust it with a piece of plastic tubing cemented to the rotary part. I can QSY about 3 kHz with an 8-MHz crystal, which results in 18 × 3 = 54-kHz variation on 2 meters. This gives me crystal stability, and VXO capability. The added capacitance lowers the frequency, but if you start from the right spot it works out quite well. This will not work with all oscillator circuits, but does very well with the circuit in my Ameco TX-62, and with the crystal oscillator used in the National VFO-62.

If you can't find a modern-day equivalent of the Phillips trimmer, you may not get as great a frequency change, because the Phillips has a very low minimum capacitance. The ΔC is large, whereas in ordinary trimmers the minimum-to-maximum ratio it not as good. – *Richard Smith, W1FTX*

MOUNTING A 2-METER 5/8-WAVELENGTH ANTENNA ON A VW FASTBACK

Since the product review describing the Regency HR-2 appeared in *QST* for August, 1971, this writer has been asked many times how he



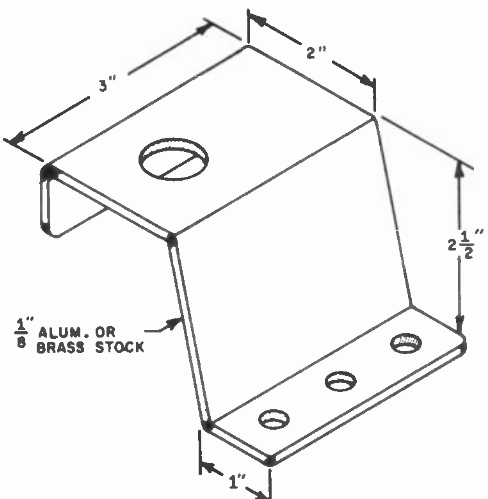
mounted the antenna mentioned in the write-up. Because a VW was specified as the automobile in use during the evaluation period, several VW owners have asked for this information.

The photo shows how an aluminum bracket can be formed to support the antenna and its base mount. Shown here is an Antenna Specialists 5/8-wavelength vertical whip for use on 2-meter fm. The assembly is mounted on the right front side of the car, just ahead of the windshield (opposite the bc antenna). The transceiver is mounted under the dash on the passenger's side of the front seat. This arrangement permits a very short length of 50-ohm coaxial feed line to be used between the rig and the antenna – approximately 3 feet.

The aluminum bracket is made from 1/8-inch-thick stock. The heavy-grade material is necessary to assure rigidity and long life for the bracket. Attachment to the car body is made inside the trunk lid by means of three No. 8 sheet-metal screws. The coaxial cable is simply routed through the mating surfaces of the trunk lid and car body, and is held in place (without undue crimping) by the weather seal of the lid.

The advantage of using this mounting technique is that no exterior holes need to be made in the car body. By installing the antenna at the front of the car, ignition noise is less likely to cause a problem with reception because the VW engine is at the rear of the vehicle.

Performance has been good with the antenna side-mounted as shown. No troublesome lobes have been evident. W1KLK has his antenna mounted in a like manner on his VW Squareback, and reports good results. – *W1CER*



Sketch of the aluminum bracket showing the approximate pitch of the bends. Some experimenting may be necessary to obtain the precise bend angle needed to provide a true vertical positioning of the whip.

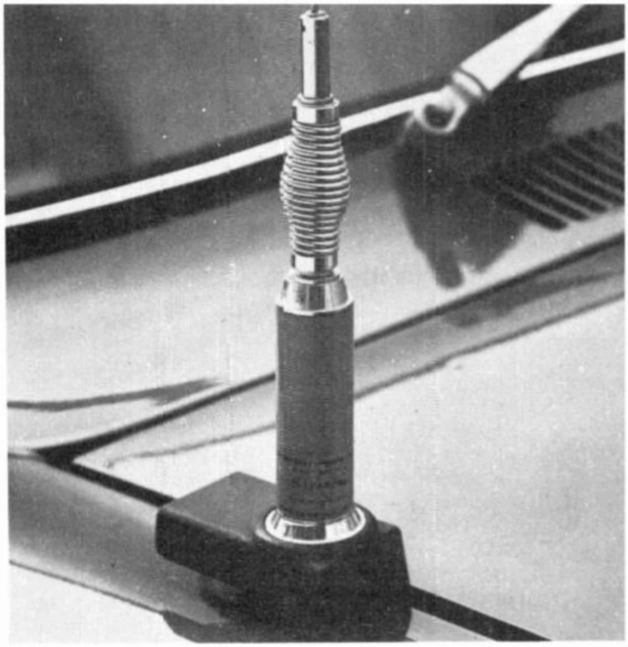


Photo showing the antenna attached to its homemade bracket. The bracket has been painted to match the color of the car. The feed line is routed through the crack between the trunk lid and fender.

ANOTHER WAY TO MOUNT A 2-METER ANTENNA ON A VW

Hints and Kinks for January, 1971, *QST* showed a method of mounting an antenna on a VW Squareback sedan. The "bug" does not lend itself well to that mounting bracket, so a different method was devised. The photograph shows a way of mounting a homemade quarter-wavelength antenna without drilling holes in the car body.

A 1/2-inch-thick piece of Plexiglas, 2 × 3 1/2 inches, has a 1/4-inch-diameter hole drilled through one end. At a right angle to this hole are two other holes which are tapped for No. 6 machine screws. A 1/4-inch-diameter aluminum rod, 19 1/2 inches long, is inserted in the vertical hole and secured with two setscrews. The bottom setscrew has a solder lug attached to it for cable connection.

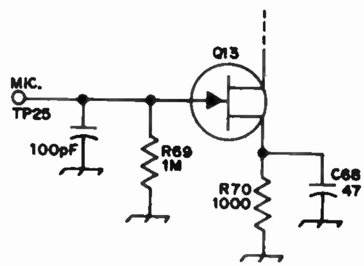
The Plexiglas assembly is fastened to a small piece of 1-inch angle aluminum with two No. 8

screws. The bracket is attached to the parking lamp using the existing self-tapping screws. A few metal washers and a grommet are placed under the rear end of the aluminum angle to position the antenna upright. – *W1FBY*

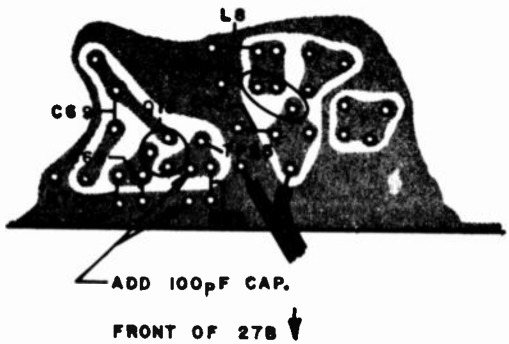
RF FEEDBACK IN THE CLEGG FM-27B

In some installations, there is the possibility of rf feedback through the mic-input circuit in the Clegg FM-27B 2-meter transceiver. Typical symptoms include hum on the transmitted carrier and poor audio quality. If sufficient rf energy is picked up on the wire going from the mic connector to the FET (Q13), the FET becomes forward biased and may detect even a small amount of ripple on the carrier.

The solution to the problem is to solder a 100-pF capacitor from the gate of Q13 to ground as shown on the schematic diagram. The capacitor can be installed in the two holes, indicated by the arrows, that are already drilled in the circuit board. – *R. M. Ziegler, WA2ILB*



Mic-input circuit of the Clegg FM-27B 2-meter transceiver. Adding the 100-pF capacitor, shown from the gate of Q13 to ground, should aid in eliminating problems of rf-feedback into the microphone circuit.

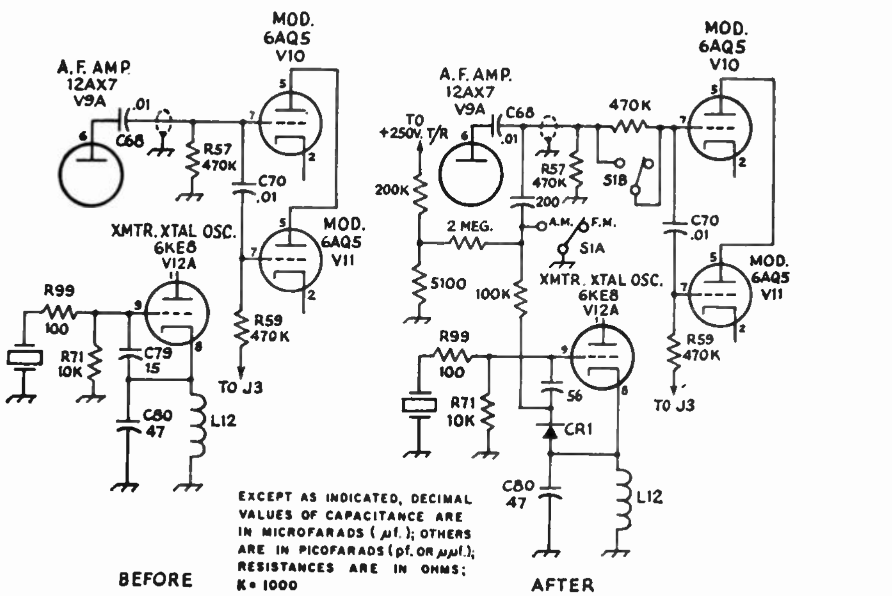


The 100-pF capacitor may be added at the point shown. Holes already exist on the circuit board of the FM-27B for installation of the capacitor.

F M FOR THE CLEGG 22'ER

Adding f m operation to the Clegg 22'er is very easy. The schematic diagram shows how the transceiver is modified to permit frequency modulation of the transmitter crystal oscillator. Instant selection of a-m or f.m. can be achieved by installing a slide or toggle switch under the accessory control jack, J_2 on the rear of the 22'er. No changes to the receiver are necessary to copy f m signals; slope detection can be accomplished by careful tuning. – *Dave Porter, K2BPP*

Modifications to the Clegg 22'er for f m operation. With the exception of CR1, a 1N2071 or 1N3182 diode, and S1, a d.p.d.t. toggle or slide switch, components with designators are original parts. Resistors are 1/2-watt composition, and capacitors are disk ceramic.



Hints and Kinks . . .

Chapter 9

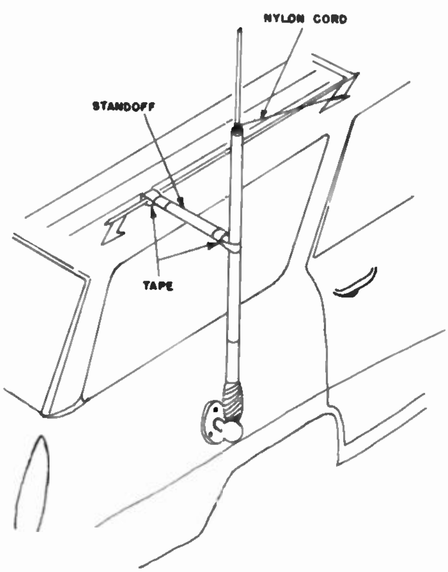
for Mobile and Portable Gear

ELIMINATION OF STATIC IN FAN DRIVE BELTS

Receiver static is sometimes a problem for me when my forced-air furnace operates. I traced the trouble to the fan belt. I had heard that a belt dressing was available that would cure static, but I wanted to eliminate the noise as quickly as possible. Using a rag saturated with alcohol, I cleaned the belt thoroughly and the static completely disappeared. – *James S. Collier, W2QBB*

PREVENTING MOBILE ANTENNA SWAY

It wasn't very long after going mobile that I had to solve the problem of antenna detuning because of antenna sway while in motion. As many before me have done, a piece of nylon cord tied to the luggage rack eliminated the leaning backward of my Webster Bandspanner. But *sideways* motion caused operating problems.



