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RADIO KINKS AND WRINKLES

For Service Men and Experimenters

A Complete Compendium on the Latest Radio Short-Cuts and Money-Savers

by C. W. Palmer

A GERNSBACK PUBLICATION

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Contents

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CHAPTER 1
INTRODUCTION

EVERY Service Man and radio experimenter has his own "pet" way of accomplishing certain details of set repair or construction, whether it is the way in which he hangs his soldering iron on the bench or some individual way of testing a circuit or piece of apparatus. Many of these "Kinks" are a distinct advantage over the accepted ways and naturally will interest the serious radio man.

It is the purpose of this book to present some of the most useful of these "Kinks" and Short Cuts in a form that will be of interest to everyone. Naturally, we can all learn from the experience of others and even the most clever technician will profit by a careful study of this little volume.

The financial return in servicing radio equipment today, depends to a great extent on the speed with which the Service Man eliminates the trouble and places the receiver or equipment in correct running order. The man who can handle the greatest number of service calls a day is the one who will gain most, either directly in service fees or indirectly in increased business. A number of the "Kinks" are directly applicable to service work and may be instrumental in reducing the time required to locate an obscure difficulty in some set.

We all know the peculiarities of short-wave sets and the fact that some work much better than others for no apparent reason. The Short-Wave Fan will note that he has not been slighted as a generous number of short-wave hints will be found in the chapter on this subject.

In compiling the volume, the editor found that a large percentage of the available material could be classified under general headings such as Servicing Short Cuts, Testing Equipment, Vacuum Tubes, Speakers, etc. However, some of the "Kinks" were rather stubborn and refused to be untangled into the headings selected. It was necessary to place these unruly items in the topic most nearly associated with them. The headings in the Contents can, therefore, only be used to supply a general idea of the details included.

CHAPTER 2

Servicing Short Cuts

A DYNATRON VACUUM-TUBE VOLTMETER

By C. W. Melotte

IN Fig. 1 is shown the wiring diagram of a vacuum-tube voltmeter I use. Its advantage is that very small voltages can be measured with it without the use of an ultra-sensitive meter.

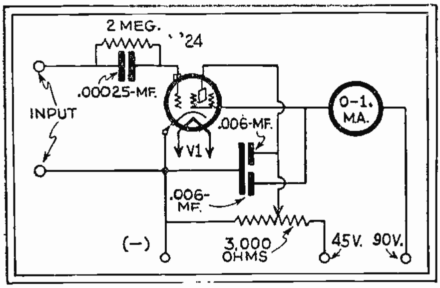


Fig. 1

A "dynatron" V.T. voltmeter circuit.

An ordinary 0-1. milliammeter is sensitive enough to measure such small voltages as would not operate an ordinary V.T. voltmeter using the more standard three-element tube. An input of 0.05-volt gives a reading of approximately 0.2-ma.

The potentiometer is used to accurately adjust the plate voltage to the correct operating point.

FINDING ELIMINATOR "REGULATION"

By Samuel Eidensohn

IF the experimenter knows just how the voltage delivered by his power supply varies with the load, he is in possession of some important information.

He knows, for instance, whether he can change the audio circuit to include push-pull operation without altering his "B" supply; perhaps by purchasing a new power transformer.

The simplest method of determining the "regulation" of the "B" output is to connect a 0-100 milliammeter MA, a 0-500 voltmeter VM, and a 0-25,000-ohm variable resistor R3 (capable of carrying 100 milliamps without burning) in accordance with the diagram (Fig. 2) R1 and R2 are portions of the voltage divider in the "B" unit.

As indicated, only one wire in the unit, the "B Max.", is broken. The lead from the rectifier and filter net-work is to be connected to the "+" post on the milliammeter.

The resistance of the voltmeter doesn't matter; because the current it consumes is a relatively slight proportion of the total amount indicated by the milliammeter. However, if the resistance of the voltmeter VM is wanted the following procedure is followed: Read MA with VM disconnected; reading equals Io. Re-connect VM, and read both meters; current in milliamps Ia, and voltage equals V. To find the resistance of the voltmeter, these values are to be interpolated in the following formula:

$$\frac{V}{Ia - Io} = 1000$$

With the instruments connected as shown in the diagram, resistor R3 is varied and the readings on the meters are plotted.

This method is applicable to all power supplies. It is advisable to keep the voltage-divider unit, R1-R2, and the milliammeter permanently in circuit to avoid the strain on the filter condensers that would result if this portion of the filter circuit were open while the current is on.

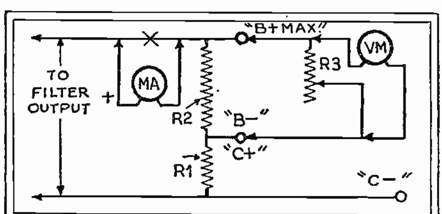


Fig. 2

It is standard practice now to test the A.C. input for fluctuations. It should be equally so, to test the D.C. input of the voltage divider.

A CONVENIENT METHOD OF NEUTRALIZING

By Boris S. Naimark

IT is not generally known that two tubes of similar characteristics have exactly equal grid-to-plate capacities. (Any difference that may exist is so small as to be difficult of measurement.)

This immediately suggests that, if we have a set employing, say, type '01A tubes in the radio-frequency stages, we can use burnt-out '01A tubes, whose grid and plate elements are not shorted, as neutralizing capacities to take the place of a regular neutralizing condenser.

Referring to Fig. 3, it should be quite apparent that, if point 2 in the tuned circuit(at left) is the exact electrical center of the grid inductance, stability is obtained only when the value of the capacity C2 is exactly equal to the value of the interelectrode capacity C1. In such a circuit arrangement a burnt-out tube V2 (of the same type as V1, and whose grid and plate electrodes are intact) will constitute an ideal neutralizing tube is just right; (3) per-no adjustments to achieve stability.

Use a socket, or solder the leads directly to the grid and plate prongs of V2—the "neutralizing tube."

(The exact position for tap 2 must be determined by experiment. It will be approximately at the mechanical center —as seen or measured.)

The advantages of such an arrangement, wherever the set design permits, are as follows: (1) Low cost, since burnt-out tubes may be used; (2) no capacity adjustments are required, since the grid-to-plate capacity of the neutralizing condenser C2 and will require

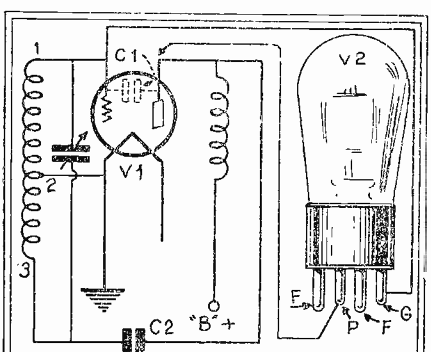


Fig. 3

The burnt-out tube at the right has the same capacity as V1, and therefore is an ideal neutralizing condenser.

manence, since the grid and plate electrodes within the glass bulb form a moisture-proof condenser of the highest type possible to obtain.

A SIMPLE METHOD FOR MEASURING A.C. RIPPLE IN FILTERS

By Clifford E. Denton

THERE are many times when the experimenter or Service Man wants to know the exact ripple voltage from a high voltage power system or motor-generator.

A simple method which has been used by the author for this purpose employs a rectifier-type A.C. voltmeter, which will measure the average (0.636) value of the A.C. or "ripple" voltage. See Fig. 4.

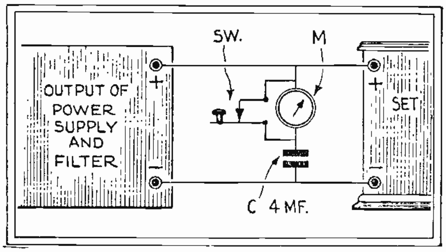


Fig. 4

Measuring "ripple." A.C. Voltmeter M, D.C.-insulated by C, indicates potential when switch Sw. is depressed.

To isolate the meter M from the D.C., but allow the A.C. to pass through it, condenser C is used; a 4-mf. high-voltage type unit will be satisfactory.

It is important that the "working" voltage of the condenser be equal to, or greater than, the power supply's "peak" voltage; which is equal to the "R.M.S." value of the voltage applied to the plate of the rectifier tube, multiplied by 1.41.

The switch Sw. should be of the closed-circuit type, which remains closed except when pressed; this prevents the initial charging current drawn by the condenser C from passing through the meter. The meter should be connected into the circuit only after the receiver is in operation. This places the actual working load on the filter system and reduces the chances of ruining the meter.

If we have a power supply which delivers, say, 500 volts under load, and the meter range is 50 volts, then a full-scale reading would indicate that the ripple is 10% of the applied voltage. It can readily be seen that this method requires a minimum of parts; and satisfactory approximations of the ripple voltages can be obtained.

OLD MODELS—AND BAD TUBES

By J. Paul Miller

IN an Atwater Kent early model electric set that is dead, when no plate voltage shows on the detector tube, it is probably due to the phone condenser which is connected from plate to ground; this is either shorted or leaky. Remedy by replacing. The first diagnosis is, naturally, the resistor in the power pack or the primary of the first audio transformer.

In an old model Steinite series-filament receiver, that would not tune above 30 on the dials, the trouble was traced to a short-circuit in the third variable condenser. (This short was in the bearing, and not in the plates touching.) This resulted in the last tube on the chassis being cold. The remedy was to rewind the secondary just like the original; and find and correct the short-circuit.

In the Sparton "Model 89A" a baffling problem presented itself in that the volume control was of no effect. The control was not at fault, but a tube was found with a leak between the heater and the cathode. This often happens in new tubes, and a wise Service Man will check very carefully on this item first.

In using a set analyzer remove the tube very carefully, so as not to jar it in any way, and insert in the analyzer; if the tube is jarred the leak may not show up. Perhaps the better way is to remove one tube at a time from the radio-frequency can, and try the volume control with the set analyzer plugged into one of the sockets. When the leaky tube is located the volume control will function; and you will see that the plate current can be controlled from zero to about six or seven ma. (Never have more than one tube out of the circuit at any one time; otherwise a damaged tube may result.)

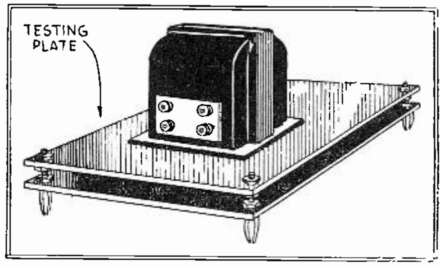


Fig. 6
The plug-in instruments thus made permit a test of any component of a circuit conveniently.

"CONVENIENCE MOUNTINGS" — IMPROVED NEUTRALIZING TOOL

By R. H. Siemens

FOR several years, the writer has been specializing in the construction of special receivers; usually, they consist of five stages of T.R.F., single-dial controlled. During the course of many experiments, it has been desirable to make rapid comparisons in a given set, between different makes of apparatus. Satisfactory results in this respect were obtained by arranging the different instruments on removable plates, such as are illustrated in these columns.

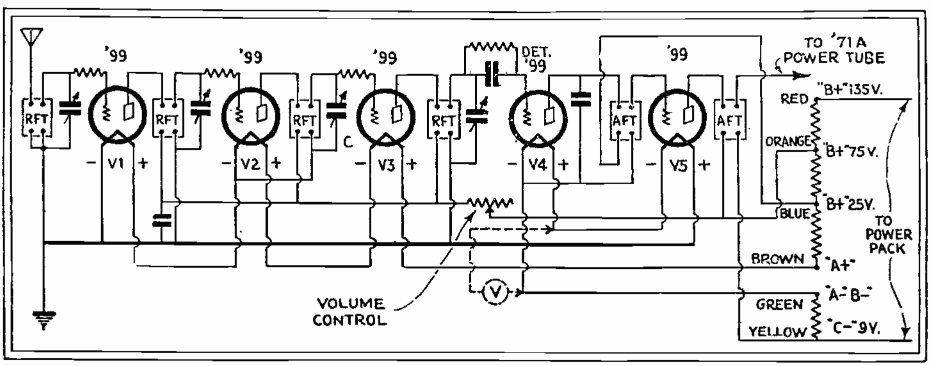


Fig. 5

This diagram of the tuner of an old Steinite model ("991," "992," "993") shows the series-filament arrangement. As Mr. Miller points out, a grounding of the third tuning condenser cuts out the filament of the first tube.

General Radio plugs, and receptacles, of the type used on their plug-in coils, were used as shown (Fig. 6). In the illustration, only the plugs at three of the four corners are visible.

Each instrument is mounted on its own bakelite plate; wiring is run under-

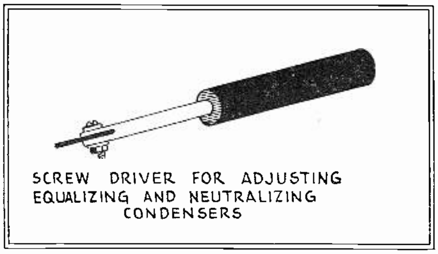


Fig. 7

A very convenient tool for circuit adjustments.

neath. To prevent the wiring from touching any other apparatus, the lower plate, or "cover" plate, is then made. The plugs bolt these together.

Although an A.F. transformer is shown, the idea has been applied to almost every instrument which can be used in the receiver.

Most of the experimental circuits incorporated neutralization. The usual "screwdriver," made by putting an edge on a rod of bakelite, was used to balance the stages. However, tight condensers necessitated continual filing of the bakelite, as the edge twisted off. As this became annoying, the tool shown in Fig. 7 was developed.

A small rod was inserted into a larger one, then slotted; and a small piece of hard brass was inserted into the slot, where it was held in place with a small bolt, and then edged.

The area of metal used as a blade is so small as to cause negligible disturbance of the fields.

USES OF THE TEST PROBE

By Jos. Riley

TECHNICIANS breaking in to the service field may be interested in knowing the uses to which the simple test probe (illustrate on page 275 in the November issue of RADIO CRAFT) may be put. As stated in the issue referred to the probe is small, extremely handy, and should find a place in the pocket of everyone who tests a radio receiver.

(1) Open Circuited Bypass Condensers

If a receiver oscillates, or has excessive hum, remove the lamp from the probe end, attach the test probe clip to the chassis, turn on the set, and touch the high voltage end of all the bypass condensers. The set will perform normally when the faulty condenser is touched. This is illustrated in Fig. 8A.