The 15-cent golf club separator, widely acclaimed for its coil-form shape in the Delta Loop antenna article, was again pressed into service. It is easily fashioned into a standoff insulator. The ends are notched to fit both the antenna and luggage rack, and it is held in place by wide flexible tape. If the tape breaks and the standoff is lost, it can be replaced cheaply and easily. – *Baxter Williams, W5KYB*

A LOCK FOR THE COLLINS KWM-2 MOBILE MOUNT

The Collins KWM-2 transceiver represents a rather large financial investment for most hams and also a considerable temptation for any would-be thief who sees it mounted in a car. Rather than sacrifice the utility of the rig by always removing it from the car whenever I parked, I decided to add a simple locking adapter to the mount. In addition to the necessity of making the locking adapter rugged enough, a secondary consideration was that the unit not require the drilling of any holes in the KWM-2, which might detract from its resale value.

My solution was to buy a common hasp which was modified as shown in Fig. 1. The hasp was then bolted to the KWM-2 mount by means of 6-32 screws.

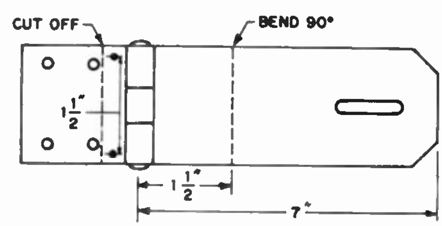
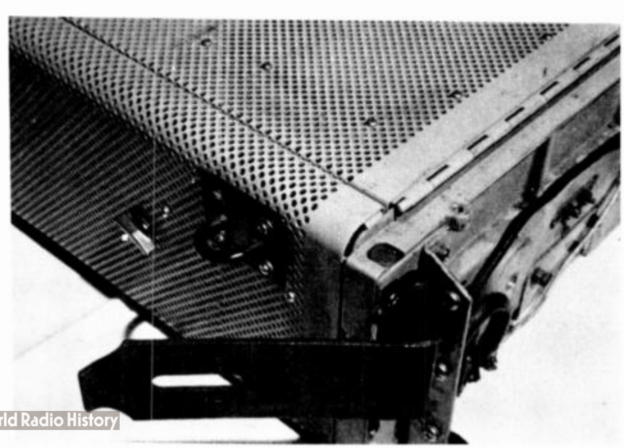


Fig. 1 – Recommended modifications of a standard hasp.

The other part of the hasp was screwed to the right side of the KWM-2 with four No. 4-40 screws. These screws pass through the existing holes in the transceiver case without any additional drilling. They are secured by means of nuts and lock-washers on the inside of the case. The nuts are inaccessible to a potential thief because of the position of the final-amplifier rf shield. The transceiver must, of course, be removed from its case in order to attach the locking adapter. – *Thomas Biddle Perera, K2DCY*



SOME ANTENNA IDEAS FOR 1.8-MHz PORTABLE OPERATION

Antennas for portable operation should be simple to erect and easy to adjust. The hf bands present few problems, but 160 and perhaps 80 meters require a bit more thought. A cottage was available to the writer, where the local operating competition was minimal, so this location was used during the last few ARRL 160-Meter Contests. Since frequent ice storms in the area made permanent antennas unadvisable, a Field Day approach to the problem evolved. Some of the more successful ideas may be of interest to amateurs in similar situations.

While a number of antennas were considered, the end-fed half-wave wire antenna had a number of desirable features. It can be bent into a variety of shapes and doesn't require a low-loss ground connection at the feed point. A single ground stake should suffice since a current node exists at the ends of a half-wave radiator. Other types of ground loss exist (unless an extensive radial system is used) but resistive losses at the feed point are minimized. Most of the useful radiation results from those parts of the antenna where the current distribution is the highest. In the half-wave case, this occurs in the middle third, which should be the highest part of the antenna. An inverted-V arrangement can be used, but if it is symmetrical about the center, be sure the apex angle is greater than 90 degrees. The outer thirds can then be run off in some convenient direction and folded back if necessary. In fact, one of them can act as a lead-in to the matching network. A half wavelength on 160 meters may seem like a lot of wire to get up in the air but remember, only the middle third (approximately 90 feet) has to be strung between the highest support points.

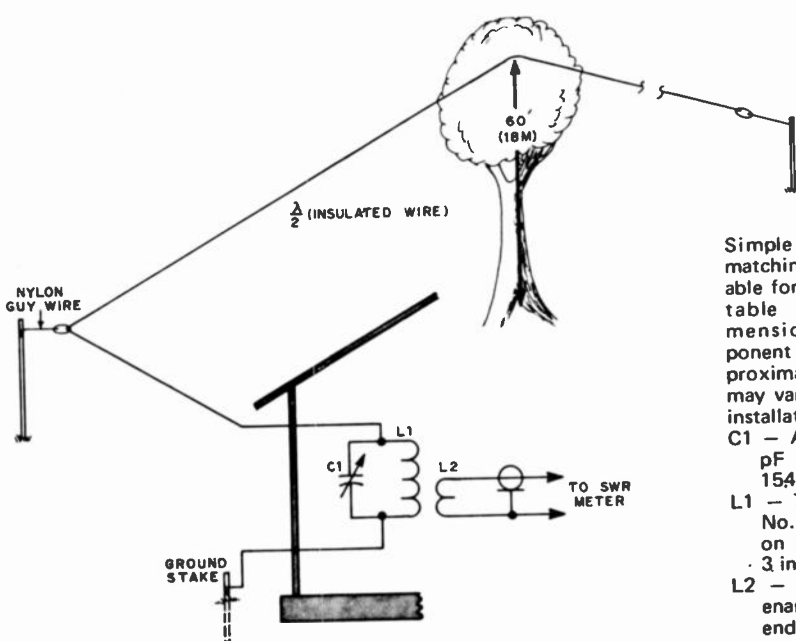
Before the contest, the writer spotted an assortment of plastic-coated hookup wire at the local outlet of Allied Radio Shack. There were five rolls of various gauges with 100 feet on each roll. The price (less than \$4) was attractive. A roll of the heavier-gauge wire was used for the middle of the antenna where the current distribution is the highest, with the lighter-gauge wire spliced on each side. A line attached to an arrow was shot over some trees and then the wire was pulled through. The plastic coating on the wire eliminated the need for insulators. While existing structures can be used to support most of the antenna, one portable support is usually needed for the most convenient layout. Surplus MS-44 mast sections are handy for this purpose since they are practically self-supporting up to 25 feet.

The matching network shown in the drawing can be constructed easily from junk-box parts. With a receiver and the antenna connected, C1 is peaked up for maximum signal strength. Only slight adjustment with the transmitter on should be necessary to get the SWR to a minimum.

Although the height of the antenna might be considered low, the performance of this one was very satisfactory. Signal reports were superior to those with previous antennas used. But perhaps best of all, the entire system can be dismantled in a few minutes and the wire rolled up on a short piece of board for next time. – *W1YNC*

ALTERNATOR NOISE SUPPRESSORS

Recently, while working on noise suppression after the installation of a mobile receiver in my car,



Simple antenna and matching network suitable for 160-meter portable operation. Dimensions and component values are approximate only, and may vary with different installations.

C1 – Air variable, 150 pF (E. F. Johnson 154-8).

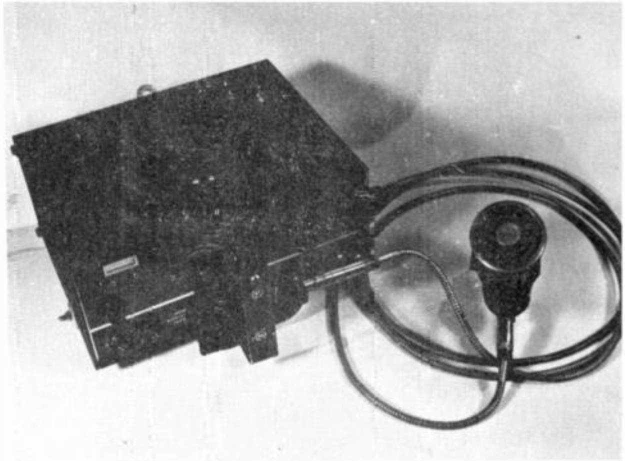
L1 – 70 μH, 28 turns No. 18 enam. wire on 3-3/4-inch form, 3 inches long.

L2 – 4 turns No. 18 enam. wire on cold end of L1.

for Mobile and Portable Gear

I found a simple and easy way to protect the suppressor from the engine compartment environment, and provide a neat appearance also. The 4-ohm resistor and .002-μF capacitor, series connected as suggested in the *ARRL Mobile Manual*, is encapsulated by the use of a hot-glue gun, an item which is in prominence these days.

I have found that this filter works every bit as well as a commercially built unit did before it fell apart. My suppressor has not failed to work in weather where the temperature has dropped to −10° F, nor has the glue come apart as it did in the previous unit. – *Richard T. Pomerleau, WAØSTJ*



REMOTE CONTROL FOR A MOBILE TRANSCEIVER

Why clutter up the front seat of your car with mobile gear? It can be installed easily back in the trunk compartment, out of the way, and still be controlled from the dashboard. Running the speaker, volume control, and mic leads up front is relatively simple, but frequency control is more difficult. This article shows one method of how the latter can be done with a Swan Cygnet 260.

Two surplus-type CRV-23253 receiver-tuning controls are needed, with 12 feet (4.6 m) of flexible control cable, type MC215. These can be obtained from Fair Radio Sales in Lima, Ohio. Other components necessary are a flexible coupling to fit a 1/4-inch shaft and hardware to mount one of the receiver heads on the transceiver.

Construction

The dial assembly from one of the receiver heads is removed and the head is mounted on front of the transceiver as shown in the photograph. The author drilled a hole in the front panel of the 260 and fastened a flange directly to the transceiver dial, as shown in Fig. 1. This was necessary since the dial drive on this transceiver was of the friction type and some slippage occurred. Only minor modifications may be necessary with transceivers that use other types of drives.

The flexible cable is then run up to the dash where the other receiver head is mounted. Before the setup is installed, the calibration on the dashboard head should be changed so that it matches up with the one on the transceiver. A new one was made up by the author and consisted of a plastic base with a shoulder and a dust cover. Sandwiched in between is an opaque dial with the new calibration marks. These can be of the builder's choice and decal-type numbers were used in the unit shown. – *George Tamer, W4BAD*

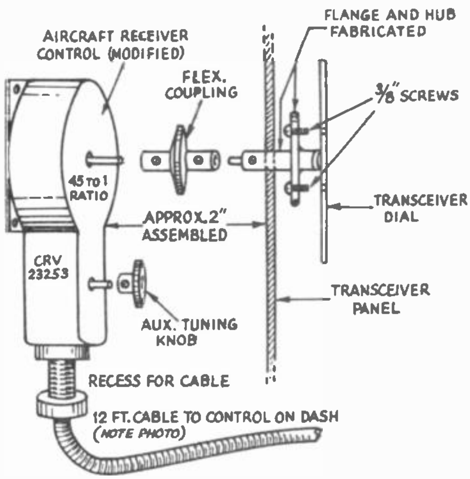
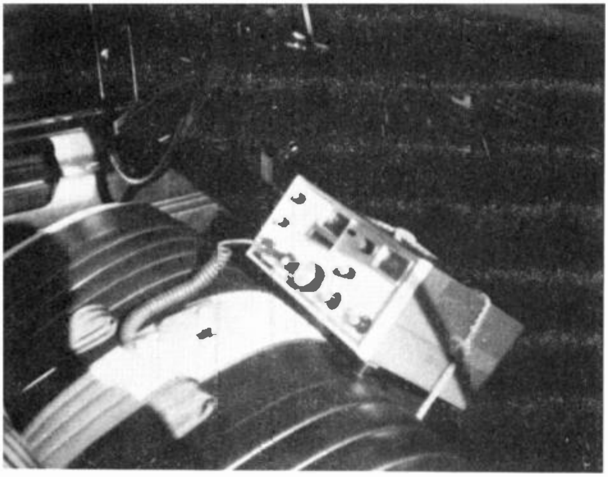


Fig. 1 – Detailed drawing showing how the receiver head is coupled to the transceiver dial.

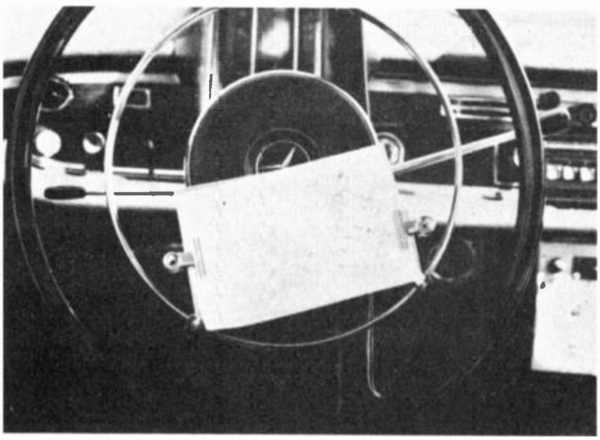
Modified drive head and remote tuning control. The head at the right was simply calibrated by drilling holes in the original dial plate at the calibration points and pasting numbers on the back of the plate.



AN INEXPENSIVE MOBILE MOUNT

The heart of this mount is a boat tie-down strap. This strap is made of cloth-covered nylon, or rubber, and is available from marine supply companies in almost any length. The price ranges from 49 cents to one dollar and the strap comes complete with hard plastic hooks on each end. (Even in colors!)

Just set the rig on the transmission hump, prop the front feet on the seat, and hook one end of the tie-down strap to a spring under the seat. Then stretch the strap across the rig and hook it to a spring on the other side of the seat. If you have any slack in the strap, and can't find a spring far enough back to keep tension on the rig, tie a knot in the strap. If the connections for the rig are too near the floor, place a small piece of wood or rubber under the rear of the rig. Removal is easy; just unhook one end of the boat tie, pull the rig up, and let the tie fall under the seat until you wish to use it again. – *Dave Ingram K4TWJ*



MOBILE WRITING BOARD

The photograph shows a writing base made from a small piece of sheet aluminum. It is secured to the horn rim by means of two cable clamps. The spring clips allow the paper to be changed easily. – *O. W. H. Johnson, W1JY/6*

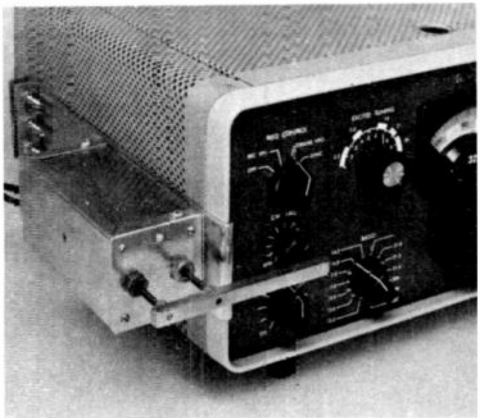
MOBILE-ANTENNA-TUNING TRICK

When matching a mobile antenna there is a simple trick to use in determining whether the antenna is resonant higher or lower than the desired frequency. With an SWR bridge in the line, tie 10 feet or so of fish line or twine to the top of the antenna. Switch the SWR bridge to read reflected power and then pull the whip over toward the body of the automobile. This effectively increases the capacitance across the whip. If the reflected power reading drops, it indicates the antenna is too high in frequency. Pulling the antenna away from the body, and having the reflected reading drop, indicates the antenna is too low in frequency, because the capacitance across the whip is reduced. If the reflected reading increases with the whip bent in either position it indicates the antenna is matched.

If a tapped coil is used in the antenna, the tap can be changed to raise or lower the resonant frequency as required. Many of the commercially made whips are adjusted by raising or lowering the top section, above the loading coil. Lengthening the top portion *lowers* the resonant frequency and shortening the top length *raises* the point of resonance. – *W1ICP*

Hints and Kinks . . .

for the Rig



External actuator allows convenient spotting of the 32S-3 without internal modification.

A CONTEST SPOTTING SWITCH FOR THE 32S-3

For the cw operator, spotting with the Collins 32S-3 can be difficult. It is a two-handed job, one hand on the VFO knob, the other on the spotting button. Some operators have big enough hands so that they can actuate the spotting button and turn the VFO knob at the same time, using one hand. Most don't. Now the question was, "How to remedy this situation?" An obvious answer was to obtain a duplicate of the spotting switch and place it in a more convenient position.

After opening the cabinet of the 32S-3, this little spotting switch was found to be a multilayer, multicontact type. The switch is by no means of the common junk-box variety. Since the idea of handling the problem electronically was rejected, the prospect of a mechanical solution was considered. The next step was to find a means of closing the existing spotting switch. After taking a relay, and building a mechanical linkage for it, it was found that the relay could not deliver enough force to actuate the switch. Something bigger was needed. While digging through the junk box, an old washing machine solenoid was found. Once it was determined that the solenoid still worked, and more importantly, definitely had enough power to actuate the switch, work on developing a mechanical linkage was started.

Construction Details

The major problem that presented itself was how to mount the unit without causing damage to the cabinet of the 32S-3. A 2-inch aluminum bracket was made and hooked at one end to the front lip of the transmitter, and through the mobile mount in the rear. The bracket is made taut by bolts which can be tightened. This system means that no holes need be drilled in the cabinet. To this bracket a 2 × 2 × 6-inch aluminum box (which houses the solenoid and its mechanism) was

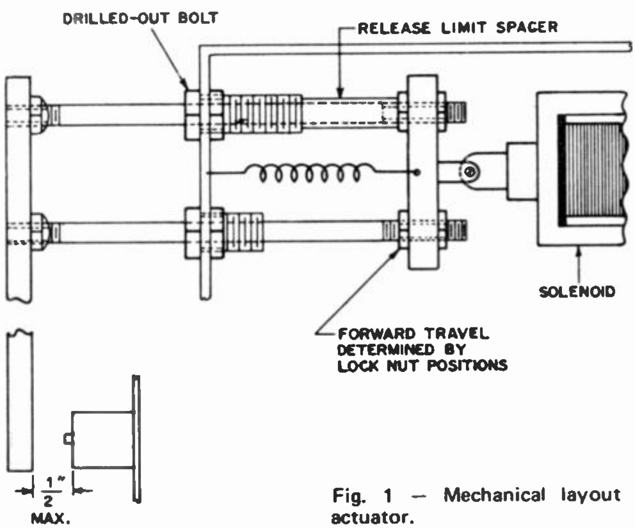
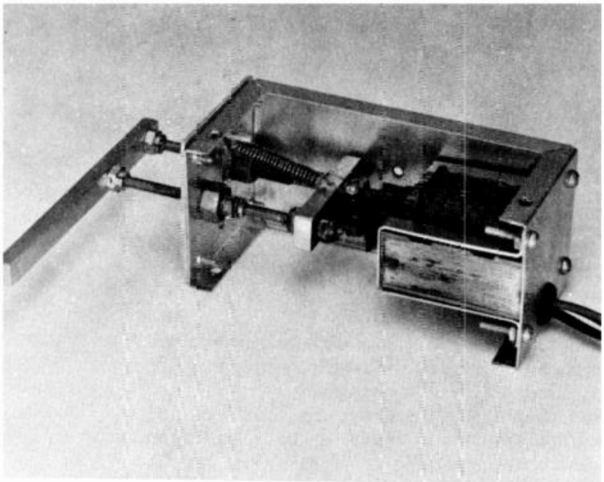


Fig. 1 — Mechanical layout of spotting-switch actuator.



Close-up view showing solenoid, actuating mechanism, and return spring. The limit sleeve is on rod behind return spring.

riveted. The solenoid was then mounted to one end of the aluminum box by means of two aluminum straps.

The actuating mechanism consists of a 1/4 × 3/16 × 1/4-inch aluminum bar which reaches from the outboard solenoid box to the spotting button. Two 1/8-inch rods are tapped into the bar and backed up with stop nuts. These rods run from the actuating bar into the solenoid box. The reason that two 1/8-inch rods were used was to assure the positioning of the aluminum bar over the spotting button. A spring is utilized to return the bar to the neutral position after the solenoid has been released. Bearings for the two linkage rods are made from two 3/8-inch bolts. A hole is bored through the center of each bolt, slightly larger than 1/8 inch, to provide a sliding fit for each rod. In order to limit the outward travel of the arm when the solenoid is released, a sleeve is fabricated and slipped over one of the rods. The inner diameter of the sleeve should be slightly larger than 1/8 inch, to provide either a sliding or snug fit with the rod. Inward travel of the rod is limited by the position of the bar itself. Adjustment of this inward travel is accomplished by adjusting the depth of the rods into the bar. Once the adjustment is made, the stop nuts are tightened.

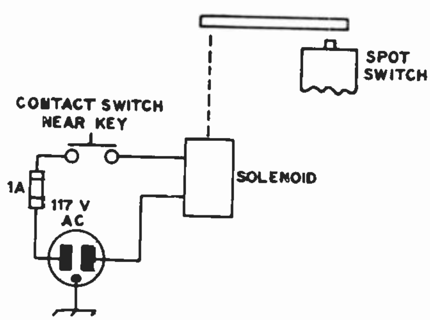


Fig. 2 — Schematic diagram of solenoid and momentary switch.

The travel of the spotting bar should be setup as shown in Fig. 1. This is important since if the arm is allowed too much travel, the force of impact is increased and the chances of damage to the 32S-3 spotting switch are greater.