(2) Short Circuited Bypass Condensers

Insert the standard lamp in the probe, connect a 4½ volt battery in series with the clip lead, connect the other end of the battery to the chassis of the receiver, and touch the probe point to the opposite terminals of the condensers. A shorted condenser is indicated by the lighting of the lamp to full brilliancy.

(3) Testing Tuning Condensers and Coils

Turn off the set. Connect a 4½-volt battery in series with the probe and the chassis. With a standard lamp in the test probe, touch the probe to the grid end of the R.F. coil. The lamp should light at half brilliancy. The tuning condenser should then be rotated and if at any point the lamp jumps to full brilliancy, then the condenser is shorted at that point. See Fig. 8B.

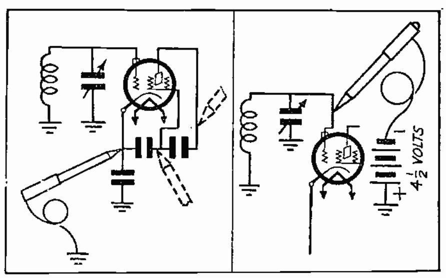


Fig. 8

At the left, A, locating shorted bypass condensers; at the right, B, testing tuning coils and condensers.

(4) Aligning Tuning Condensers

Turn on the radio set, start the test oscillator and tune it in. Attach the test probe clip to one terminal of the voice coil of the speaker and touch the probe point to the other. (A few sets will require connecting the tester in series with the voice coil, rather than in parallel with it.) Adjust the volume control for minimum brilliancy of the lamp. Then adjust the individual tuning condensers for maximum illumination. This operation should be repeated several times.

(5) Checking R.F. Coil Polarity

Connect the tester to the set as described in (3). With the lamp at one-half brilliancy, place a small magnetic compass beside the probe and note the direction of the pointing needle. This should be repeated for every other R.F. coil; the compass should point in the same direction in all cases.

(6) Checking High Voltage

For making voltage or current tests beyond the means of the tester, the standard lamp may be removed and a neon lamp inserted in its stead. Using this arrangement every high voltage point in the receiver may be tested with ease.

(7) As a Trouble Lamp

By directly connecting a 4½-volt lamp across the terminals of the probe, it may be used as a very handy trouble lamp for examining the chassis of radio sets.

(8) Miscellaneous

By replacing the standard lamp with one rated at 6 volts, complete continuity of the ignition system in an automobile may be easily and conveniently checked. The clip is attached anywhere on the chassis of the car and the probe touched to the "high" side of the lamp indicates the presence of voltage.

Continuity tests may also be made by connecting the probe as described in (3).

A NEUTRALIZING TOOL

By Ralph L. Green

BAKELITE "screwdrivers," used in neutralizing and making similar adjustments, become dull with a few minutes' use and must be resharpened. After becoming bored with this, I hit upon using an ordinary bone knitting needle of large size (about ¼-inch). After filing this to a screwdriver edge,

Fig. 9
Another tool which the Service Man or experimenter may convert from household uses.

I found that it held its edge fairly well. It will not break readily and is long enough to reach into comparatively inaccessible places. See Fig. 9.

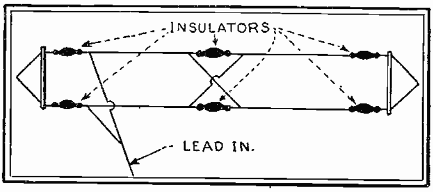


Fig. 10
"Phasing" an antenna to reduce the effects of interference pick-up.

ELIMINATING HUM FROM NEARBY LIGHT LINES

By J. H. Mills

When your antenna must be placed parallel and close to high tension lines, a great deal of hum is picked up by it.

To eliminate the biggest proportion of this hum, put up a two-wire antenna, as shown in the drawing above. See Fig. 10.

The wires cross in the center of the span and they must not come in contact with each other.

The principle on which this aerial works is as follows: The pick-up of the interfering current is equal in each end of the wire and as the positions of the wires are reversed at the central point, the current picked up in the opposite wires opposes that picked up in the other.

TEST PANELS AND PRODS

By Luther C. Welden

NOT long ago, battery kit-sets were put on the market with drilled front and sub-panels, some 30 inches long. These are now out of date, and the panels can be bought of some salvage stock houses very cheap. By using one of these panels, an efficient test panel can be built without a great outlay of money, especially if a few meters are on hand.

That the panels are drilled does not matter since, with a little care in arranging the meters and switches, etc., these holes may be used or hidden. A tube tester may be included; also an inexpensive ohmmeter for continuity testing. By using Fahnestock clips at the bottom for antenna, ground, and battery connections, a receiver may be quickly "hooked up" for test.

The panel may be set away from the "back board" of the workbench by using 2-inch pieces of bakelite or fibre tubing and long screws. Phone-tip jacks may be used at the meters and elsewhere for outside use through flexible leads and test prods.

Good test prods may be made by taking No. 8 insulated wire, (used on light and power lines) and cutting it into the desired lengths; leaving the insulation on except for about ½-inch at each end. One end is filed to a point, to the other the flexible leads are soldered and then taped.

Another way is to use hollow bakelite rods of proper length, through which you may pass a No. 12 or 14 insulated light wire. File the tips and connect as above.

LOCATING A GROUND

By Herbert W. Jones, W9DUH

OFTEN a Service Man goes on a job, and finds two wires of the same size and color passing up through a hole in the floor. To make it easy to tell which is the aerial wire (without having to trace through, go down in the basement, crawl over barrels, etc.) the following is suggested:

With an A.C. meter cord plugged into the wall socket, but only one wire connected to the meter, touch one of the pair of wires in question to the other post of the meter, and note if there is a voltage reading. If no reading obtains, touch the other wire of the pair to the meter. If no voltage is obtained with either wire, then give the socket plug half a turn, or connect the other side of the A.C. line to the meter, and repeat the test with the two wires that come through the floor. The one of the pair that shows a voltage reading is the ground wire; the other is presumably the aerial. If voltage readings are obtained from both wires, the aerial is grounded.

This little stunt saves time, and eliminates guesswork.

THE PERSONAL TONE CONTROL

By Louis Rick

THE idea of tone control is so old it has whiskers; but, like most bewhiskered gentry, it has a modern descendant. In this instance, we find the radio sets of today are equipped with a timbre-modifying arrangement in which the central position of the control knob corresponds to the normal quality output of the receiver; while moving the knob to left or right accentuates either the bass or treble.

Service Men may introduce this modern twist (Hi!) into the older receivers by following the schematic circuits shown in Fig. 11. (A, recommended circuit for sets having the output push-pull; B, connections to single power tube.)

Condensers and R.F. choke made into a unit (as at C) may be mounted directly on the output transformer; the potentiometer P being placed where most convenient.

A final and "commercial" touch is obtained by placing a piece of white celluloid, marked with India ink, underneath the potentiometer arm, as shown at D.

The result is a modern and almost unbeatable tone control.

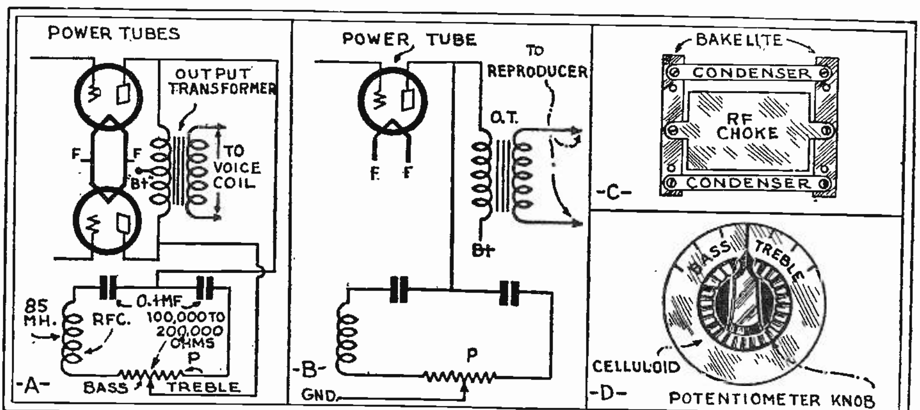


Fig. 11

The experimenter who wishes to build his own tone control will find a handy method here; the device is easily made and easily connected.

FINE RESISTOR ADJUSTMENTS

By J. E. Noble

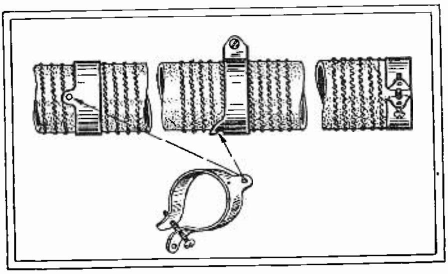


Fig. 12
Mr. Noble uses this slider to obtain very fine adjustments on a standard wire-wound resistor for calibration purposes.

WHEN a fine adjustment of resistor values was required for some experimental work, I made up the vernier slider, for a "Truvolt" wire-wound resistor, which is illustrated herewith. As may be seen, it consists of a slider made slightly wider at its midpoint, with a distinct semi-globular indentation impressed or stamped therein; this indentation is made to ride the threaded channels of the resistors, allowing almost a micrometric adjustment to be made. Rough adjustments are first made in the regular up-and-down manner; then a turn to the right or left does the trick.

Those who desire an easier method of constructing the slider can simply cut two small slots in a standard slider; filing away the part which is not required, and giving the remaining small portion a slight inward bend with a pair of pliers. Be sure to file off any sharp corners which remain, to prevent cutting the resistance wire when making the adjustment.

THREE SET HINTS

By Helmers J. Huebner

IF an Apex "Model 80" gives low volume and a popping noise, see whether the volume control is touching the metal shield. It should be centered and tightened.

When a late 1930 model Apex begins to motorboat, or give harsh tones and incorrect tube readings, it is an indication that the small condensers are out of step. They should be adjusted with the shield in place, by the aid of an output meter.

When an Atwater Kent gets noisy, look for a dirty volume control, in almost any model. The cure is a good cleaning with gasoline.

RAPID METHODS OF LOCATING FAULTS IN RADIO RECEIVERS

By Delbert Myers

FAULTS occurring in radio receivers are all similar in characteristic manifestation.

One common trouble or fault in both type sets is tube failure. For rapid work we proceed by the process of elimination. All tubes are tested for emission, and possible shorts, and all faulty tubes are replaced.

To test, put receiver in operation. Remove detector tube and replace. If this action produces a click, we can consider that the audio system is O. K. Tapping the detector tube lightly with the finger should produce a ring in the speaker if the detector and audio system are O. K. We, therefore, eliminate this part of our circuit. Next pull out the tube in the radio-frequency amplifier preceding the detector and replace. If click is heard the trouble is in preceding stages. Take each succeeding R.F. tube out of socket and replace. If one of the tubes does not produce a click the fault is in that stage or in one of the preceding stages. This process will work for any part of the circuit.

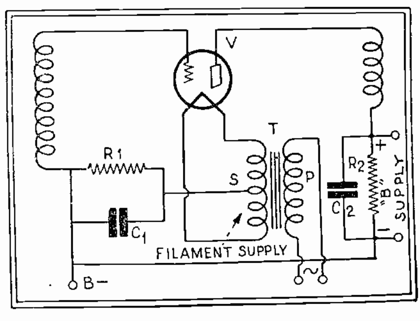


Fig. 13
The elements of the voltage supplies of an A.C. filament tube; check first speaker; then tubes, voltages, and receiver circuits, says Mr. Myers.

AN EMERGENCY REPAIR

WHILE servicing an expensive radio set, located in the furthest suburbs of a certain city, it became necessary to complete a filter resistance circuit which had opened. As the voltage requirements of the set were unusually exacting, the writer had visions of a long trek to town and back again, a matter of about two hours' time.

A sudden recollection that there was in the old "bag of tricks" a variable resistor of the type known as a "duplex, sub-panel-mounting" unit, brought a gleam of hope. Connecting this into the circuit, as shown in the schematic diagram, Fig. 14, effectively solved the problem.

This unit may be mounted on a sub-panel, in any convenient place; final adjustment being obtained by screw-driver manipulation until the voltmeter or set performance indicate that the correct setting has been found.

It is hoped that this idea may be of assistance to other service men; for we are told that forewarned is forearmed. See Fig. 14.

It will be remembered that the duplex resistor contains two separate resistors. These resistors are adjusted separately, so that the correct voltage can be applied to each tube in the set.

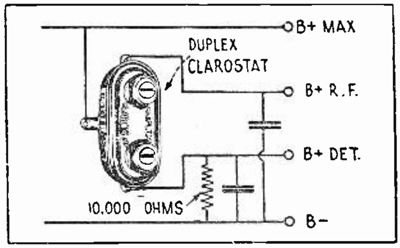


Fig. 14
The circuit arrangement of a clever emergency repair.

ANTI-MOBO

THE service man will find an anti-motorboating unit of the type to be described herein of considerable aid when making radio service calls where the complaint is motorboating. These calls will usually come just after the purchase of a "B" eliminator of a size and type unsuited to the service required.

Chokes L may be A.F. transformer primary or secondary windings; if secondaries of better grade transformers are used, the voltage drop through them will probably be too high, with consequent loss of "B" voltage. Also, windings of wire too fine for the current drain will burn out. (Fig. 15)

Condensers C may all be of one size, one mf., or even less; although, in some cases a high value may be needed. The detector plate is the worst offender in this respect.

This anti-mobo unit supplements the usual filter network of the eliminator.

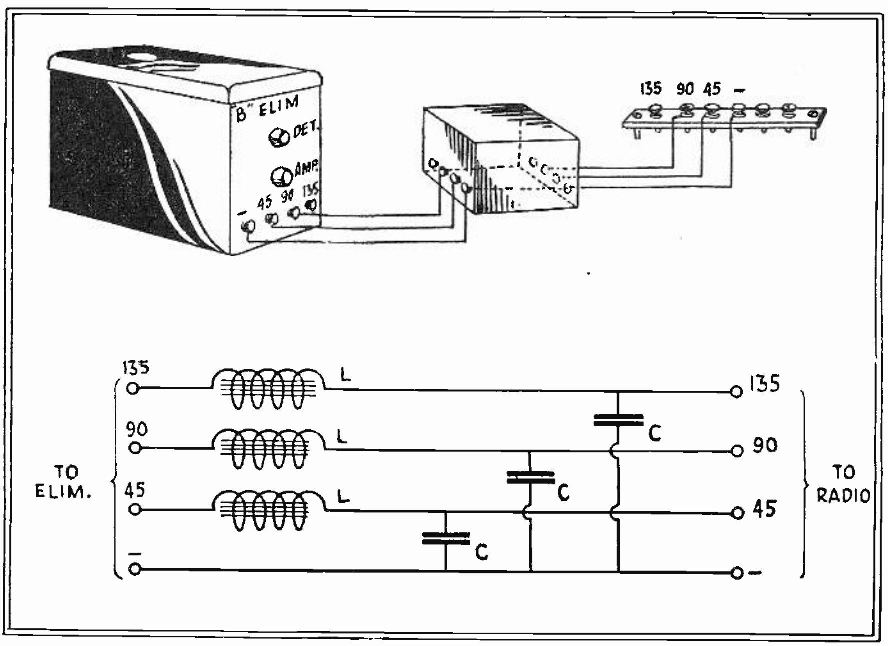


Fig. 15
A simple ripple-smoothing ("anti-mobo") device.

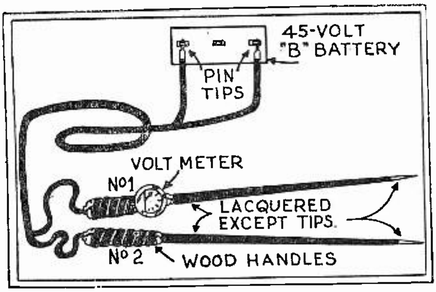


Fig. 16

The tester thus made measures resistances and determines continuity very quickly. By omitting the battery, it may be used also for voltage readings up to its scale limit.

In fact, it may replace this network if care is used in selecting the chokes and condensers.

If the constructor so desires, a complete unit may be built up and the condensers and chokes housed in a small box, placed between the usual "B" eliminator and the radio set, as illustrated. The unit shown has been wired to use only two choke circuits; although the schematic circuit has been drawn to include three. As the power stage (marked "135") seldom causes any trouble due to feed-back, it has not been shown. This filter circuit may be applied to a "C—" bias lead.

MODERNIZING THE ICE-PICK

By Luther C. Welden

A CIRCUIT tester, which the writer finds a great convenience, was quickly made by mounting a 0-50-scale voltmeter on one of two ice-pick handles. All but the tips of the picks were insulated with a coat of lacquer. A "double-conductor" loud-speaker cord was soldered to the steel of one pick; and to one terminal of the meter on the other (the other terminal of the meter being soldered to the pick on which it was fastened). Tape was used on the handles to securely hold the cord leads and meter. (It was necessary to use a loudspeaker cord of the "fine-wire" type; for the old "tinsel" kind is not sufficiently conductive or strong.) The assembly is shown in Fig. 16.

The remaining two ends of the cord are connected to a 45-volt "C" battery.

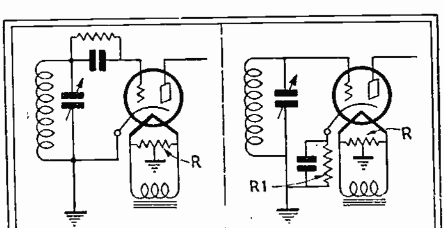


Fig. 17 Fig. 18

While the filament and cathode are both at ground, there is considerable difference between them in a power detector. Then, too, late models are apt to have a positive bias instead of a ground tap at R.

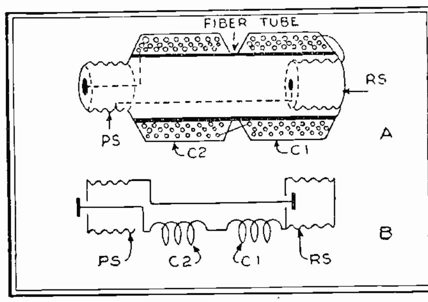


Fig. 20

"Skeleton" and schematic circuit of the radio-frequency choke coil.

VOLTAGE TESTS ON '27s

By R. D. Wills

IN taking voltage measurements of a set employing type '27 tubes, it must be remembered that some older equipment takes the reading between plate and filament, even though a 4-to-5-prong adapter is used.

Unless the equipment is arranged to show the condition of the cathode circuit, this circuit must be tested separately; since a correct plate-filament voltage is not enough to show how the tube is functioning. In tubes of this kind, the plate current must flow through the cathode return. (See Figs. 17 and 18.)

In most sets employing '27 type tubes, the volume control is inserted in the cathode circuit and, since moving parts are most subject to acquired defects, the volume control is always a good place to look for an open cathode circuit, as a short cut in trouble finding.

This article was inspired by knowledge of a case where half a day was spent by two Service Men looking for trouble with socket meters which did not show the open cathode.

A PILOT-LAMP ADAPTER

By Audie Robertson

FOR the Service Man, the device shown in Fig. 19 is very convenient when working in the dark corners of the set. A miniature socket, to fit a dial-light bulb, and a burnt-out bulb, the base of which forms the plug, with two flexible insulated wires are the only requisites.

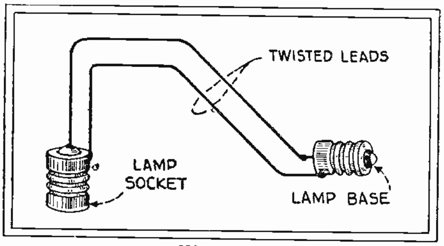


Fig. 19
The dial-light is converted into a trouble-shooting lamp by the use of this simple adapter.

Take the pilot lamp out of the set, put it in the socket of the extension lead; and screw the plug of the latter into the pilot lamp's socket. The lamp continues to operate from the set's current. Two-foot leads are usually enough.

AN EFFECTIVE INTERFERENCE ELIMINATOR

By Ernest V. Amy

MOST Service Men are familiar with the use of a choke coil for the suppression of artificial "static" radiations. However, it is generally believed that a successful unit must be purchased. The construction and application of the unit pictured in these columns will explode that fallacy.

In practically every instance of interference from motors it is usual to apply a palliative **at the point where the motor line connects to the power line.** This materially reduces interference **conduction** into the light lines; **but, it does not prevent interference radiation from the current lead between socket and motor.**

The design of this device is based on the fact that all motors of any real size have "fused switches" close to them.

To install this **air-core choke** (Fig. 1A), a fuse is removed from this switch box, the choke inserted, and the fuse screwed into the choke. The opposite side of the line is tried; one in each side may be necessary—in extreme cases.

Fig. 20B illustrates the series circuit so formed. This is schematically indicated in Fig. 20A.

A brass shell is arranged in one end of a fiber tube. This is the receptacle shell, R.S. for the fuse. In the opposite end is fastened the plug-in shell R.S. On the tube are two windings; each of which consists of 140 turns of No. 18 D.C.C. wire, plain layer-wound. They are spaced as shown to reduce self-capacity which would act as a high-frequency by-pass and nullify the reactive effect of the choke. The complete unit is shown in Figure A below.

POPULAR RADIO ACCESSORIES

By J. G. Sperling

IN spite of many opportunities, the average Service Man does not avail himself of the possibilities of selling various radio accessories in the home.

The writer has carried a few items in his kit for the past year, all of which have proven very successful. It is a rare home, indeed, in which at least one of these accessories could not be sold.

Noise Reducer

The first of these accessories is a noise or static reducer. As seen from Fig. 21, it consists of a neon glow-lamp in series with a variable resistance. This device is connected across the

Fig. A

At left is pictured an effective "static" radiation reducer, for use on sparking devices, wired as described by the author. It is quickly and inexpensively constructed and easily applied; and will give relief from the "man-made static" generated by so many installations. The closer it is to the sparking device, the better.

voice-coil terminals of the loudspeaker Its operation is relatively simple, it being a form of an automatic volume-control. First, the manual volume-control is set at some definite level. It

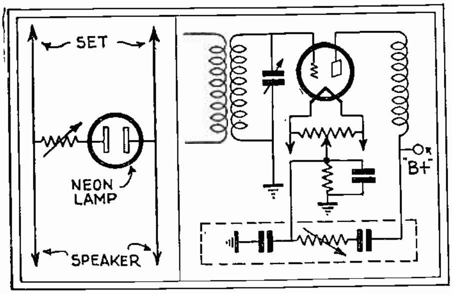


Fig. 21, left. Circuit of the static reducer.

Fig. 22, right, Hum-control circuit.

will be necessary to mark this point on the dial, for successful operation of this device depends upon the correct position of this volume control. Then the variable resistance in the unit is adjusted till the lamp starts to flicker.

Therefore, if there are any extraneous noises such as static or electrical interference it will be shunted or by-passed through this device. There will not be any loud crackling such as previously present, but only a low-pitch noise or "plop" whenever there is a large amount of static. Whenever this occurs, the neon lamp will glow.

The parts used in this device are a G.E. 1-watt neon glow-lamp with a small Edison base, and a 10,000 ohm variable resistor. This unit is housed in a small container and sold to the customer for $2.50. After a free demonstration on a bad night, the customer will always buy this device.

Hum Eliminator

Many of the early type as well as some of the later model A.C. sets had a very bad hum. Different methods have been tried to combat this evil but only one device seems to be the panacea for all our hum troubles. This is an adaptation of the hum-bucking unit designed by Miessner and used by Loftin-White in their amplifier. Almost everybody knows what a success it has been in the above units. It is simple to construct and adjust. It promises an inviting field of revenue for the wide-awake Service Man. As seen in Figs. 22 and 23, it consists of two .5-mf. condensers of 400-volt rating and a 5000-ohm variable resistor. When installed, it is only necessary to turn the arm of the resistance to a point where no hum is heard.

This hum-bucker has been used with success in such sets as the Majestic "70" and "90," Temple "8-80," Victor "RE-32" and RCA "16," "18," "33" and "60." It should be connected in the last radio-frequency stage.

Tone Control

In spite of the great popularity of dynamic speakers, many sets are still found employing the magnetic speaker. Very often the owner complains of insufficient bass and a superabundance of tones in the middle register. This situation can be remedied by the use of a device called the equalizer.

The constants for the trap for use with magnetic speakers are one .1-mf. condenser, one 80-mh. choke such as Samson, and a 0-50,000-ohm resistor. The resistor is adjusted until a pleasing response is obtained. The schematic is shown in Fig. 24.

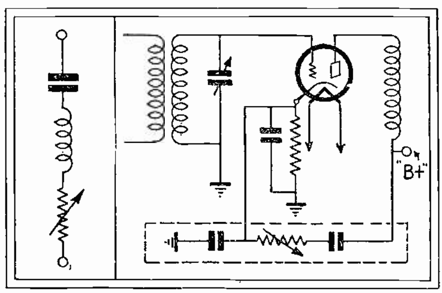


Fig. 23, right. Another hum-control connection.

Fig. 24, left. Tone-control unit.

MEASURING PLATE RESISTORS

By J. E. Kitchen

WITH the increased use of resistors in plate circuits, it may be sometimes desirable to determine their value, without pulling the chassis, and using an ohmmeter.

Plug a set tester into the receiver in the usual manner and place the tube in operation in the tester. Note the plate voltage reading, say 130 volts, and the plate current reading, say 0.2 ma. Now take a lead from the "B" tap concerned and plug it into the unused socket of the analyzer (which is connected in parallel with the socket being used). Note the new plate voltage reading, say 180 volts. The voltage drop across resistor is seen to be 50 volts. As a current of .0002-ampere is flowing, the resistance will therefore be 50/.0002, or 250,000 ohms.

This method shows up high-resistance joints in the place circuit and is quicker and slightly more accurate, than going over the set with an ohmmeter. It also affords an easy way to try new values of resistors.

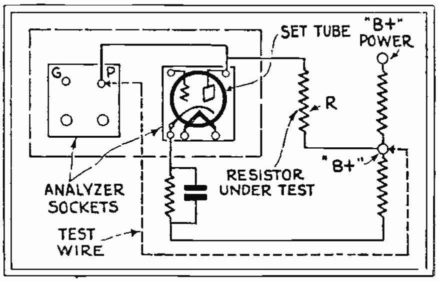


Fig. 25

This simple method of measuring voltage on both sides of a resistor, when the current is known, quickly gives its value. (A high-resistance meter is needed.)

A HUM KILLER

By George W. Brown, Asso. I.R.E.

MANY A.C. sets hum, even though the filter system is quite efficient. I have found that, in sets using push-pull audio stages, a 100,000-ohm resistor R1 connected across the secondary of the input transformer will reduce the hum considerably. In extreme cases, another 100,000-ohm resistor R2 may be connected across the secondary of the first audio transformer. This second resistor may make a very slight change in the volume; but it will certainly kill whatever hum may be left.

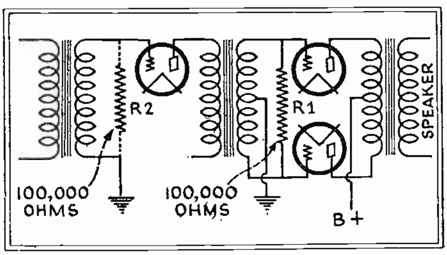


Fig. 26

Mr. Brown finds the use of these resistors a solution of the persistent hum problem.

IMPROVING SENSITIVITY

By C. H. W. Nason

SOME of you may have noticed that, in the old Freshman "Q" sets, the antenna was connected to the detector circuit through a small variable condenser. In this receiver a '22 tube was used as an R.F. amplifier with raw A.C. on the filament. In order to reduce the modulation hum, the tube was given a relatively high grid bias which, in turn, reduced the sensitivity of the receiver. In order to regain this lost sensitivity many tricks were attempted; but none was so successful as this means of obtaining regeneration.

Radio receivers bordering on the antique may be given a boost toward longevity by the use of a similar system, as shown in Fig. 27. Connect a Hammarlund "MC-S" 100-mmf. midget condenser between the plate of the detector tube and the plate circuit of the last R.F. stage. In order that this system may be effective, it is essential that the signal voltages in the two plate circuits be in phase; if this is not the case a loss rather than a gain in sensitivity will result. If the two voltages are out of phase, the feed-back voltage will neutralize the signal rather than increase it. All this is readily discovered by trial; and failure of the system to regenerate at the high-frequency end of the tuning range may be remedied by reversing the connections to the primary of the R.F. transformers, thus changing the phase relations.