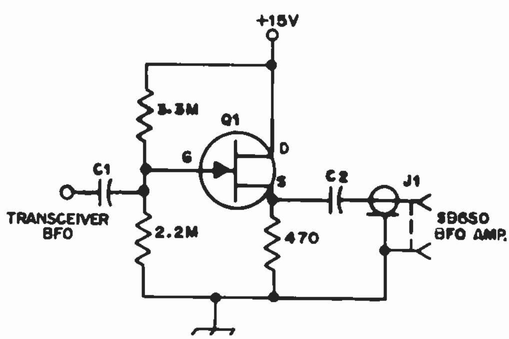
Using the Switch

A momentary switch located at the key for easy access, is used to actuate the solenoid (Fig. 2). Now spotting is much simpler, since one hand can be at the key while the other is turning the VFO knob. As soon as you have spotted, you can start sending, not having to take your hand off the transmitter and reach back over to the key. During about two months of operation, no problems have been encountered with the spotting unit.

The solenoid which was used in the system was found to have much more pull than was necessary. If a smaller one could be obtained, it would be advisable to use it. The aluminum box was purchased at Radio Shack. The rest of the parts were of junk-box origin and a homemade spring was used to return the solenoid to the neutral position. – *Jim White, WA1NNC*

USING THE HEATH SB650 WITH OTHER THAN HEATH TRANSCEIVERS

Because the various oscillators in the Drake 4-line, Yaesu FT transceivers, and Collins S-line have the proper relationship (first LO above the signal, second oscillator below the first i-f) the Heath SB650 digital readout unit may be connected to them directly with the following changes: on the BFO input of the SB650, change the coupling (47 pF) and bypass (.001-μF) capacitors to a low value of reactance at the BFO frequency. For instance, in the Drake R-4B and Collins 75S3, the capacitors should be changed to a 0.1-μF disk ceramic. The output should be taken from a low-impedance point such as the cathodes or emitters of the oscillators. If for some reason.



C1 – Selected for a reactance of approximately 25,000 ohms at lowest operating frequency.
C2 – Selected for approximately 25-ohms at lowest operating frequency.
Q1 – 2N3819, HEP801, HEP802, MPF102.
J1 – Phono jack.

this is not possible, a source follower, similar to the one shown here, may provide the proper amount of isolation. – *Dave Windisch, K3BHJ*

HEAT REDUCTION IN AMATEUR TRANSMITTERS

Excessive heat is sometimes a problem in amateur gear. It becomes acute if the unit is placed in a position which restricts the air circulation. An easy solution is to place a small fan, such as a Rotron Whisper Fan, on top of the cabinet over the final amplifier compartment. The fan will pull out hot air and bring in cool air from underneath the cabinet. This system is especially helpful when used with TV sweep-tube amplifiers.

A Venturi type of fan has a supporting structure around the fan blades. This serves as a place to mount small rubber feet to protect the top of the cabinet. – *Paul Kent, WAØUPD*

A HOMEMADE VOX ACCESSORY

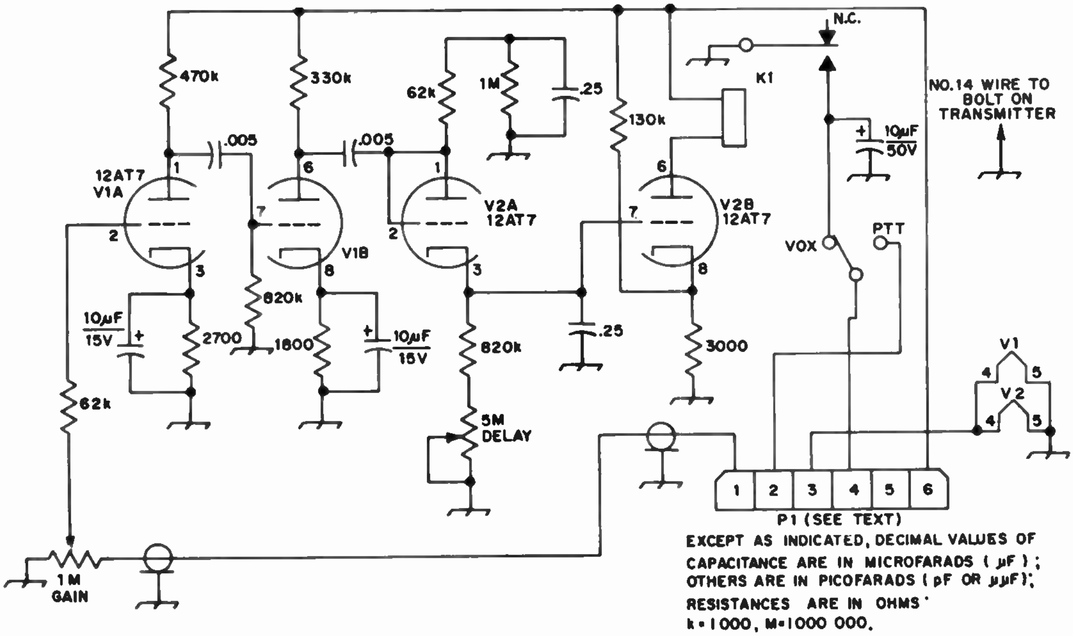
Here is an easy-to-build piece of accessory equipment that performs the VOX function very well at a minimum cost. The circuit is simple but does not have the anti-VOX function. Eliminating the ant-VOX requires two less stages. The operator has to use a headset rather than a loudspeaker, however.

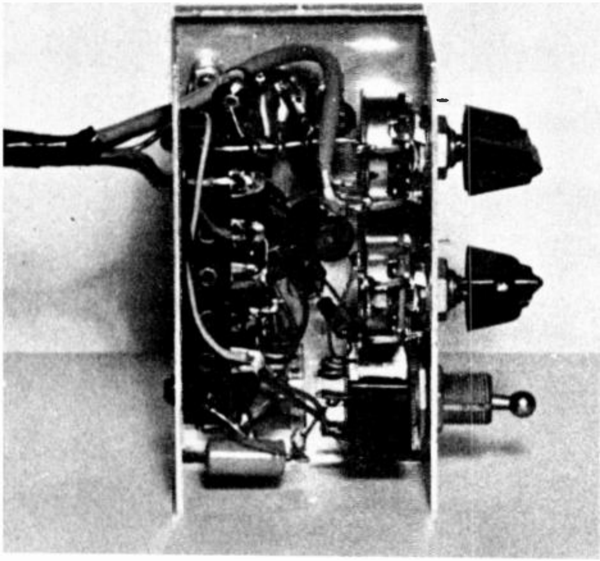
This unit is made for use with the Hallicrafters HT-46 transmitter but it does not have the "bolt on" feature of the Hallicrafters HA-16 VOX control unit. This VOX unit should work with any transmitter that has provision for a plug-in VOX unit. The only change necessary would be the plug needed to match to the accessory socket of the equipment you are using.

The circuit is shown in Fig. 1 and uses two 12AT7 tubes. One 12AT7 is used for two stages of audio amplification in a common triode circuit. The other 12AT7 is the audio voltage rectifier and current-control amplifier that controls the keying relay. The heart of the unit is the relay. It is a Herald SW-34, a low-cost item made in Japan. It has a 10,000-ohm winding and single-pole double-throw contacts. Calectro has similar relays.

The VOX-PTT switch on the front panel transfers the transmitter keying circuit from the relay in the VOX unit to the microphone PTT switch. The unit has the heater and plate voltage

Fig. 1 – Schematic diagram of the VOX accessory. Resistors are 1/2-watt composition and capacitors are disk ceramic with a 600-volt rating unless otherwise noted.
K1 – Herald SE-34 relay or equivalent.





General layout of the VOX accessory.

applied whenever the transmitter is on. The result is that you will hear the relay clicking and following your speech pattern while using PTT. This allows you to change the GAIN and DELAY adjustments while in the PTT position and you need not transmit a signal to determine the proper settings. The correct settings will generally be GAIN at maximum, and DELAY at minimum. The chassis is 2 × 2-1/4 × 4 inches and gets crowded before completion, so a smaller chassis is not recommended. No. 14 bare copper wire is used from the VOX unit chassis to the grounding bolt on the rear of the transmitter. This wire is taped together with the other wires that make up the interconnecting cable. There is no other common or grounding circuit and a shock hazard exists if this common wire is disconnected. It should be securely bolted in place. To eliminate or minimize this hazard, always connect this common wire first, and disconnect it last, and of course, always have the transmitter turned off when making connections.

The front-panel lettering was done with Deca-Dry Transfers by Chart-Pak, Inc. The dry letter transfers are first transferred to a self-adhesive label. The label is trimmed to size, backing material removed, and applied to the front panel. – *Frank Jerome, W5OJZ*

MEASURING PHONE-PATCH LEVELS

Phone patching became a legitimate activity the first of January, 1969, for most areas of the country. Soon afterwards, the first telephone interface specification was published; it covered the voice coupler, and defined the signal limitations to be allowed at the electrical interface device in rather clear terms. On one point, however, the specifications were a puzzle to most amateurs. The maximum in-band voice level was orginally specified as being so many dB below a volt, *averaged over a three-second interval.* Such averaging is unfamilar to most amateurs, and the test equipment listed in the specification is usually found only at the telephone company and in commercial laboratories. More recently, interface specifications have been issued to cover unattended (automatic) interconnection arrangements of the types that might be used for a amateur repeater. When these devices are used, different voice-level specifications apply because different circuit impedances and signal losses are encountered. Some confusion has resulted because later interface specifications define maximum voice levels in terms of power, related to one milliwatt, with three-second averaging.

Some amateurs are using VU (Volume Unit) meters for setting telephone-line levels, bridging the meter directly across the input leads to the voice coupler. If the meter indicates an averaged peak voice level of –5.3 VU (a reasonable interpretation of the interface specification) an amateur certainly won't exceed the voice-power limit allowed, but he will risk supplying an unnecessarily low level to the party at the far end of some long-distance calls. Clearly, there is a need for a level-measuring device specially designed for telephone interconnection work. Until one comes along, the author will present a way to build a close approximation with materials that are available now. The approach described here involves selecting a VU meter of modest cost. The meter is modified to respond in a fashion that is nearly identical to that of the *modified* Western Electric Co. (W. E. Co.) No. 3 Noise Set described in the interface specification.

What Is a VU Meter?

A VU meter was selected because such an instrument is basically an ac voltmeter which has dynamic characteristics that are carefully controlled. For example, the reference or zero-level point of the meter must be between 2/3 and 3/4 of the full-scale value. When a sine-wave voltage of the reference level is applied to the meter, the pointer must swing to at least 99 percent of the zero level within 0.3 second, with at least 1 percent but not more than 1.5 percent overswing. Many additional characteristics are described for VU meters in the American Standards Association specification No. C16.5-1954. The W. E. Co. test set specified in Bell's technical references also has a fast-acting meter of controlled dynamic characteristics. So, a VU meter is the best choice to be damped to match the characteristics of the modified No. 3-A Noise Set.

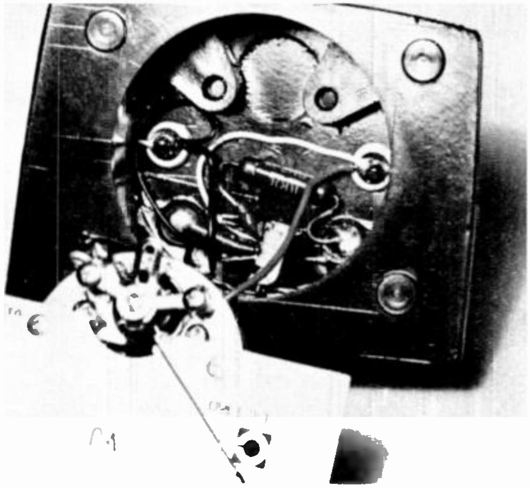
The VU meter normally has a higher impedance than the circuit on which it is to be used. For circuits employing a 600-ohm source and a 600-ohm load, the meter impedance should be at least 7500 ohms. When such a meter is bridged across a working circuit, its shunting effect can cause up to 0.4-dB loss. For this reason there are two common methods of calibrating a VU meter. In the first method, the meter is adjusted to show the power that will be delivered to the load *after the meter is disconnected.* In the second method, the adjustment is made so as to show the power delivered to the load *while the meter is connected* to the circuit. The second method represents the situation that would prevail in phone-patch work, as the meter would normally remain connected to the input of a voice coupler while a patch was in progress, to permit level adjustments to be made as required during the call. Be careful, when comparing meter readings, not to be misled by the two different calibration methods mentioned above. More importantly, you should be aware that "bare" VU meters are usually intended to become a part of a control console, test set, or other equipment assembly, and that the markings on the meter scale are relative and may not translate directly to line or load levels. For example, the Calectro meter used in this project requires about 1.03 V rms, for an indication of zero on its scale. One model of the Calrad brand is specified as indicating zero when 1.22 V rms is applied to the meter terminals. Such levels would be equivalent to +2.5 and +4 dBm, respectively, if applied to a 600-ohm load. In other words, you cannot simply buy a VU meter, connect it to your patch (or anything else) and be assured of meaningful measurements. You must know the rms voltage to which the meter is calibrated.

The Modification

A VU meter can be modified to indicate the maximum permissible voice-signal voltages for patching. Two operations are involved. The first is changing the multiplier resistor in the meter, which changes the range of the meter to a more suitable one. The second modification is to add damping capacitance so that the meter integrates speech signals over a 3-second interval. These changes will make the meter respond more slowly than the typical VU meter. As a precaution against misinterpretation, the builder may want to add a special legend to the meter scale.

A Calectro model DI-930 meter was selected for conversion because it met the general requirements given earlier and, in addition, appeared to be more sensitive than the competitive models that were available. It should be emphasized that the component values listed below apply to only this make and model of meter; others require different values that would have to be determined, as these were, by direct comparison with a modified W. E. Co. No. 3-A Noise Set.

Power in Load in dBm (1 mW reference)	*Rms Voltage Across a 600-ohm Load*
+10	2.44949
+4	1.22765
+3	1.09415
+2	0.97516
+1	0.86911
0	0.77460
−1	0.69036
−2	0.61528
−3	0.54837
−4	0.48314
−5	0.43559
−6	0.38822
−10	0.24495
−20	0.07746



An inside view of the modified meter. The two mounting bolts and the precision resistor have been added.

The meter is opened by unsnapping the clear-plastic front cover. Loosening the two screws in the back of the case will permit the movement to be lifted out. It should be handled by the sides of the scale card to avoid damage to the movement or pointer. Unsoldering the two wires that connect to the movement will permit separating it from the case. Remove the 7000-ohm resistor which is connected between one terminal on the case and the bridge rectifier. Two 7/64-inch holes should be drilled in the case at this time to accommodate the No. 4 screws which will be used to connect the external capacitors to the meter coil. Wires should be soldered to the screw heads before they are installed in the case. There are plus and minus signs molded on the back of the case. They can be used to indicate the polarity of the external electrolytic capacitors. Remember to wire the meter accordingly! The rear (insulated) coil contact is negative. A 365-ohm, 1-percent resistor replaces the 7000-ohm multiplier resistor originally furnished; the new resistor may be connected in the same place and in the same way as the old unit. A damping capacitance of 300 μF is required. Two or three individual capacitors may have to be wired in

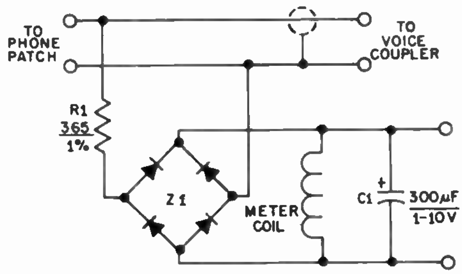


Fig. 1 — Schematic diagram of the meter modifications. R1 is a 1-percent-tolerance, wire-wound resistor; Z1 is part of the original circuit in the Calectro DI-930 meter. C1 consists of three 100-μF, 6-volt electrolytic capacitors connected in parallel.

parallel to obtain the required value. They can have a very low voltage rating as they are connected across the meter coil where a maximum of only a fraction of a volt is present. If the capacitors chosen are small enough, they can be mounted directly on the back of the meter case. For ease in handling, leave the scale card attached to the movement until the components have been reassembled in the case. The scale card can then be removed for the addition of any special legend. Transfer letters of the kind used by draftsmen and artists work very well.

The values given above have been chosen so that stock-value components can be used. A small margin has been provided to allow for manufacturing tolerances. The modified meter should respond to speech signals below 3 kHz in a way that compares very closely with the measuring sets mentioned in the Bell interface specifications. Error should be less than 1 dB and should be found to be on the safe (low) side. The meter will have a 1-kHz impedance of about 6500 ohms. It should be mounted only on a nonferrous panel.

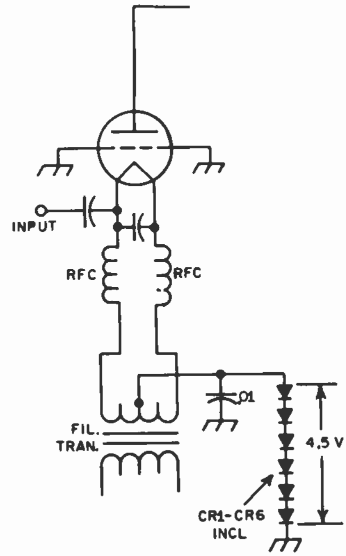
Using the Modified Meter

In use, the meter should be left connected to the input of the voice coupler whenever a patch is in progress. The speech level should never be permitted to exceed the zero or 100-percent point on the meter scale. When the telephone connection is made to a nearby location (such as a line served out of the same telephone exchange that serves you) the distant listener will receive a more comfortable listening level if the maximum signal is held to about −7 on the meter scale. Remember, too, that if the distant telephone user is not talking loud enough for good modulation of your transmitter, he can often be made to speak loudly if you *reduce* the level of the signal sent to him.

The modified meter can also be used to set levels at repeaters or other installations that use one of the unattended interconnection arrangements. In such cases, disconnect the patch from the interface and terminate it in a 600-ohm load. Adjust the audio level so that the maximum speech level does not exceed an indication of −5 on the meter scale when it is connected to the 600-ohm load resistor. In this situation, the modified meter should not be connected when telephone calls are in progress. – *George Schlecher, W9NLT*

REDUCING AMPLIFIER DISSIPATION

After building a kilowatt grounded-grid linear amplifier, which used a voltage doubler in the power supply, I found that the voltage regulation was poor. During idling periods (no speech), the higher plate voltage increased the tube dissipation substantially. Even between words, the idle current went up, running the tubes red hot. I decided that adding a small amount of bias should cool things off a bit. High-current Zener diodes can provide bias, but they are expensive. In checking some garden-variety silicon power rectifiers I learned that the barrier voltage across their junctions remained fairly constant with changing current. Although they are not intended to be regulators, they actually do a fair job of regulating.

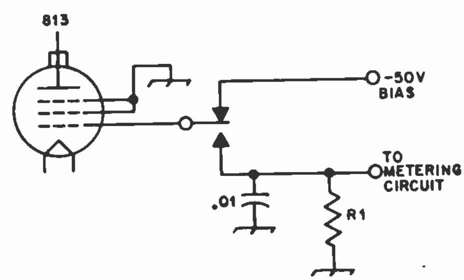


Six silicon diodes are wired in series to provide 4.5 volts of regulated bias. The voltage rating of the diodes is unimportant but the current rating must be greater than the tube plate current at full power input.

Six of these ordinary diodes, connected in series with the cathode of the amplifier tube, decreased the idling current from 120 mA to 80 mA. More bias can be obtained by using additional diodes. The six diodes in my system provided 4.5 volts.– *B. H. Brunemeier, W6FHM/DU1*

ELIMINATION OF IDLE-CURRENT HASH IN AMPLIFIERS

My son and I built the 813 version of the amplifier described by Lew McCoy, W1ICP, in October 1970 *QST*. We were satisfied with its performance in every way but one, the excessive amount of hash heard in our receiver when the amplifier was on, but in standby.



We cured this problem by applying a cutoff bias during the standby period of the amplifier. The antenna relay, K1A, was replaced with a relay having a third set of contacts which were used to switch the −50 volts used. The negative voltage was connected to a normally closed set of contacts and the armature was connected to the grid of the 813. Leads from the open set of contacts were routed to the metering circuit, as shown in the drawing. This circuit could be used with many types of amplifiers (with some modification) to eliminate diode hash coming from the power supply that may impair reception of signals. – *J. D. Keeling, Sr. WA5ZGN, J. D. Keeling, Jr., WA5AGM*

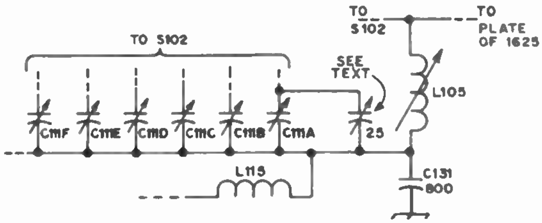
ART-13 ON 160 METERS

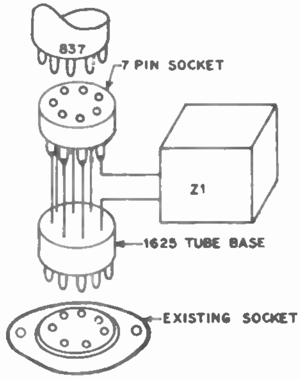
When the Collins AN/ART-13 transmitter is operated on 2.0 MHz, the 837 Colpitts VFO is on 1 MHz. Adding external capacitance across the VFO lowers its output faster than it does the frequency. Since 1800 to 1850 kHz is a common allocation, the modifications shown are necessary for operation of the unit in this range.