The new Hammarlund midget condensers are fitted with a set-screw for locking the adjustment. If an additional control is not desired, the condenser may be adjusted so that the receiver just breaks into oscillation at the high-frequency end of its range. The condenser setting may be locked in this position by means of the set-screw, and will hold its adjustment indefinitely.

Should no case against the additional control be established the condenser

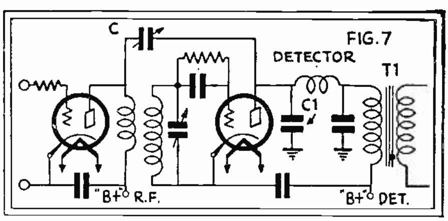


Fig. 27

This condenser is used, not to neutralize, but to give a bit of regeneration.

may be brought out to the front of the panel and used to increase the sensitivity and selectivity of the receiver over its entire range.

TAKING THE KICK OUT OF CONDENSERS

By S. H. Boyce

AFTER receiving several bad burns from pack condensers which had retained their charge for a considerable time, the writer conceived the idea of using a "Jazz Stick" for discharging them. This device, obtainable from any musical supply house, consists of a "fan" of fine wires (arranged to collapse into the handle, for portability) and when brushed across the terminals of a charged condenser bank, will discharge every one of the condenser units. This has been found quicker and more convenient than the usual method of using a screwdriver to short the terminals. The implement is about a foot long when open, as illustrated in Fig. 28.

Caution: Tape the handle before using the "jazz stick."

A "CROSLEY V" OSCILLATOR

By Walter I. Warner

ALTHOUGH thousands of 2-tube "Crosley V's" were sold, how many Service Men have realized how easy it is to make one into an excellent oscillator for circuit balancing, etc., by a slight change in the wiring? The circuit for this purpose is shown in Fig. 29.

A Hartley-type oscillator was decided upon, using a type '99 tube for V1. Condenser C1 is the regular "book-type" unit in the receiver; C2 the regular .00025-mf. condenser in shunt with grid leak GL; C3 a 0.5-mf. condenser; the rheostat 30 to 50 ohms. A 4½-volt "A" battery and a 45-volt "B" battery were used.

Audio-frequency modulation may be obtained by using a variable high resistor for GL, and adjusting it to the proper value.

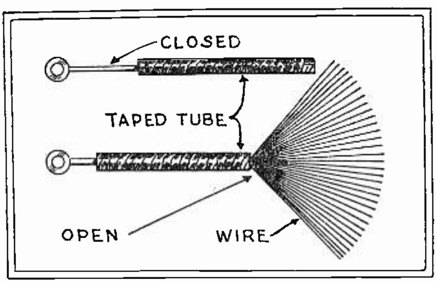


Fig. 28
This "jazz stick" may save the user from inventing a few new, fancy steps—after a jolt from a condenser.

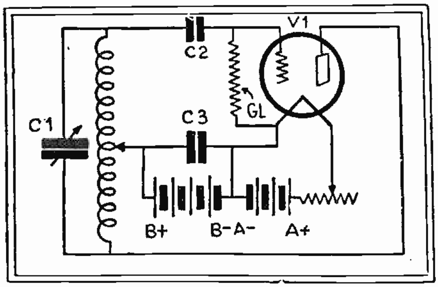


Fig. 29
The old regenerative sets, now junked, supply exactly the parts required for an R.F. oscillator.

A KINK FOR THE CAREFUL SET-TESTER

By Alvin Porter

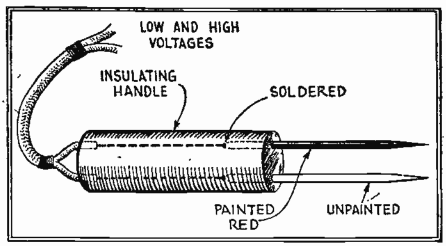


Fig. 30
The tester shown here will make the routine shorter for the Service Man; but it is not to be recommended for the absent-minded; as an application of the wrong point is hard on the meter.

THE tester who is careful in his work will find no difficulty in using the double-prod unit for circuit testing that is illustrated in Fig. 30.

In testing the voltages of electric sets, two test points usually are needed for testing "B" and "C" voltages, or any other circuit voltages requiring extremes of meter reading.

The writer uses only one prod; but it is "duplexed" in the manner shown. A wire from the high-voltage binding post of the meter is connected to one prod; while the low-reading side of the meter has its lead connected to the other prod, which is in the same handle. The negative side of the meter is connected to the set through a flexible lead and a clip, the latter connecting to the negative terminal of the set.

The prods may be driven into the wooden handle, and the flexible leads soldered to them, or the unit may be made in any other convenient manner.

IMPROVING RECEIVER OPERATION

By George Stoneham

THOSE Service Men who wish to improve the operation of the seven tube Federal Orthosonic receiver at a very low cost, may make the changes outlined below which resulted in a decided improvement in operation over that received prior to making the change.

This receiver uses the BA Raytheon tube for rectification, and consequently the slightest change in line voltage manifests itself in corresponding changes of the filament voltages and current of the '01A tubes whose filaments are connected in series. By substituting two '80 tubes for the Raytheon as shown in the diagram of Fig. 31, the hum experienced with the old mode of connections entirely disappeared and excellent stability of operation was secured.

The five volt winding for the pilot lamp is used to supply the filament of the '80's and there is sufficient room in the power unit to house the two new tubes. The cost of the additional parts necessary for the change is negligible compared to the increased satisfaction

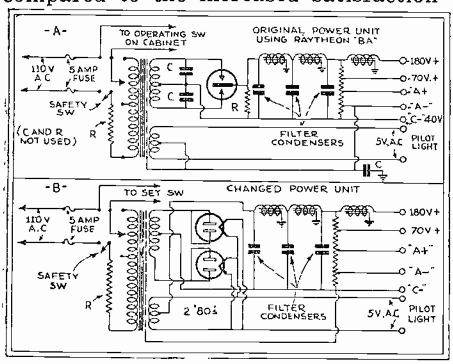


Fig. 31
By replacing the BA Raytheon with two '80's, the operation of the Federal Orthosonic receiver is much improved. The three condensers marked C and the receiver R which are used in the original circuit, are not needed after the unit has been rewired as shown.

secured.

Incidentally, if a small coil, tapped in the center, that will match the tuning condenser is used in the first stage instead of the loop, and is connected to a short aerial, an increase in the selectivity and distance received will be noted.

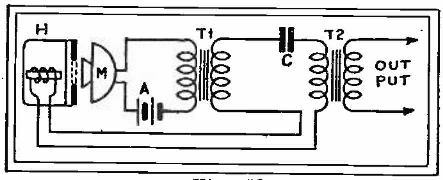


Fig. 32
A telephone transmitter, receiver, and transformer, are the essentials of this "audio howler," designed for use in radio adjustment.

THE "HOWLER" AS A SERVICE OSCILLATOR

By B. Fox

THE old idea of putting a microphone transmitter against a receiver may now be put to more practical use than annoying the party at the other end of the wire, as illustrated in Fig. 32.

Transformers T1 and T2 are any handy telephone or high-ratio audio transformers; while condenser C (ordinarily about .01-mf.) may be varied for different tones. The telephone receiver is designated as H; the microphone, M; the voltage supply for the microphone, A (which will vary with each mike—although its average value is 3 to 4½ volts).

If no microphone is available, one may be conveniently made by mounting on the diaphragm of the receiver a "microphone button," obtainable for about a dollar. The assembly is to be taped together and placed in a box, padded with felt or cotton to prevent the audio howl being heard in the room.

A GLOW-LAMP TESTER FOR CONDENSERS

By J. B. Calpark

THE most efficient trouble lamp I have ever used is a type 874 voltage regulator, used as shown in Fig. 33, with a 10,000-ohm variable resistor in the other leads from the house lines. It is especially useful for testing fixed condensers, since very little current is needed to produce a purplish glow. If the slightest amount of glow appears

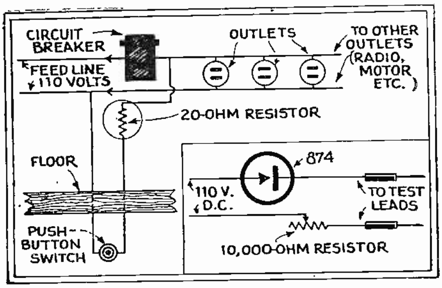


Fig. 33
Left and above, a simple connection of a relay to shut off the radio and other appliances while telephoning. Right lower, another continuity tester, using a glow-lamp.

in a tube when a condenser is under test, the condenser is leaky or due for a "blow." **(A large condenser will give an instantaneous glow while it is charging, although it may be in good condition.**—Editor.) Some tubes have to be warmed up, by shorting the test leads, for about 30 seconds, before they will glow on a leaky condenser.

The adjustment of the resistor is not critical; vary it until the tube glows distinctly. If you are in doubt whether a condenser leaks, turn the variable resistor up to full; if the tube does not glow, the condenser is undoubtedly O. K. The tester may be used for any number of continuity tests on circuits, etc.

AN EMERGENCY WIRE-CONNECTOR

By X.

EXPERIMENTERS will welcome the little idea, illustrated below, for quickly connecting two wires.

There are objections, at times, to twisting leads, or to soldering them. A convenient and quick way to connect wires is to use a paper clip, and weave the wires back and forth. Most temporary connections are so insecure that they develop microphonic contact; but this idea seems to afford good contact. Fig. 34.

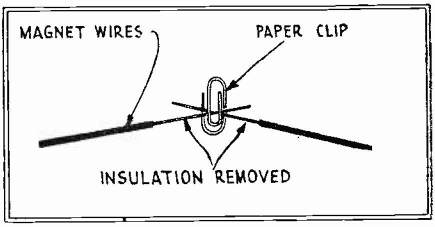


Fig. 34
The paper clips shown effect very rigid contact with comparatively low resistance, for temporary use.

REWIRING MAJESTIC SETS

By Bertram M. Freed

MUCH has been said and written about extra dividends for the Service Man. There is, in many a home, a set which is giving the owner a good deal of satisfaction but is not up to date; among these will be found the Majestic "70, 71, 72" series. This model used '71A tubes in push-pull; usually the quality of reproduction is not faultless. It is a simple task to rewire the last push-pull stage so that the filaments are in series; a pair of '45 tubes may then be employed. The winding will supply sufficient current to operate these tubes satisfactorily.

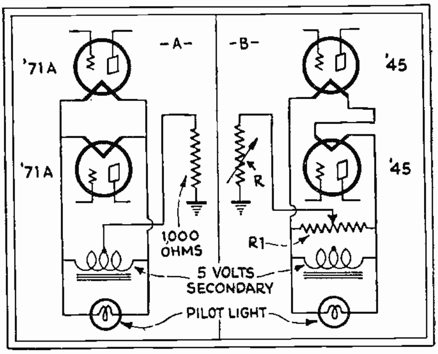


Fig. 35
The combination of series-filament tubes in push-pull is not completely balanced; but the circuit tends to equalize the effect of differing grid biases.

The biasing resistor for this stage is located in the pack; it may be replaced, at R, by a "Type C" Electrad resistor, which may be adjusted until the tubes get the proper bias. The resistance value will depend upon the plate voltage available: if the voltage is about 200, place 35 to 40 volts on the grid; if it is above 220, 45 to 50 volts will be needed. Line voltages and the efficiency of the rectifier vary in different sets.

TESTING THROUGH INSULATION

By Arthur Bernd

ON close wiring jobs, and where it is not desirable to scrape insulation from wires, the following kink is useful to check continuity, shorts, etc.:

Take ordinary steel sewing needles; stick them in through the insulation until they make contact with the wires; and apply the test prods to the needles.

CHAPTER 3

Testing Equipment and Meters

A PHONOGRAPH-CASE OSCILLATOR

By R. Douglas Clerk

SINCE my article, "The Flying Service Man" aroused such comment, perhaps the constructional details of one of my earlier test sets will be of some interest to the readers of **Radio Kinks.** It is shown by diagram in Fig. 1.

Totally shielded, and fitting into a portable phonograph case, is an audio-modulated R.F. oscillator covering the broadcast band. The R.F. coil used in this job was taken from an Atwater Kent "Model 35" receiver; coupled to this coil L1 is a 10-turn winding L2 in variable inductive relation. This pick-up coil is connected to the antenna and ground binding posts of the receiver under test.

The electrical characteristics of an average antenna are simulated in the electrical values of a "dummy antenna" arrangement of the complete input connections to the radio set being tested; its components being L2, R, and C.

The entire set-up is shielded, as indicated in the diagram, and the phonograph turntable motor and the phonograph pick-up are grounded to this shield. In this particular unit, tube V was a Northern Electric "peanut" tube (which has a 1.1-volt filament), and the pickup was a Canadian Marconi unit

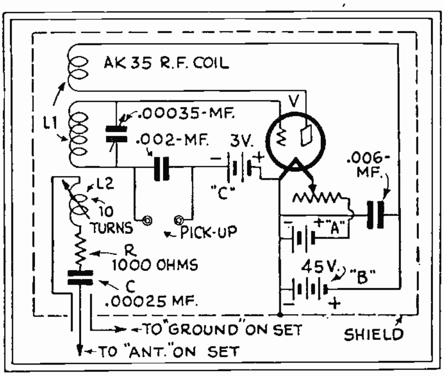


Fig. 1
Mr. Clerk's "portable broadcaster" is a very compact oscillator, built into a portable phonograph, which gives modulation.

of the high-impedance type; although, of course, any make of apparatus having equivalent characteristics may be used without the least bit of trouble.

The writer referred to a similar unit, in the November, 1930, issue of **Radio-Craft Magazine** and described its use in his letter on page 523 of the March, 1931 issue.

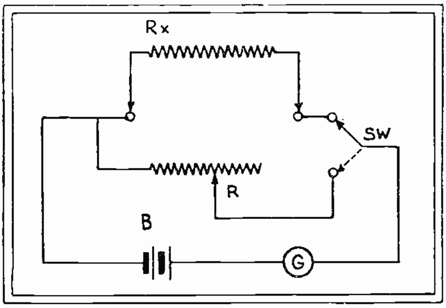


Fig. 2
A good wire-wound potentiometer, a galvanometer, some calibrated resistance standards, and a few odds and ends, complete this handy instrument.