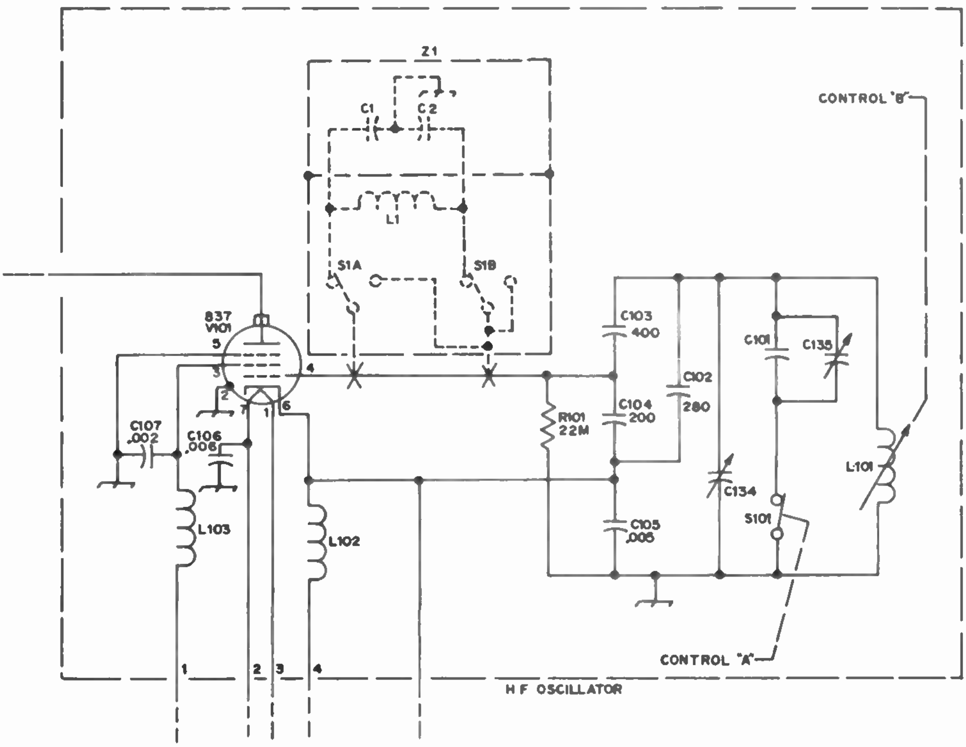
With the ART-13 control "B" set to 00.0, and control "A" set to 1, C1 and C2 are adjusted until the output of the VFO is on 900 kHz. The trimmer capacitor that was added in parallel with C111-A is then peaked up for maximum output.

Except for wiring in the capacitor, no other existing circuit changes are necessary. The plug goes into the 837 VFO tube socket in the ART-13, and the 837 is mounted horizontally with a lead from the plate cap going to the existing plate clip in the unit. The dpdt switch allows the VFO to be switched between 160-meter and normal operation. A random-wire antenna between 22 and 64 feet in length should be used, with the original CU-24/ART-13 shunt capacitor. – *Allen W. Porterfield, W2ISL.*

Modification which allows the use of the ART-13 on 160 meters. The box Z1 contains a network which lowers the frequency of the VFO sufficiently to cover 160 meters, without a decrease in output. S1 allows the network to be switched out for normal VFO operation.
C1, C2 – 365-pF broadcast variable.
L1 – LO coil from bc set.







AN ATTENUATOR FOR AUDIO

Here is a handy piece of equipment for measuring amplifier gain, distortion, and noise. Units similar to this one have been used for many years in broadcast stations and laboratories.

Fig. 1 shows a block diagram of the attenuator. If all impedances are equal and the generator output is applied to the amplifier, the gain can be read directly from the settings on the attenuator box when the output voltage is the same as that from the generator. Assume, for example, that both 20-dB pads are switched in and the variable T-pad is set down 8 dB. The amplifier is now making up the difference, or showing a gain of 48 dB.

Frequency runs can be made by reading the number of dB required to be reinstated in the attenuator box to keep the output level constant as the frequency of the generator is changed. The amplifier output must be held well below saturation to make response readings valid. Transistor amplifiers will fail if anything near full output is held during sine-wave testing.

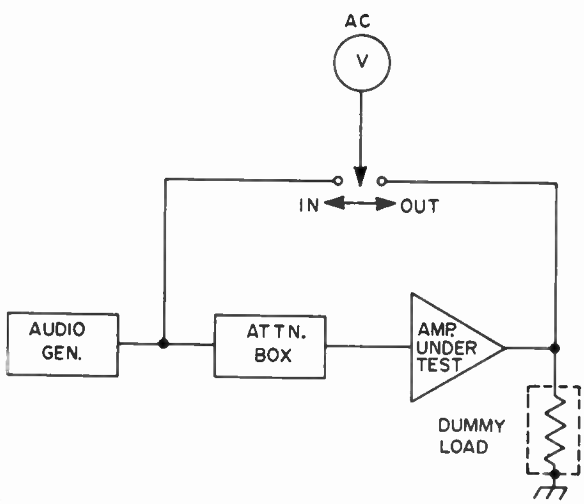
The attenuator is composed of three pads in a 600-ohm unbalanced circuit, feeding a 1-to-1 transformer so that both balanced and unbalanced leads can be connected. The fixed pads can be switched in or out, and the variable pad can be turned down 40 dB in 2 dB steps. The maximum reduction is 80 dB. A variable pad with detents is ideal for this device. New mixing consoles are being built for broadcasters with slider-type controls, and the rotary types are available at some surplus houses.

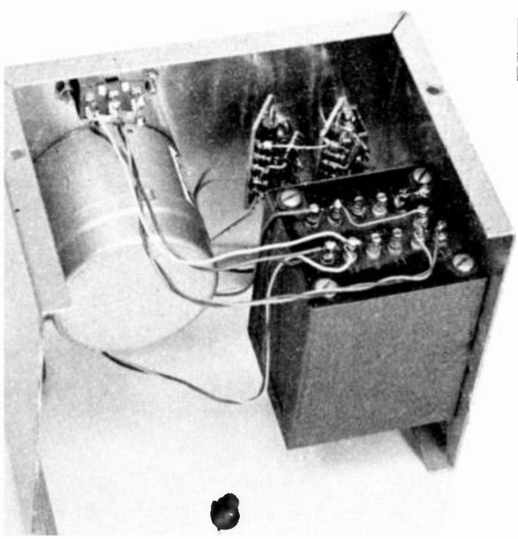
The fixed 20-dB pads are made with 1/2-watt carbon resistors and the 490-ohm series arms are made from 470-ohm units that read near 490 ohms on an ohmmeter.

Shielded wire must be used from the output of the box to the input of the amplifier to eliminate hum or rf pickup. The signal level at this point is normally very low.

Fig. 3 shows how to feed a single sideband transmitter for audio response measurements, from the microphone input to the output rf load. The curve will include both audio-amplifier and rf-filter responses. – *Stan Oehmen, W2HG*

Fig. 1—Block diagram showing a typical set-up for testing an amplifier.





Two small terminal boards are attached to the slide switches. The variable pad can be seen on the left. The transformer used in this particular unit had several secondary taps so a switch was mounted above the variable attenuator to allow the device to be used with either 150 ohms or 600 ohms. This switch is not a necessary feature.

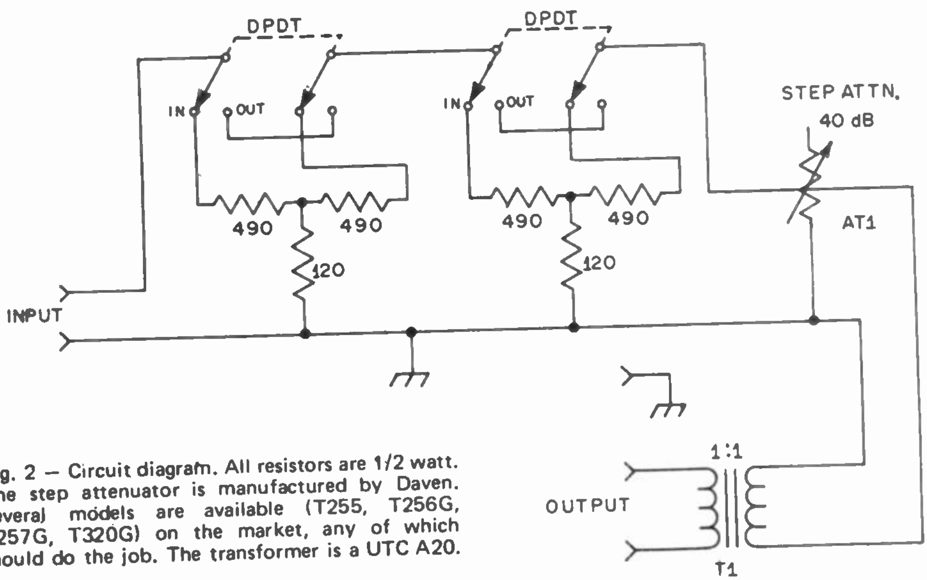


Fig. 2 – Circuit diagram. All resistors are 1/2 watt. The step attenuator is manufactured by Daven. Several models are available (T255, T256G, T257G, T320G) on the market, any of which should do the job. The transformer is a UTC A20.

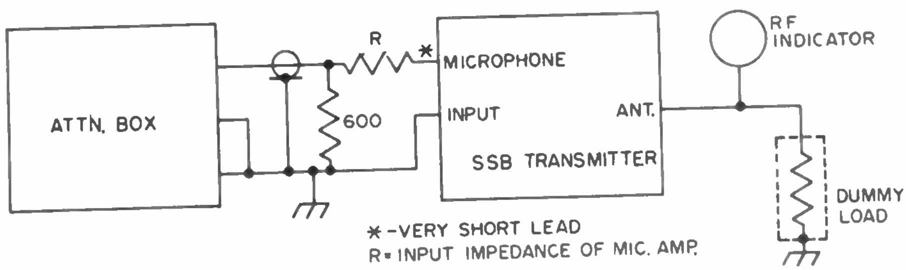


Fig. 3 – Typical set up for testing a single sideband transmitter.

NOISY FAN MOTORS

Most of the small fans in modern exciters and amplifiers use shaded-pole motors. The thrust of these motors is against the back bearing, which is usually surrounded by a thin hardened-brass oil well stuffed with wadding. Between the end of the armature shaft and the thin brass shell is a small ball bearing that pinpoints the motor thrust against a small spot on the brass shell. Excessive end play (which causes noise) results when this pinpointed thrust finally pushes the brass shell outward. Press the brass shell flat and the motor becomes quiet again.

Many of these shells are fitted to the motor frame in the same manner that an on/off switch is crimped on a volume control. If it is necessary to remove the shell, be careful to bend the tabs slowly as the hardened brass will break easily. Also, be careful not to lose the small ball bearing. – *Al Hudson, W9SCD*

PUTTING THE HW-16 ON 20 METERS

With the declining number of sunspots and a corresponding drop in activity on 21 MHz some General licensees owning HW-16s might be interested in a simple conversion that I have done that replaces the 21-MHz band with 14 MHz. After obtaining the correct crystal, the modification takes about one hour to accomplish when performing the following steps:

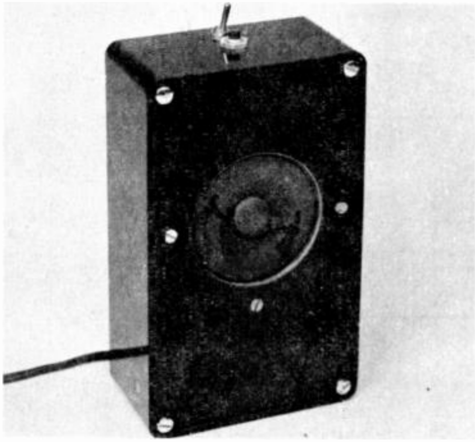
1) Replace the 26.545-MHz crystal with a 19.545-MHz unit.

2) Move tap on PA tank coil to exactly half way between the 15- and 40-meter taps.

3) Install a 150-pF mica capacitor across driver coil L9.

4) Remove rf coil L1 and add 6-1/2 turns of hookup wire to the coil.

The transceiver is then aligned on 14 MHz by adjusting L1, L4, and L9 as stated in the instruction manual for the HW-16. – *Bud Haake, WØMSV*



A TONE GENERATOR FOR NETTING OF SSB STATIONS

Net operation requires that all of the particpating ssb stations be on frequency, preferably within 20 Hz. The operator usually tunes his receiver for a normal-sounding voice quality. Carrier insertion is used occasionally for netting, but at best, this is crude. The passbands of the ssb filter and the audio system restrict the response below 300 Hz. This makes it very difficult to hear the low-frequency note when zero beating. Some years ago it was suggested that a small amount of carrier be transmitted (30 dB below the output signal) for the receiver to lock on. The system required an extensive amount of equipment at the receiving station and proved to be impractical.

A Better System

It is easy to set two suppressed carriers to the same frequency when they are both modulated by identical audio oscillators. An audio tone, when transmitted, will appear as a single carrier. While listening to the tone being transmitted, the transceiver VFO is adjusted so that the received note is the same as a "standard." The frequency of the transceiver-transmitted signal then will be the same as the one being received.

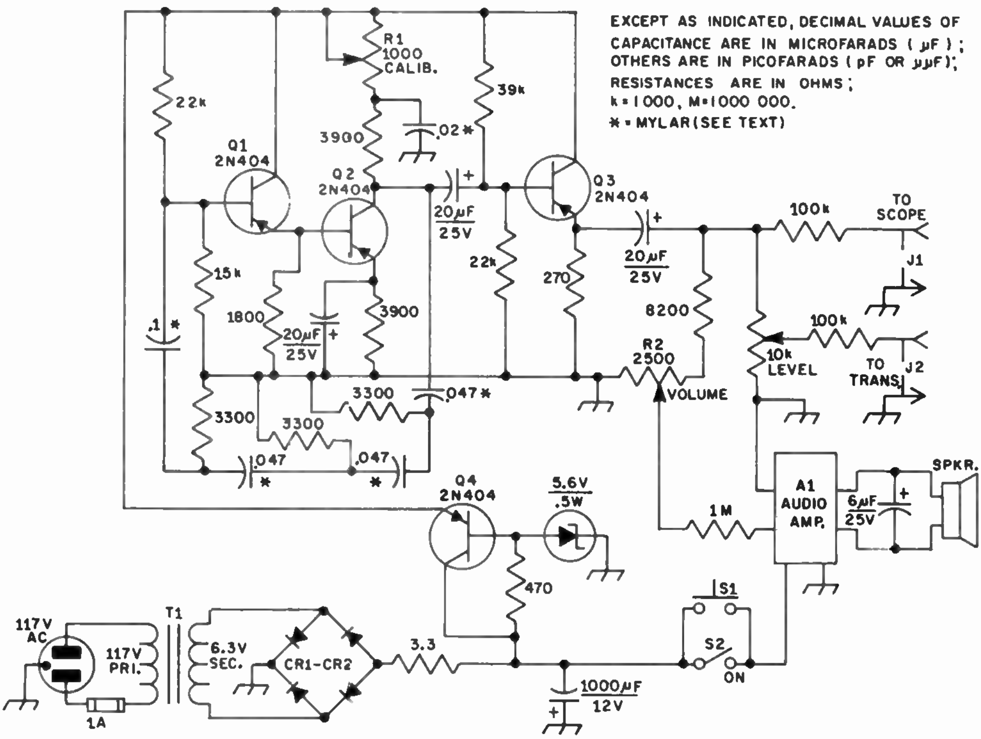


Fig. 1 — Circuit diagram of the tone generator. Capacitors are disk ceramic or Mylar (except those marked with polarity, electrolytic). Resistors are 1/2-watt, 10-percent-tolerance, composition. Component designations not listed below are for text reference.

A1 — Audio amplifier module (RCA KD2115 or equiv.).
CR1-CR4, incl. — 100-PRV, 1-A, silicon diode.
J1, J2 — Phono jack, panel mount.
R1 — 1000-ohm, linear-taper, 1/2-watt control.
R2 — 2500-ohm, linear-taper, 1/2-watt control
S1 — Spst push button.
S2 — Spst toggle.
T1 — Filament type 6.3 V (Stancor P-8389 or equiv.).

The Tone Generator

There are several reasons for selecting a musical note for a standard. First, a 440-Hz tone can be calibrated against WWV transmissions. Additionally, the generator can be checked by comparing it with a musical instrument.

A two-stage phase-shift oscillator is used to produce a sine wave at the proper frequency. See Fig. 1. The tone can be varied by altering the amount of phase shift in the last stage. R1 serves as the calibration control. Mylar capacitors should be used in the phase-shift circuit. The power supply consists of a silicon-rectifier bridge circuit connected to the secondary of T1 – a 6-volt filament transformer. The series regulator and Zener diode provide 5.4 volts for the oscillator and emitter-follower stage. A 6-μF capacitor is connected across the speaker voice coil to reduce its high-frequency response. S1 allows the operator to listen to the tone momentarily, and S2 is used for longer calibration periods. The power requirement is so low that the unit can be left on continuously.

The oscillator output is coupled to an emitter-follower stage which drives the internal audio amplifier (A1) for speaker operation. A phono jack permits connection to a monitor scope (such as the Heath SB-610) and the station transmitter. Fig. 2 shows how this equipment is interconnected with the existing station components. While the monitor scope allows visual display, aural zero beating is just as accurate.

Operation

Some operators may mistakenly zero against 220 Hz or 880 Hz. This can occur if there is an unusually high amount of distortion in the receiver or generator output. As soon as speech is applied to the transmitter however, the mistake will be immediately apparent. The accuracy of this zero-beating technique is dependent on the VFO remaining stable between the transmit and receive modes. Since the calibrator does not rely on the ac line for determining its frequency, it can be adapted to mobile use by powering it from a battery supply. – *Stan Oehmen, W2HG*

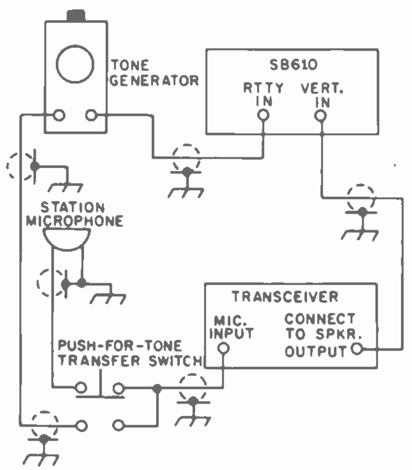


Fig. 2 – Connections between station equipment and the tone generator should be made with shielded wire. A push-button switch can be included to select either the station microphone or the tone generator.

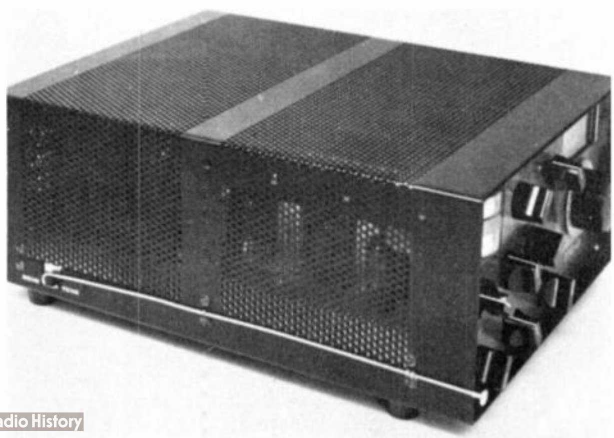
EASY TRANSCEIVE/RECEIVE SWITCHING FOR THE TR-4

In my station setup I have a Drake TR-4 transceiver and a Heath SB-301 as my second receiver. The antenna switch and muting circuit built into the TR-4 worked perfectly with the SB-301 for split-frequency operation. However, one problem always came up. The RCVR/TCVR switch is mounted on the left side panel near the rear of the TR-4. This is not a very handy place for a control that I use frequently. Although it's very Heath Robinson (the G-land equivalent of Rube Goldberg), my modification performs well and allows instant switching of the RCVR/TCVR switch on the TR-4 from the front panel without the disadvantage common to remote VFOs – the ease of transmitting on the forbidden portion of the band.

My solution, shown in the photograph, was to secure two solder lugs, one under each lower left case-securing screw, and bribe the XYL to let me have one of her thin metal knitting needles. Hold the blunt end of the knitting needle about 1/4 inch in front of the left-hand side of the transceiver case and gently bend the pointed end of the needle around the RCVR/TCVR switch. Secure the needle in place by bending the solder lugs around the needle.

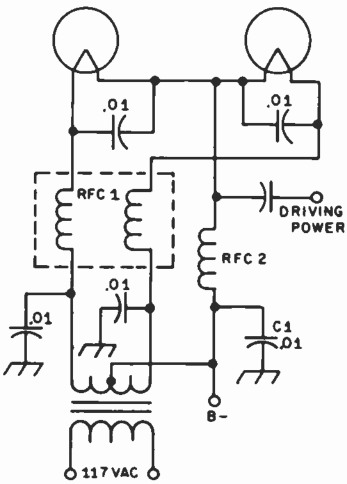
You may now place other gear next to the TR-4 without having to fumble for the side switch. This modification needs no holes drilled in the cabinet. When trade-in time comes you still have a mint rig. – *Richard E. Tinson, G3XPM/W1*

Shown is the method of securing the knitting needle to the side of the Drake TR-4 to operate the RCVR/TCVR switch from the front panel.



SERIES CONNECTION OF FILAMENTS IN GROUNDED-GRID AMPLIFIERS

When two identical high-power tube filaments are connected in series, the filament voltage may not split equally since there are some differences in the warm-up time. One of the tubes may heat faster than the other, resulting in a greater voltage drop across that tube's filaments. The increased voltage will heat it further and the added heat will increase the resistance. The hotter tube will receive the higher voltage. In my amplifier, a pair of 4-250s, one tube received 9 volts while the other received 1 volt.



Circuit diagram for series connecting the filaments. Component designations are for text reference.

Connecting the filament transformer center tap to the point where the tubes are joined together will eliminate the problem because each tube is fed independently. In the grounded-grid configuration, the circuit shown can be used. The only additional part required is RFC2, which is similar to RFC1. The new choke could be wound on a separate piece of ferrite rod, or the original choke could be rewound with three conductors instead of two. Of course the cold end of this new choke must be properly bypassed with a capacitor (C1 in the circuit shown). – *Leonard Lehmann, WB2GTU*

TEN-TEC POWER-AMPLIFIER REPLACEMENTS

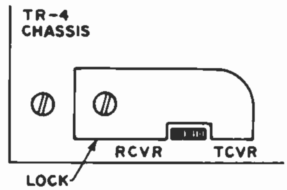
As any Ten-Tec owner who has blown the power amplifier transistor knows, the SE8010 is hard to find and costly to replace. I have found that the GE-18, an audio amplifier/oscillator, works well and the cost is less than $3 a pair. Anyone with fears about using an audio transistor at rf can relax. The pair in use at this station has been giving good output on 20 meters for over a year. – *John D. Young, WA8KNE/6*

[EDITOR'S NOTE: The HEP714 is listed as a replacement for the GE-18 and may also give good service in place of the SE8010.]