CONSTRUCTION OF A RESISTANCE METER

By Malvern H. Berry

ALMOST every radio and electrical experimenter has need of an efficient and reliable resistance meter. With this he can design his own resistors, choke coils, and many other things. The instrument mentioned in this article was constructed from a potentiometer, a galvanometer, two binding posts, one dial, and a small box (Fig. 3).

Assemble and wire in accordance with the diagrams; Fig. 2 is the schematic circuit. The potentiometer R should be one of about 1000 ohms. The galvanometer G may be replaced by a high-range milliammeter and the results will be the same. The battery B is just a two-cell flashlight battery, which can be purchased from the ten-cent store.

After everything is assembled comes the calibration of the potentiometer R. This can be done with a Wheatstone bridge. (If the constructor does not have a Wheatstone bridge, one may be had for the asking at your local high school. In the event that the constructor is not familiar with the Wheatstone bridge, the physics instructor at the high school would be glad to explain it.) If you can use the bridge, proceed as follows: attach to the potentiometer a dial, (vernier preferred) and adjust the potentiometer for a reading of 5 on the dial. With this fractional part of the potentiometer in the circuit, connect it to the Wheatstone bridge and find what the resistance of that part is. Get a piece of "graph" squared paper and graph the resistance in ohms, for every five marks or degrees on the dial, **across the paper**; and graph the reading or degrees on the dial **up and down.** Where the two intersect on the graph page, place a dot. After the resistances have

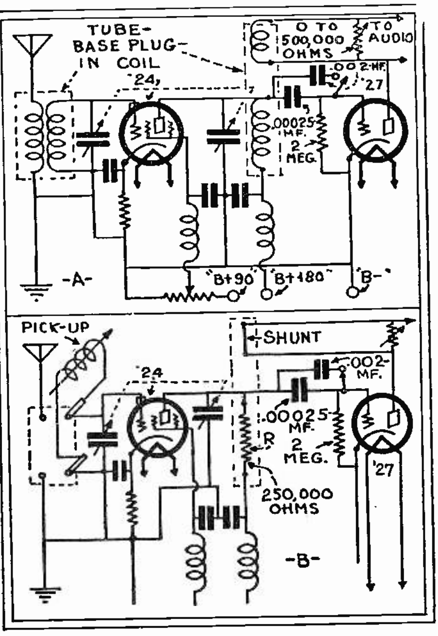


Fig. 5
Below, a method of converting a short-wave set into a powerful phonograph amplifier.
Above, the original tuning unit as utilized for short-wave reception.

been calibrated from zero to the full value of the dial for every five degrees, draw a line through all of the dots. This will be your calibrated curve for the resistance meter.

To operate the meter, place an unknown resistance Rx across at the binding posts, and note the reading of the galvanometer G when the unknown resistance is placed in the circuit. Switch

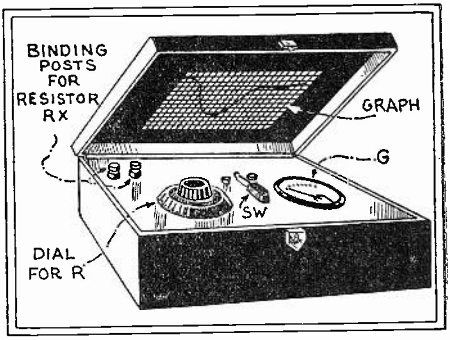


Fig. 3
Mr. Berry's layout; the graph in the lid is the reference calibration.

on to the calibrated potentiometer R and adjust until the galvanometer reads the same as before. The value is then the same in both resistances. Take the reading of the dial in degrees and look that reading up on the graph, and the value of the unknown resistance can be read direct from there.

By ganging several variable resistors of assorted ranges at R, and tapping them to a selector switch, the resistance range may thus be greatly increased.

TWO NOVEL ADAPTER KINKS

By Jerry Minter

SEVERAL suggestions have appeared in magazines calling for a tube-socket plug. The most difficult part about these plugs is removing them from the socket; some sort of handle is desirable.

An india-ink bottle stopper, a knife, and a tube base, and you have such a handle, as shown in Fig. 4-A. The cork is to be cut off; and a hole drilled through the length of the stopper, for the lead wires.

In the July, 1929, issue of **Radio-Craft** a "detector-booster" was described; and the circuit of this device was shown in

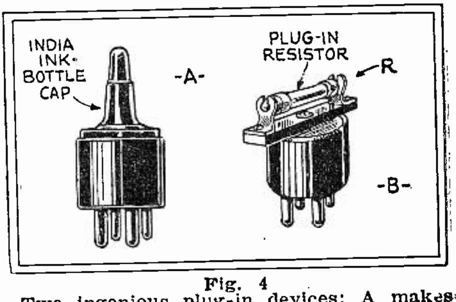


Fig. 4
Two ingenious plug-in devices; A makes a useful switch for some circuits.

the January, 1930, issue. For some time the writer has been using an adapter working along somewhat similar lines.

As shown in Fig. 5B, it is quite convenient to convert a standard short-wave receiver (such as the "Wasp," or the "Super-Wasp") for operation with a phonograph pick-up by plugging into the coil receptacles two little adapter-plugs; one contains tip-jacks for the pickup, and the other carries a shunting lead and, on top, a resistor mounting and the resistor R. (Fig. 4B.)

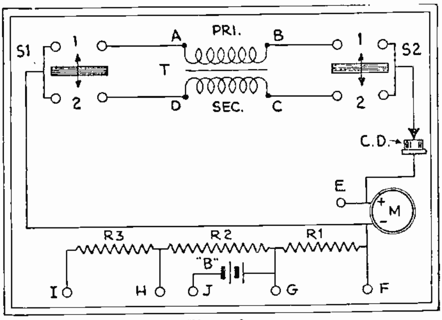


Fig. 6
This set-up is flexible for measurements on various sets; and also for continuity tests.

One set which I have in mind used a '24 in the R.F. stage, (which thus was converted into a first audio stage); a '27 detector (which became the second audio); a '26 first audio (now the third); and push-pull '71A's as second audio (now the fourth audio stage); followed by a dynamic reproducer. A good pick-up was used, and the resulting volume and quality were excellent.

SIMPLE OUTPUT METER

By Andrew Frevert

A SMALL output meter, that is made up to use in conjunction with a service oscillator, is shown in the sketch. (Fig. 6.)

The combination (of jacks A, B, C, D; switches S1, S2; and transformer T) makes a variable input to meter M and detector CD which forms the output indicator; depending on types of sets.

With connections to set on jacks A and B and switches in No. 2 position, primary of transformer is in series with speaker: secondary in series with meter and detector. With switches in No. 1 position, input with primary in parallel is fed direct to meter and crystal.

With input leads in jacks C and D and switches in No. 1 position, secondary is in series with input, primary feeding to meter. With switches in No. 2 position, input is in parallel with secondary and feeding to meter.

With input leads in A and C jacks, S1 on No. 1 position and S2 on No. 2 position, meter is connected direct to input signal.

For use as voltmeter: Jack E plus, G minus 5 volts; Jack E plus, H minus 25 volts; Jack E plus, I minus 100 volts.

Jacks E and J are for continuity testing or, if scale is calibrated, for use as ohmmeter.

IMPROVING THE OHMMETER

By J. E. Kitchin

THE ordinary method of measuring resistances with a 4,500-ohm resistor and 0-1-scale milliammeter will not go below 50 ohms with a shunt; and the slide-wire bridge is not suitable for carrying around. The answer to Mr. Prince, on page 611 of Radio-Craft for April, 1931, gave the right idea, but used too much gear. It formed, however, the basis of my experiments, which resulted in the method shown; it can be incorporated in many set testers by adding one binding post to the existing circuit. The writer used two positions on his Weston bi-polar switch, instead of adding a D.P.-D.T. switch. See Fig. 7.

To operate it. close the meter switch on the low side, and adjust the current to one milliampere. Then, if the unknown resistor Rx is of high value, switch the meter to the high side, and connect Rx across H and C (as at B). The higher the resistance, the less will be the current indicated by the meter, as is well known.

If Rx has a low value, leave the meter

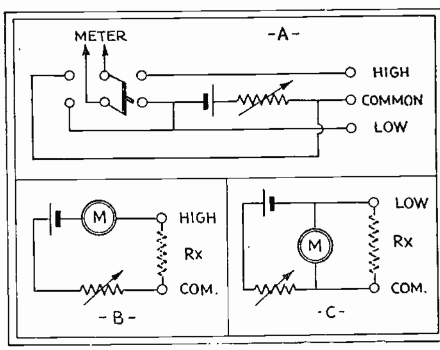


Fig. 7
Mr. Kitchen designed his ohmmeter thus; the D.P.D.T. switch may be part of a larger unit.

on low, and connect Rx across terminals L and C (as at C). The meter reading will be low in proportion as the value of Rx is low; for Rx is a shunt around the meter.

Calibration, by means of Ohm's Law, is performed in the usual way; the low scale should be calibrated with known resistance values, since the internal resistance of the meter must be taken into consideration.

BUILDING A RESISTANCE CALCULATOR

By S. H. Burns

FEW experimenters are fortunate enough to have an ohmmeter or other instrument for the measurement of resistance. There is no end to the occasions that call for the use of some such device, even while carrying on the simplest of experiments.

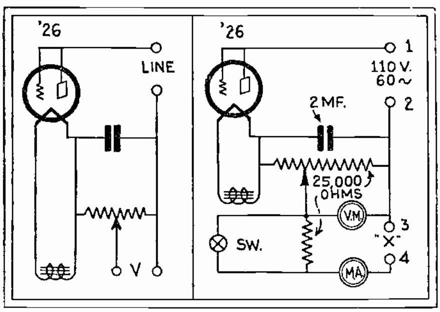


Fig. 8 left
Theoretical circuit of the resistance calculator.

Fig. 9, right
Final circuit diagram of the calculator.

With the current and the voltage known, the resistance can be calculated by applying the formula for resistance in Ohm's Law. A voltmeter and a milliammeter, when used in connection with a battery, will give these values. The disadvantage of this method is in having a voltage supply that is constant while the current that must flow through the resistance being measured, is drawn from it. Then too, a considerable variation in the voltage must be available to accommodate the measurement of greatly different resistance values with any degree of accuracy. For a low resistance measurement, it is not possible to use a high voltage; on the other hand, when dealing with higher values the voltage should be increased.

Where the work can be done quickly, batteries are satisfactory, but oftentimes the voltage required for accuracy may be as high as 100 volts. In these days of battery eliminators, it is somewhat of a problem to secure this battery voltage.

A Reliable Voltage Source

Various schemes were tried out while searching for something that would supply any reasonable voltage for as long a time as was necessary to complete the work at hand. It was decided that 100 volts would be sufficient for all requirements. The A.C. lighting circuit seemed to offer an unfailing source of energy. Now to convert this into the direct current required. After discarding several ideas as altogether too complicated, the scheme illustrated in Fig. 8 was adopted.

The only things needed are a tube for rectifying and a variable resistance to regulate the voltage output supply. Several tubes were tried and a '26 was selected since the rectified voltage was plenty high enough and the current output sufficient. Then also, most experimenters will have several of these tubes not in use since they have been replaced by other types.

The 110-volt line has one side tied to the grid and plate terminals of the tube while the other side of the line is not connected to the rectifying tube directly. A variable resistance of 25,000 ohms is in series with the tube filament and the other side of the line. The 2-mf. condenser shown across this resistance levels out the rectified voltage just as in any rectifying circuit. It can be of the low-voltage bypass type since the voltage is not great.

The filament of a '26 operates on 1.5 volts and consumes 1.05 amps. An idle filament transformer having such a winding can be used for this; or, if one is not handy and the device is to be made more or less permanent, a heater transformer can be quickly made. For the core, remove the laminations from a burned-out audio transformer. That portion of the core inside the coil is in most cases about ½-in. square.

If the dismantled transformer had a bobbin in which its coil was wound, remove the wire and use the bobbin for the new coil. Otherwise, a form can be easily made of cardboard. The total current is low, therefore a primary wound with No. 32 B&S wire will carry it. Using this wire with enamel insulation, or better still, enamel and silk, wind 1800 turns on the coil and insulate it with tape. As the wire is quite thin, flexible leads had best be soldered to the start and finish of this primary. The 1.5-volt winding consists of 24 turns of No. 20 B&S enameled wire. Cover the coil with tape to protect the wire. The laminations should now be put back in place in the new coil. To eliminate any tendency to hum, dip the transformer into a pot of melted wax; this when cool will hold everything firmly.

The Variable Voltage Feature

In Fig. 9, the parts are shown connected diagrammatically. It is the connection from the movable arm on the 25,000-ohm resistor that gives the voltage and current used for our purpose. With the arm at the end nearest the filament connection, the voltage obtained will be 100 volts when the maximum of 10 ma. is being used. The drain through the resistance will be about 4 ma., making the total less than 15 ma. at maximum.

The meter connections are shown in this figure also. The voltmeter should have a 0-100-volt scale and preferably marked in 10-volt divisions. The 25000-ohm resistance in series with the milliammeter is only used when measuring low resistance, and can be cut in or out of the circuit at will, with the single pole switch shown.

The Resistance Curve

To eliminate the necessity of working out each resistance problem, the curve given in Fig. 10 is used. Along the lower edge appear the current values in milliamperes. The resistance in ohms is at the left, vertically. This curve gives the resistance value directly when the voltage used in measuring is 10.

To make a measurement, proceed as follows: referring again to Fig. 9, the unknown resistance is connected to the terminals at 3 and 4. There is no need for haste in taking the readings as the current used will have no effect whatever upon the voltage. Assuming that the resistance is not known, have the switch at the left open thus cutting the 25000-ohm resistance into the circuit. Move the arm P to the right as far as possible, thus decreasing the voltage to a minimum. Plug into the 110-volt lighting circuit. Next move the voltage adjustment to the left until the voltmeter indicates 10 volts. If the reading on the milliammeter is low, close the switch and forget about the 25000 ohms. The most accurate conclusions are arrived at when using that part of the curve between 2 and 5 ma. Therefore, should the meter show less than 2 ma., move the voltage up until it comes within these limits.