SWITCH LOCK FOR DRAKE TR-4

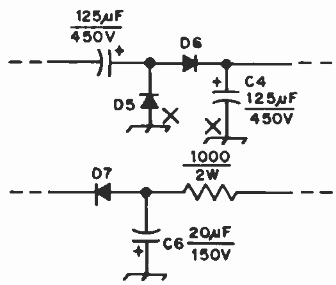
Rare is the owner of the Drake TR-4 who has not wasted a lot of time troubleshooting his sick rig only to find that the TCVR/RCVR switch on the left side has been accidentally moved.

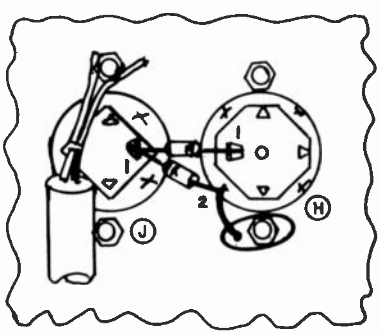
The author solved the problem by making a simple lock which is held in place by some of the chassis screws near the switch. It was made from a discarded ice tray section but any piece of flat stock will do. Cut a notch the exact size of the small protuberance with a nibbling tool or a saw. Secure the lock to the rig with the chassis screw and the job is done. – *Dumas M. Robinson, WA6SBP*



IMPROVED GROUND CONNECTION IN THE HP-23

An instability problem in the low-voltage leg of the Heath HP-23 power supply (used to power the HW and SB series of transceivers) was found to be caused by a poor ground connection. It was corrected by placing a soldering lug and lock washer under the mounting nut of capacitor C4. A short heavy wire was then soldered between the lug and the grounded side of diode D5. Use a heat sink on lead of D5 to protect it while soldering. This makes an effective ground return for D5 and C4. – *Bob Richardson, W6WHM*



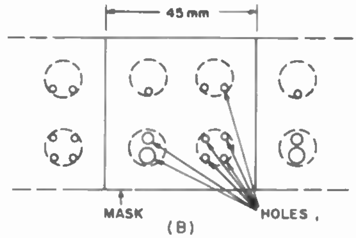


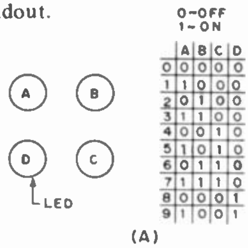
A SIMPLE BCD CONVERTER AND READOUT

The arrangement shown will take a binary input and convert it directly to a decimal readout using four lamps (or LEDs). This eliminates the need for decoder/drivers, Nixie tubes or neon lamps and provides the ultimate in a low-cost readout.

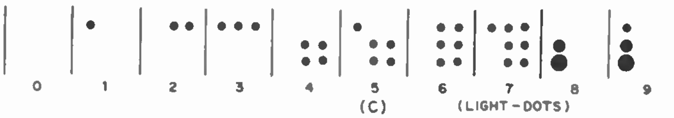
Each decade digit consists of four lamps in back of a mask as shown in the drawing. The lamps correspond to the binary positions for 1, 2, 4, and 8. One hole is drilled in the mask for the "1" position, two holes for the "2" position, and four holes for the "4" position. A small hole over a larger one is drilled to represent the "8"

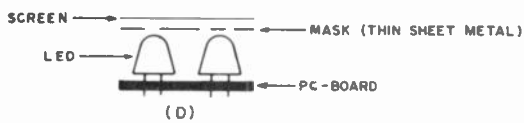
In reading the display, one could merely count up the lighted dots (except for 8 and 9). But with a little practice, the digits can be read on sight. The figures for 1, 2, 3, 4, and 6 resemble the numbers themselves (with a little imagination). Only 5 and 9 are new but can be learned with little difficulty. – *Peter Hansen, DK4YD*





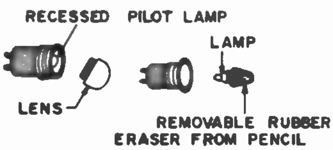
	A	B	C	D
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1





REMOVING RECESSED PILOT LAMPS

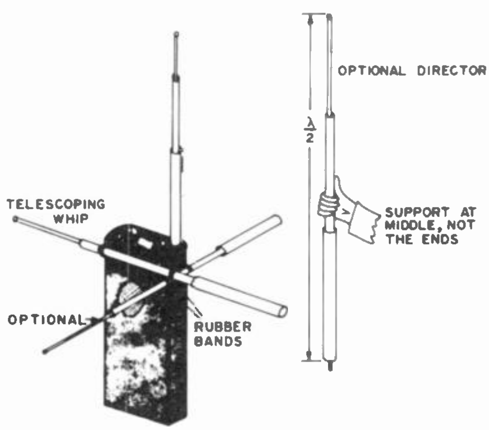
Having trouble extracting recessed pilot lamps? A rubber eraser of the cap type makes a nifty lamp puller. – *C. Westrich, WB8OWM*



INSTANT GROUND PLANE FOR WALKIE-TALKIES

The performance of hand-held equipment can often be improved by the addition of a simple ground plane. Attach a whip antenna (such as that used with a transistor radio) with rubber bands to the base of the walkie-talkie as shown. You will note a difference in radiation efficiency.[1]

The radials should be adjusted in length to a quarter wavelength or better yet, they should be tuned by watching a field strength meter. A simple field-strength meter can be jury rigged by placing a 1N34A diode (or equivalent) across the test-lead terminals of a VOM set in the microampere range. The test leads themselves act as the pickup antenna.



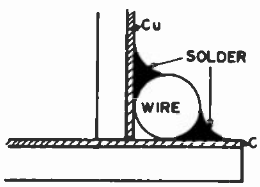
By holding a telescoping whip in front of the radiator with the radial(s), you should note an increase in signal strength. Stand with your back against a metal post which will act as a reflector. Even a quarter-wavelength wire is better than no counterpoise. – *Katashi Nose, KH6IJ*

[1] **[EDITOR'S NOTE: The roof of a car also makes an effective ground plane for small hand-held vhf receivers such as those used for ESSA weather broadcasts. While not very convenient for transmitting applications, it can often mean the difference between solid copy and not hearing the station at all.]**

RF-TIGHT ENCLOSURES FROM PC BOARD

When constructing high-performance receiving equipment for the vhf and uhf bands, proper shielding from the outside world and between various sections of a system is mandatory. A popular and very inexpensive means to achieve this end is to build small boxes from scraps of double-sided pc board. While the results are nearly as good as the most exotic professional techniques, the method has one deficiency – once the box is soldered together, it's nearly impossible to get it apart again! This is a bit frustrating when expensive components are used and circuit modifications are contemplated.

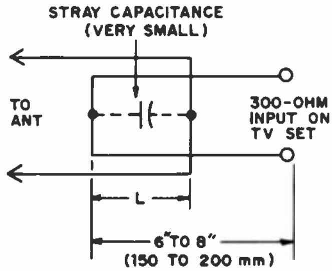
A less committable approach to the problem is to build an rf-tight box without the usual lid, again using double-sided pc board. Then, after initial circuit adjustments are made, the shielding is completed with a lid which is soldered to the box. However, prior to final soldering, a file is used on the edges of the box to remove the copper adjacent to the lid. A piece of bare copper wire is then used to bridge the electrical gap that would otherwise exist. A cross-sectional view is shown in the drawing. Later, when (*not if*) it's necessary to change the circuit, the wire is easily peeled away with a pair of long-nose pliers and a medium-sized soldering iron. – *Wes Hayward, W7ZOI*



A SIMPLE CURE FOR TVI

The seemingly ever-present problem of TVI may occur even though the rig may be properly shielded and adjusted to prevent harmonic radiation. The TVI is then likely to be caused by pickup on the television Twin-Lead and being coupled into the front end of the TV receiver, overloading it. This signal energy is coupled to the TV set in "common-mode" fashion – that is, the Twin Lead acting as a single conductor.

Most TV sets have very little rejection to this type of signal, as may be demonstrated by disconnecting one side of the Twin-Lead. A simple method of increasing this common-mode rejection, and thereby reducing TVI, is to add an inductive coupling loop in the Twin-Lead. The procedure is to cut the Twin-Lead about 6 to 8 inches (150 to 200 mm) from where it enters the set. Short each of the cut ends and overlap the ends approximately 1 to 4 inches (25 to 102 mm). The amount of overlap used should be the smallest amount possible that will still give a satisfactory picture on all channels. It would be wise to start with the lower frequency channels first. Once the proper amount of overlap is found, secure the two leads with electrical tape. This trick will often cure TVI problems without resorting to buying high-pass filters or making modifications to the TV set. Doubtless, the TV owner would appreciate not having to incur service charges for this type of problem.



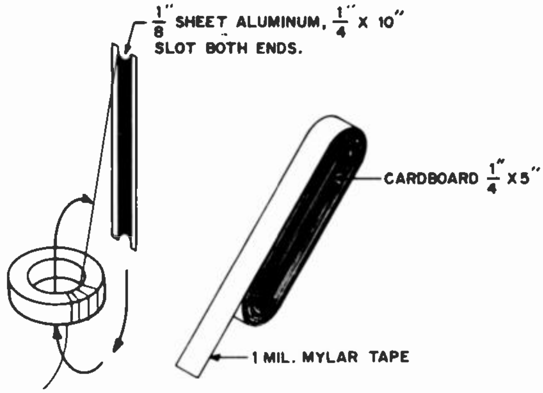
The circuit functions as a one-to-one transformer. The overlap distance, *L*, controls the coupling and inductance. The balanced currents from the antenna are coupled with little attenuation. Common-mode signals, on the other hand, must be capacitively coupled by the conductor-to-conductor capacitance which is very small due to the short overlap distance. – *Wilmer Radke, K7MCL*

EASY WAY OF WINDING TOROIDS

Here is a way of winding toroid inductors, especially ones with many turns. A bobbin is made from thin aluminum stock (No. 18 to No. 14) 1/4 × 10 inches (0.6 × 25 cm) on each side. Thinner or wider bobbins can be made for particular toroid diameters. A slot is made in each end (make two cuts with a hacksaw and break the tab with a pair of long-nosed pliers) and the wire is then wound on the bobbin as shown.

The bobbin and the wire can then be passed through the core all at once, alleviating the need to pull ten or twenty feet of fragile wire through for each turn. Remember that the diameter of the hole will decrease as the number of turns increases.

Also, for the professional touch, and some extra protection for the windings, a layer of tape



can be added in much the same way. Wind 1-mil Mylar tape on a suitable piece of cardboard and then rewind it back over the inductor. The above method results in a toroid that is easier to build and is better to look at. – *Ken Voelker, WB6KBI*

160 METERS AND THE FT-101

Some models of the Yaesu FT-101 do not provide full output power on 160 meters. In those units which deliver approximately 60 watts of rf output (low dc input as compared to the 80- through 10-meter bands), a cure has been effected by replacing C130, a 1000-pF capacitor in the driver circuit. Apparently the original part is faulty in some instances. Those who have made the change recommend that a silver-mica capacitor be used in place of the original part. There have been reports of a power-output increase of 100 percent after the change was made. – *Tom Williams, Jr., W8NSF*