Assume that it requires a potential of, say, 40 volts to produce the desired current flow, and again for purpose of explanation, assume that this current is 3 ma. Following the vertical 3-ma. line to the point where it intersects the curve, and looking left along the horizontal line also intersected at this point, it is found that the resistance value lies between 3000 and 4000 ohms. And as each horizontal line represents 100 ohms, the exact value is 3,330. This would be true if the voltage used was 10; however, as 40 volts were used simply multiply the result by 4, giving 13,320 ohms as the resistance.

In this manner, one curve is used for any multiple of 10 volts by simply multiplying the result by the multiple used. Using 50 volts, multiply by 5; or using 90 volts, multiply by 9. Any value can be measured with 10 volts between 1000 and 10,000 ohms and taken directly from the curve.

PLUGS AND JACKS IN THE LAB.

By Joseph Riley

SINCE the convenience and adaptability of plugs and jacks in the laboratory are not known to every experimenter, the writer ventures to call attention to the numerous arrangements illustrated in Fig. A. Although not new, having appeared originally in an issue of the "General Radio Experimenter," it is believed they are ex-

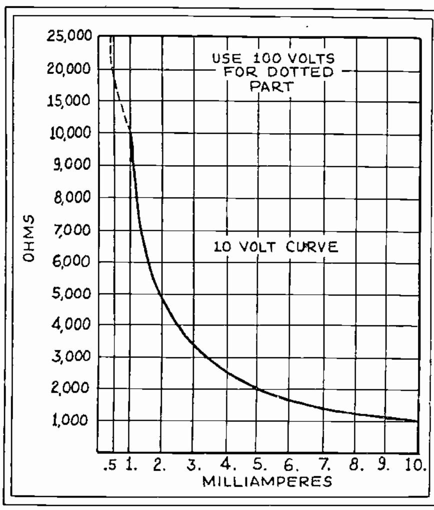


Fig. 10
The 10-volt calibration curve. The dotted portion is for an applied voltage of 100.

cellent examples of the versatility of plugs and jacks.

The following lines are quoted from this interesting number of the "Experimenter":

"In the laboratory, the space provided under the bench too often becomes the resting place for discarded "breadboards," a procedure which soon proves both unsightly and uneconomical. A satisfactory solution is a "universal breadboard" provided with the necessary jacks for plugging in various circuit elements. This sort of device is illustrated in Fig. B.

"To meet this need for a flexible system of connection, "G. R." units have been designed around the Type 274 plugs and jacks. A spacing of ¾-in. has been adopted."

This manner of arranging test equipment makes it extremely convenient to make comparisons between units of a given type, such as audio transformers; for that matter, even systems of operation may be compared, such as the relative performance of transformer or resistance audio-amplification, provided the voltages, etc., are correctly balanced.

TESTS WITH SIMPLE EQUIPMENT

By Duncan Salmond

THE first thought of the average radio owner is to call the Service Man before he stops to consider whether the noise (or lack of noise) is the fault of the receiver. However, when the Service Man arrives, he will find as a rule, if any trouble is evident, that it is in the accessories; these, therefore, are first to be checked. If, however, the trouble is in the chassis, it is best to

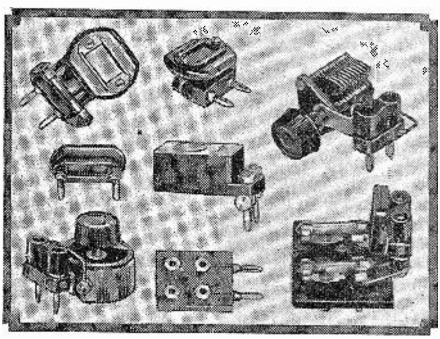


Fig. A
A number of plug and jack arrangements that facilitate experimental work. It is clean-cut apparatus like that illustrated above which makes experimenting easy.

take everything to the shop for repairs; for the customer, whether he will admit it or not, dislikes to see the set pulled apart, and usually feels that it never sounds the same again.

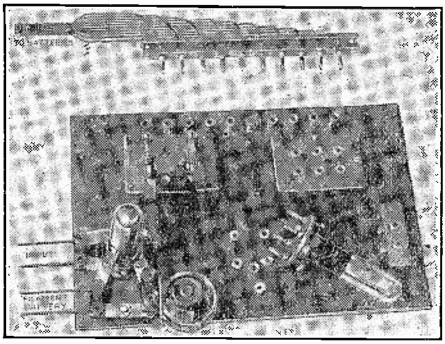


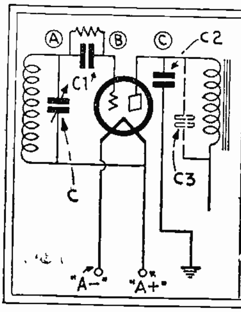
Fig. B
A laboratory breadboard illustrating one of the many uses for which plugs and jacks may be used. Observe the clean-cut arrangement of the parts.

Suppose an ordinary six-tube battery set is placed on the shop bench. Hook it up; if a by-pass condenser is shorted, this will be shown at once by the spark as soon as the connection is made. Take an ordinary voltmeter, with a scale of at least a hundred volts; it is not necessary that it be a precision instrument. Put the negative lead of the voltmeter on the "A—" binding post, and touch each plate contact in turn. The detector and two audio readings should be partial (in the latter case because of the drop through the transformer primary) while the readings on the R.F. plates should be full; no reading at all indicates an open plate circuit, or that the bypass condenser (C2, Fig. 1) is shorted to ground. If, however, this condenser only bypasses the primary winding (C3), we have instead a full reading when it is shorted.

To check grid continuities, a low-range meter is best. It will give a reading on the coil side of the grid condenser (C1 at A, Fig. 11) but none on the socket side because the grid-leak has too high a resistance to permit a reading on the meter. If these tests show no lack of continuity, test the audio assembly by touching the grid of the detector tube; a buzz shows that the audio assembly is O. K.

Apply the aerial to the plate of the last R.F. tube, with a local or your oscillator tuned in. If nothing is heard, the plates of the detector tuning condenser are shorted. Test backwards to the aerial. This completes the test: it is assumed that good tubes have been used and that they all light, showing switch and rheostats to be good.

With the all-electric receiver, we test from the ground. However, correct voltage may be read from the plate of a tube to ground when the plate circuit is open. (See Fig. 12.) That is, with a '26 tube, for instance, if the grid-biasing resistor is open, there is no reading between ground and filament; but there is a return to "B—" from the plate through the ground. Shorting the grid to the filament with a piece of wire will give a loud hum and distorted signals, if the trouble is due to an open resistor. (Do not confuse the biasing



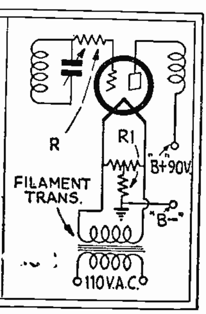


Fig. 11 Fig. 12
A few quick continuity tests which require only an inexpensive voltmeter; at the right, a point to watch when testing a '26 tube circuit.

resistor with the grid-suppressing resistor, which is used in the R.F. stages of many receivers.) The "B" supply is conveniently tested for opens or shorts where the power cable is connected to the chassis.

If a short-circuited tube is found, look for an open primary or grid suppressor resistor; and if one of these is burnt, look for a shorted tube. A tube may test O. K., and yet have weak elements which are shorted readily by a jar or shock. This should be borne in mind when testing. If the first tube is shorted, examine the antenna coupling choke. Opening this may cause oscillation, or hum in electric sets.

INCREASE THE METER'S RANGE

By John J. Nothelfer

MANY good Weston or Jewell meters, designed for the old RCA battery-model receivers, can now be bought very cheap in some of the salvage stores. The fan who cannot afford

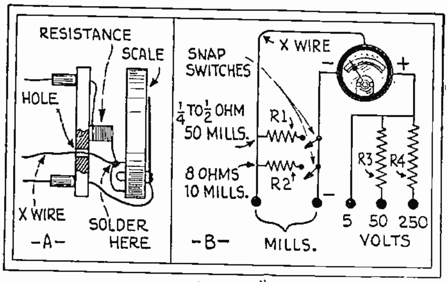


Fig. 13
Diagram showing the connections to the meter illustrated above. With the action used, R3 is 5625 ohms; R4, 61,875.

to buy a new voltmeter, or milliammeter, can make use of an old instrument by a few changes and convert it into a volt-ammeter of all ranges; with great saving to his purse, since these meters can be bought for around a dollar to a dollar and a half.

As the diagram shows, the case is removed from the meter and a small piece of insulated stranded wire is soldered to the resistance terminal which leads to the armature at the bottom of the meter. (Care should be taken not to solder to the terminal that leads to the terminals of the meter). A small hole is drilled in the bakelite back, and the wire is drawn through. The case is then replaced, and the meter is ready to be mounted on a small box.

Various meters have different internal resistances and draw more or less ohms per volt, so the correct resistance values cannot be given. However, the manufacturers of most instruments will be willing to give the rated resistance, upon request. The Jewell and Weston meters mentioned, however, have a resistance of 125 ohms per volt. So, for each volt to be added, a resist-

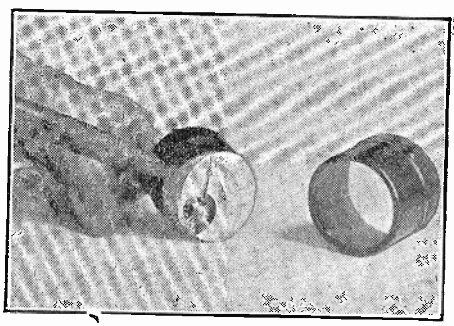


Fig. C
A voltmeter, with its case removed, undergoing the operation described by Mr. Nothelfer, which gives access to the basic milliammeter unit.

ance of 125 ohms should be used. (Fig. 13.)

The meter has already a 5-volt scale, with a 625-ohm resistance built in. To increase the voltage of this meter to 50, a total resistance is required of 50 x 125 = 6250. The meter already has 625 ohms resistance; subtract this from 6250, and the additional resistance required is found to be 5625 ohms. A fixed resistor of this size is quite hard to obtain; and a good substitute is one of variable type, with 6000 ohms maximum, adjusted to the required length.

To obtain milliampere readings from the meter, the wire which was soldered to the armature is used with the terminal of the meter which connects directly to the other winding of the armature. Resistance wire from old, heavy rheostats will answer nicely as a shunt.

CONVENIENT WORKBENCH LIGHT

By Boris S. Naimark

THIS handy extension light for the workbench takes the place of several lamps permanently installed; it is available at any point of the workbench and can be shifted from point to point with ease; and it requires nothing, that can not be found in the junk-box, for its installation.

Stretch a length of steel or "stovepipe" wire from one end of the bench to the other, preferably over the center of the bench and approximately three feet above it. Slip over it a piece of insulating tubing which may be between three and five inches long. Secure the electric-light socket, as shown in the accompanying drawing, at the height considered most convenient.

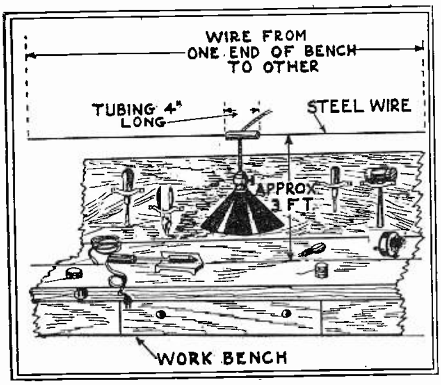


Fig. 14
The method of suspending a lamp above a work-bench is safe and convenient to a high degree.

The lamp can now be moved the entire length of the bench, and thus makes light instantly available where it is needed most. (Fig. 14.)

UTILIZING A GALVANOMETER IN TESTING WORK

By J. M. Conesa

ELECTRICAL meters are the eyes of the radio experimenter and Service Man, for spotting trouble and I am a close adherent and zealous user of these valuable electrical devices. I know of many a Service Man who still depends upon guesswork, a pair of phones with a battery, or 110-volt line with a lamp in series, as the only means of locating faults, disregarding other factors and ignoring the actual cause of the trouble. For most Service Men are interested only in shorts and breaks in the wiring; and anything else is immaterial to them.

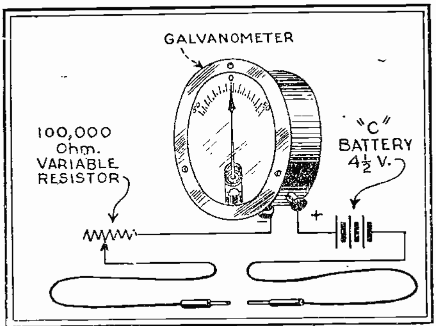


Fig. 15
A galvanometer (or milliammeter) takes the guesswork out of servicing. All data sheets are based on the assumption that the Service Man has means of measurement.

A continuity test is all that is required in most cases, but there are instances where partial breaks or shorts occur and a phone or lamp test yields very little information, if any.

A galvanometer (or a low-reading milliammeter—which is practically the same instrument, in principle) is the ideal device for testing; and very valuable information may be gained through its use. See Fig. 15.

With a small "C" battery and a variable high resistor in series with the instrument a number of different tests may be performed.

Be Careful with Instruments

This combination is exceedingly helpful for testing windings in audio-frequency transformers and, by taking readings, we may determine the approximate transformation-ratio of the

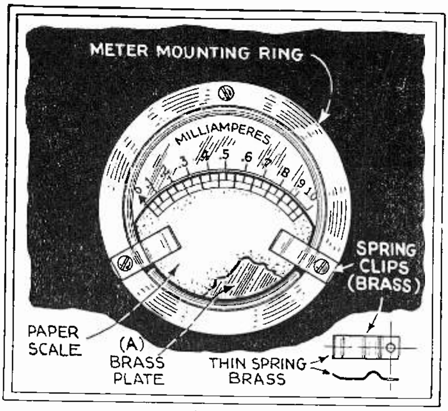


Fig. 16
The desired paper scale is pasted over a removable non-magnetic plate (A).

windings and establish the identity of the primary and secondary when these are not marked. Other comparative tests of resistance may be performed, as one becomes more familiar with the possibilities of this valuable instrument for radio testing.

Care should be taken, when making the necessary connections to the instrument, that the resistance is at a maximum and of a value of at least 100,000 ohms, when first closing the circuit with the battery in series. These instruments are very sensitive and delicate, and may be damaged even with a small run down battery.

By varying the resistor, we may readily adjust the pointer to any desirable place on the scale, and the instrument is then ready for use. The same procedure as in the case of phone testing is followed; but instead of hearing clicks we watch the deflection of the pointer.

ADDITIONAL METER SCALES

By J. Christine

THE trend in service equipment, for the man who "rolls his own," is to use one instrument for a multiplicity of purposes. If a single meter is to be used as a voltmeter, ammeter, milliammeter, ohmmeter, capacity meter, etc., the numerous scales that are necessary complicate the reading of the meter to such an extent as to make the instrument impractical. If separate scales are to be used, then we are faced with the problem of removing the glass from the meter every time a change in the scale is to be effected. The novel scheme illustrated in Fig. 16 overcomes this difficulty.

The zero and top mark lines of the meter scale are drawn on the second scale to facilitate lining it up when it is placed on the instrument. The meter is then calibrated and the markings placed on the new scale.

With this arrangement it is possible to use as many extra scales as is desired, without, at the same time, opening the actual instrument itself.

AN A.C.-OPERATED SERVICE OSCILLATOR

By W. R. Wheatley

NO doubt, every radio experimenter and Service Man has many times wished for a small portable generator of signals of various frequencies, either modulated or unmodulated. I have constructed one which is exceptionally compact, obtains its power supply by simply plugging into the light socket, and covers a wide range of frequencies with three plug-in coils. It comprises a '27 tube used as an oscillator, in the conventional tuned-grid circuit, and an '01A tube with grid and plate tied together as rectifier.

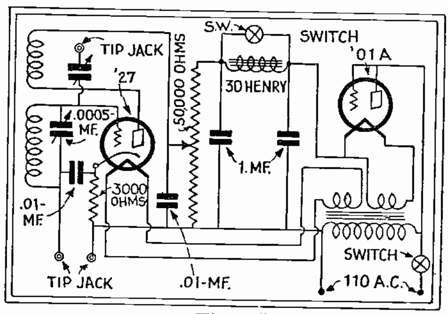


Fig. 17
Mr. Wheatley's oscillator, with a home-made power transformer, is an extremely-compact and convenient device, modulated by the A.C. hum of the light line. A jumper is put across the lower tip jacks when the meter is not in circuit.

One 30-henry choke is used in the filter circuit, which is conventional; the voltage divider is a 50,000-ohm potentiometer, with the plate of the '27 connected to the slider, so that a variable voltage is provided for the plate of the oscillator. The filament supply of the two tubes is from a transformer, and the plate voltage is taken direct from the 110-volt A.C. line; as this supplies voltage high enough for the purpose after it is rectified. Tip jacks are provided in the grid-return circuit, so that a meter may be plugged in to be used in lining up gang condensers or testing the resonance of circuits. A small variable condenser is provided, with one side connected to the grid and the other to a tip jack; so that the oscillator is easily coupled to other circuits.

This oscillator is very handy for lining up gang condensers and neutralizing sets; I have used it as the oscillator in a superhet. An ordinary set can be converted to a super by connecting the grid of the first tube to an external tuned circuit coupled to the oscillator. Although a very slight A.C. ripple remains in the voltage supply of the oscillator, when the signal of the oscillator is tuned in on a sensitive receiver it appears about the same as the A.C. hum in ordinary receivers.

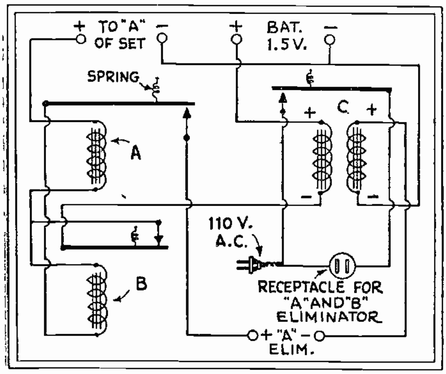


Fig. 18

Mr. Anderson's home-made relays are made from old automobile parts. The power required is taken from one dry cell.

In order to modulate the signal sufficiently, so that it may be heard distinctly, a switch is connected across the 30-henry choke. When closed, this modulates the signal with the 60-cycle hum which is very distinct. The schematic diagram shows all details.

However, when I looked for a filament transformer I was unable to find one small enough; so I constructed one. I used the core iron from a 30-henry choke, and also the form on which the wire was wound; on this I wound 1200 turns of No. 28 enameled wire for the primary. Over this were 28 turns of No. 18 D.C.C. wire for the 2½-volt secondary, and over this 55 turns of No. 20 D.C.C. wire for the 5-volt secondary. Although this transformer becomes warm when in operation, I have operated several hours without undue heating.

To illustrate the compactness of this oscillator, the panel is 7 inches wide by 9 inches long, and the entire apparatus is housed in a box 3½ inches deep.

MAKING AUTOMATIC RELAYS

By A. J. Anderson

ONE of the inconveniences that arise, when a battery radio is electrified by the use of "A" and "B" eliminators, is found in the numerous switches that have to be manipulated whenever the set is turned on or off. As a result, the eliminators must be placed near at hand, which means that, usually, they are in the way.

If the radio receiver switch itself controlled the whole combination, the entertainment value of the radio would be greatly increased. This can be done with little trouble by a simple system of "relays" and a dry cell. Three relays are needed (A, B, C, Fig. 18), one (the latter) with a double winding. If none are on hand, a visit to the battery service stations will usually net a sufficient number of burned out "automobile cut-outs." If these are used, four are needed; since there is not enough room for two windings on the one core. The armatures and contact points of the two are then connected in parallel.

The cores must be removed for unwinding and rewinding, though sometimes they are riveted on. Care must be taken when removing them so that they can easily be soldered on again.

The cores are wound with about No. 20 gauge copper wire and as many turns as possible. As the resistance is comparatively high, it will be necessary to move the variable voltage control on the "A" eliminator, if there is one, to a higher point.

Contact points should be thoroughly cleaned of oil and carbon. The contact point for relay "B" will have to be devised, by some means or other, and so arranged so that the armature touches it when at rest. Sometimes the strip which limits the upward path of the armature can be used for this purpose.

The tension of the spring on the armature of an automobile relay is quite high. It must be reduced to where it is just strong enough to hold the armature above the contact point (except, of course, on relay "B"). As the contact point is above the armature, the spring tension should be a little stronger so that the points make good contact even when subjected to vibration.

In some types of relays, the tension is difficult to adjust; one in particular gave a little trouble. The spring strip used as the hinge was fastened on with two rivets on each side; the lower contact point prevented bending it. An attempt was made to partly cut the strip, but it accidentally split around one of the rivets on the base part. By pivoting the armature around perpendicularly on the one remaining rivet, it could be bent to the proper position.

If one relay is doubly wound, the current must flow in the same direction in the two coils. A small compass will show the polarity of the core when the coils are connected separately to a battery. In this way, the positive lead to each coil can be marked when the polarity is the same.

Besides the relays, six binding posts and a baseboard receptacle (for the "A" and "B" eliminator plugs) are required.

Although a battery is necessary to operate this device, the current flows for a very small fraction of a second and only when the set is turned on. A No. 6 dry cell will therefore last a long time. The resistance of the tubes when cold is much less than normal and it is because of this that only one and a half volts is needed.

LOCATING THE FILAMENT METER

By S. Hetherington

OFTENTIMES it is inconvenient to take filament-voltage readings, of the tubes in a set, because of the compactness of the parts arrangement. Another objection: solder on the prongs of tubes, or deformation of the tubes or sockets, may cause the tube to stick; and to remove it from the socket may result in a sudden jerk that causes the filaments to break or the elements to short.

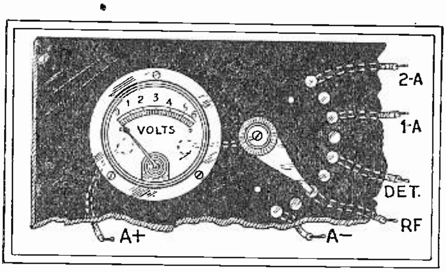


Fig. 19
The particular experimenter, who wants to know the operating condition of each tube at the socket, may follow this idea.

The writer wished to be able to take voltage reading of the potentials supplied to the filaments of several tubes in a receiver, without having the voltmeter as conspicuous as when it is mounted in a test-unit, or on the front panel of the receiver.

How the desired result was obtained is shown in Fig. 19, which illustrates a meter and a selector-switch, mounted on the **subpanel** of the receiver.

Two stops and nine contacts (four being "dead" spacers) will be required to read the filament voltages of first R.F., detector, first A.F., second A.F., and the voltage of the "A" supply.

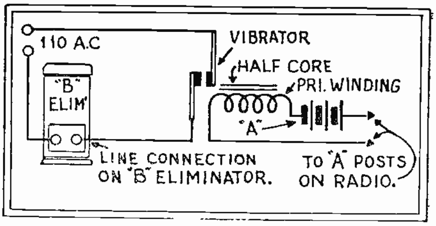


Fig. 20
Another use for the ubiquitous spark coil.

A "SPARK-COIL" RELAY

By J. H. Mills

WHEN, last fall, the writer needed a relay to control only a "B" eliminator, the thought occurred to use an automobile spark-coil primary winding. The sketch shows how this coil was wired.

The writer followed the process of removing the coil top and then the secondary coil; leaving only the core and the heavy-wire primary. This primary was then carefully removed and the core cut in half with a hack-saw. The primary was rewound on one of these core halves, and taped to prevent unwinding. (Its resistance is sufficiently low not to reduce too greatly the "A" supply to the set.)

The "vibrator" parts were then removed and remounted; so that the contacts would complete a circuit (connecting the light-line to the "B" eliminator) when battery current was put through the rewound spark-coil primary. (Fig. 20.)

CHAPTER 4

Vacuum Tubes and Circuits

REPAIRING SCREEN-GRID TUBES

By Frank C. Atkinson

DON'T throw away a screen-grid tube if the control-grid tip should pull off the top, leaving only the lead sticking up. Clean out the cap, and around the top of the bulb; clean the end of the control-grid wire, and solder to it a short length of fine wire.

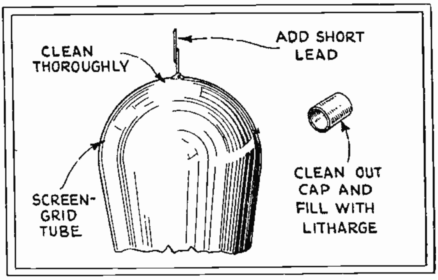


Fig. 1
The loosened cap of a screen-grid tube may be cemented back into place, quite satisfactorily, in the manner shown.

Then, procure from a paint store a small amount of litharge (yellow oxide of lead) and a small quantity of glycerine. Mix a small quantity of the litharge into the glycerine, until a stiff paste is formed; pack the grid cap with this, and run the control-grid lead of the tube through the paste and out from the small hole in the cap. Press the cap down upon the glass, clean away the excess paste; and allow this cement to set for twenty-four hours. Then clean the cap, and solder the end of the wire to it; and the job is finished. You will find the tube as good and as strong as new; I have used this method for some time and it has never failed me.

OPTIONAL DETECTOR CIRCUITS

By John C. Simorsin

FOR those experimenters who are still in doubt as to the relative merits of the "power" and "grid-leak" methods of detection, the following scheme should enable them to prove to themselves which is best for their particular receiver.

The general idea is depicted in Fig. 2. While the scheme is not new, nevertheless it affords an easy way to instantly switch from one type of detection to another. It consists of the ordinary detector circuit so connected with a double pole double throw switch, that when it is thrown to one side the grid-leak and condenser are short-circuited and a negative bias is placed on the grid. When the switch is thrown to the other side, a positive bias of four volts is placed on the grid through the grid leak and condenser. By properly selecting the point K, the positive bias may be adjusted to any desired value.

The resistors R1 and R2 should be calculated from Ohm's Law for any plate voltage desired. The values shown are for a plate voltage of 140 volts. With S1 thrown to the right, a grid bias of 8 volts is obtained; when thrown to the left, the positive grid bias is 4 volts.

A PHOTO-TUBE RELAY FOR UNIVERSAL OPERATION

By C. H. W. Nason

ONE of the writer's friends is a stage designer. He builds pretty models of stage sets with trick lighting effects. The other night he suggested that a photo-electric relay would be a nice adjunct to one of his display sets. The trouble was that the "gadget" had to operate on either A.C. or D.C., regardless.

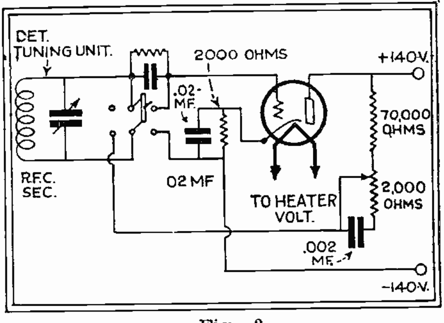


Fig. 2
A simple circuit for the experimenter; either grid or plate rectification is available.

A few moments of thought followed by a half-hour or more of intensive soldering resulted in the arrangement shown in Fig. 3. It will be noted that the new '37 automotive tube with a heater operated at 6.3 V., .3-A., is used. The filament is lighted through a series resistance and the device may thus be operated on either A.C. or D.C. 110-volt supply circuits.

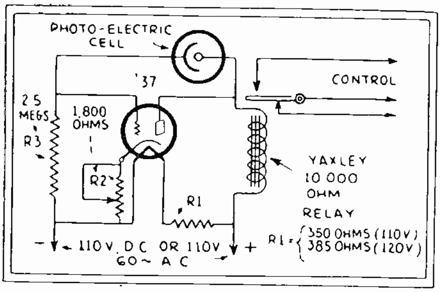


Fig. 3
A P.E. tube relay for A.C. or D.C. mains.

The grid bias is made variable by means of a potentiometer connected between cathode and ground. This should be adjusted so that the relay does not trip under normal light conditions. This permits the room to be illuminated without such indirect illumination of the photo-cell affecting the operation of the device. The relay may be so adjusted as to operate either to turn the controlled circuits on or off with the application of light.

This same device may be used so that automobile head-lamps control the opening of the garage door—so that persons intercepting a beam which normally keeps the relay closed will cause it to open and thus sound an alarm. No long-winded description is necessary, however, for a thousand uses for the device will immediately suggest themselves.

The parts are as follows: R1, 350 ohms, 5 watts; R2, 3500 ohms, Electrad potentiometer; R3, 1- to 5-megohm grid leak; P.E.C., a caesium type gas-filled photoelectric cell; Relay, Yaxley 10,000-ohm relay or device of similar sensitivity.

A GOOD SCREEN-GRID SHIELD

By John J. Nothelfer

AN efficient and attractive screen-grid tube shield can be made from an ordinary baking powder can; the latter is turned upside down and a round one-inch hole is cut for the cap of the screen-grid connector, as illustrated. Two soldering lugs are soldered to the cover of the can and bent; these are to be fastened to the chassis with screws. The socket may be mounted on top of the upturned cover. (Fig. A.)

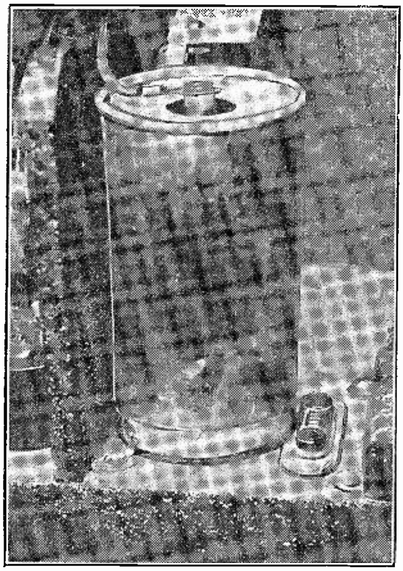


Fig. A
Almost every kind of improvised coil- and tube-shield has been used. Mr. Nothelfer finds a new one, however, which would seem sufficiently inexpensive.

If the socket is of the subpanel or sunken type, the cover of the can should be cut out so that it fits over the socket. A 1¾-inch round hole will accommodate the largest socket. The shield can easily be removed or replaced, by slipping it in or out of the fastened cover.

IRREGULAR BIAS READINGS

By Frank E. Chambers

HERE was the problem: three '26 R.F. tubes, all biased by a single resistor from filament center-tap to ground, normal filament and plate voltages on all tubes; grid bias on first and second tubes slightly high, none on the third, and plate current on the third three times normal.

Under other circumstances (as with '27 tubes) I would have said immediately—"Biasing bypass condenser shot." But when all are biased by the same resistor—!

A continuity test disclosed an open in the secondary of the third R.F. coil, and on taking off the shield can, a poorly-soldered joint was found. Re-soldering the joint restored everything to normal.

I have never, in five years of service work, struck this particular condition; and this hint may save some fellow a lot of time.

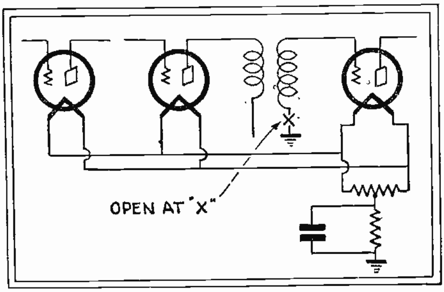


Fig. 4

In an old-fashioned, low-voltage receiver, an isolated grid would block. Now, as Mr. Chambers finds, the tube runs a high plate current.

A PUSH-PULL ADAPTER

By Louis Rick

AN easily-built unit, using a generally-known circuit, to change a final stage of audio-frequency amplification to push-pull operation, may be made by the use of resistors and sockets; as shown in the sketch (Fig. 5.)

A list of parts includes: One UX-type tube base, for a plug; two sub-panel-type UX sockets, V1, V2; four sets of mounting clips, for four resistors; two 100,000-ohm resistors, R1, R2; two 50,000-ohm resistors (heavy-duty type), R3, R4; one 4 x 4 x 3/16-in. piece of bakelite. The suggested layout is shown in the figure at A.

Insert the adapter-plug, with the associated parts wired to it, into the last audio-tube socket; disconnect the "F—" lead from the last audio-frequency transformer (that ahead of the socket) and connect it instead to the center connection between the two grid resistors R1-R2. This lead, in practically every instance, runs to a "C—" post on the connection strip; consequently, this change connects the "C" battery to the grids of the two push-pull tubes, through the resistors. The "F—" post of the A.F. transformer connects to R2, and the "G" post to R1.

When '71A tubes are used as V1 and V2, it is recommended that a protective output unit be employed; this is shown as a high-impedance choke coil used with a 2- to 4-mf. condenser, C1.

(It must be remembered that added "B" current must be available to maintain the plate voltage on the power tubes. Otherwise, two '12A's might be used instead of one '71A, with better amplification.—Editor.)

A SEMI-PUSH-PULL A.F. STAGE

By R. Wm. Tanner

RECENTLY a stage of '71-A push-pull audio amplification was needed for one of the writer's experimental receivers. A look through the "junk box" proved that no center tapped **input** transformer was available, only a regular transformer, T1, and an **output** push-pull transformer, T2. Paralleling the tubes would not do; this had previously been tried, with very poor results, under the existing conditions.

A little constructive thinking on the subject resulted in the "hybrid" circuit of Fig. 6. The plates are connected in the conventional manner.

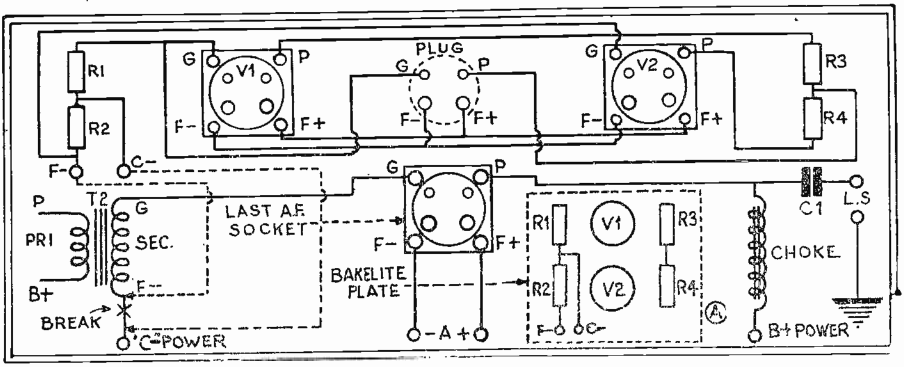


Fig. 5

The circuit shown above, plugged into a power-tube socket, constitutes a resistance coupled push-pull stage. It may be mounted on a small square of bakelite, laid out as shown at A, lower right, attached to a tube base.

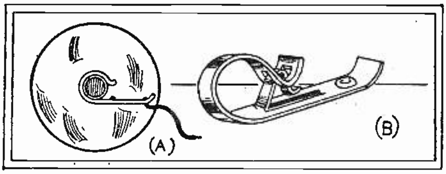


Fig. 8

A clip for the control-grid cap of a screen-grid tube is quickly and effectively made as shown.

This circuit seems to give practically the same results as the regular push-pull stage when considered from the standpoint of undistorted output and minimum A.C. hum; it has the added advantage that a lower input voltage from the preceding stage is required.

ADDITIONAL BY-PASSING

By D. V. Chambers

IN almost any set operated electrically; a 1-mf. condenser, in the detector plate circuit between the "B" of transformer or coupling resistor and ground will greatly reduce hum, and also help to clear up tone and eliminate coupling with the R.F. stages.

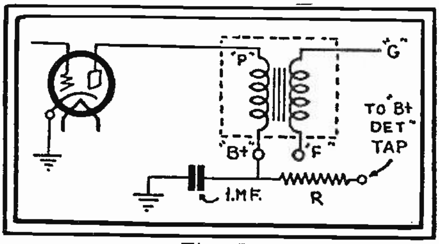


Fig. 7

The 1-mf. bypass condenser shown above will often greatly improve the output of a set, particularly when its filtering action is aided by the use of R. An appropriate value for this resistor is 60,000 ohms.

In early Kolster battery sets, the grid resistor-condenser combination in R.F. grid circuits is a frequent cause of weak or no reception.

SCREEN GRID CLIP

By Fred Erdos

THIS "kink" used by the writer may be of interest to the readers of Radio-Kinks. The first one, shown as Fig. 8A, is the adaptation of a Fahnestock clip to fit the control-grid cap connection on the top of a screen-grid tube. At 8B we have the clip before the little middle spring has been broken off and the larger, outer one, bent to fit.

AN EASILY-MADE TUBE SOCKET

By J. A. Donathan

IT is often desirable to know how commercial apparatus can be conveniently duplicated with gadgets taken from the "miscellaneous" box. A tube socket, for example, which grips a tube

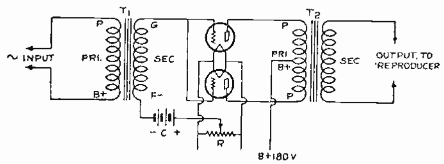


Fig. 6

This parallel input and push-pull output is economical and worked well for its constructor.

positively may be made by mounting four Fahnestock clips on a sheet of bakelite in the manner illustrated (Fig. 9).

This plate (of course, it may be any

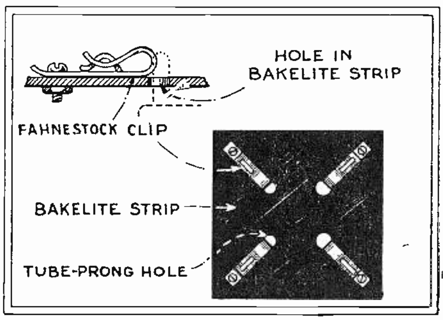


Fig. 9

A home-made socket, when one is needed quickly for the work bench, may be produced in the manner shown.

convenient material having first-grade insulation value) may be the sub-panel of a radio set, or it may be a strip, only about 2½ inches square; while the connectors may be placed either above or below the insulating plate. The plate is to be drilled to accommodate the type of tubes to be used, the holes being made only a little larger than the prongs of the tubes.

CHAPTER 5

Volume Control Methods

A VOLUME-CONTROL METHOD

By Vincent Campbell

I AM writing this "Kink" not knowing whether the method to be described has been used before.

Recently I decided to build a four-tube regenerative receiver which I knew would give me excellent volume and tone. But here arose the problem of obtaining a real volume control. Of course I tried the antenna control and "B" lead control, but all I could obtain was a continuous whistle. After some time, I finally hit upon the method to

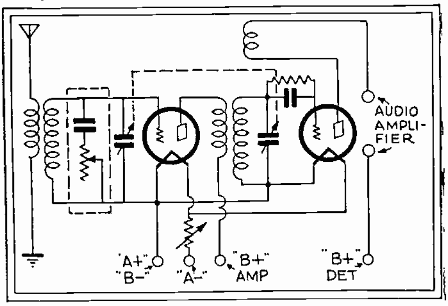


Fig. 1
Mr. Campbell's idea of a good volume control.

be described which gives control ranging from the merest whisper to terrific volume. Perhaps you could use it in your section.

The section outlined in dotted lines in Fig. 1 is the control. I have used a Centralab 500,000-ohm modulator and a .02-mf. fixed condenser. The positive "A" and negative "B" lead connects to the center post of the resistor; the condenser on the end of the resistor to the grid of the R.F. coil, as shown.

Here's hoping you can pass this on to anyone who wants a good volume control.

MODERNIZING VOLUME CONTROL

By Henry C. Mills

A FEW notes may be of use to some other Service Men, who have some of the battery-type sets still on their list. The type of set I am using as an illustration is the Crosley "Model 601," which in my experience, has been the most frequent offender in this respect; namely: varying or fluctuating volume, when operating on local stations.

The volume control of this set is a rheostat, regulating the filaments of the three R.F. tubes. When located within a few miles of a broadcast station, it is necessary to keep these filaments at such a low temperature, that the tubes are operating at the critical point where slight changes in the filament voltage cause quite a large change in the filament emission; with the result that the volume increases and decreases, with even slight fluctuations of the filament current, in a greatly amplified form.

The remedy, of course, is to operate these filaments at a temperature above this critical point; but, unless the volume can be controlled in some other manner, this results in undesirable loudness. The following method has proved very satisfactory; though it results in a slightly increased drain on the "A" battery, the improved operation of the set more than offsets this disadvantage.

Disconnect the filament rheostat, and connect the filament wires directly to the fixed resistor in series with this rheostat; this gives the R.F. tubes slightly less than 5 volts. Remove the rheostat and mount in its place, a 0-500,000-ohm potentiometer (Centralab, or other non-inductive type). It will probably be necessary to take the shaft out of the rheostat, and substitute it for the regular shaft of the potentiometer; since this set requires a long shaft to extend through the cabinet panel. Connect the aerial to the center arm, and the grid and ground to the others; use shielded wire at least for the grid connection (ordinary armored automobile wire works very well). The R.F. choke used in this set may be removed if desired; but, while this results in a slightly increased sensitivity, it also has a tendency to cause oscillation, when the volume is advanced to its most sensitive point.

Using a potentiometer of this type, connected in this manner, will control the volume effectively, even when the location is close to a powerful station, and still maintain the full sensitivity, of the set for distant reception; for, as the arm is turned toward the grounded side, the resistance between the antenna and grid is increased, while the antenna-to-ground resistance is decreased and, of course, vice versa.

AN IMPROVED VOLUME CONTROL

By Russell L. Woolley

AUTOMOTIVE radio receivers have, usually, a 50,000-ohm potentiometer, shunted across the 67½-volt section of the "B" supply, to vary the screen-grid voltage. This is a good method of volume control; but the useful range is limited to about half the arc of the slider's movement. The result is that the change in volume from "soft" to "loud" is very abrupt.

This method of volume control may be improved by using a fixed resistor of, say, 25,000 ohms value, connected in series with a variable potentiometer of 25,000 ohms; the useful range is thereby spread over the entire arc.

These particular values do not, of course, hold true in every case; conditions, such as the sensitivity of the receiving set, the field strength of local stations, the number of screen-grid R.F. stages, and the screen-grid voltage, determine the value of the potentiometer. The total resistance, however, should be 50,000 ohms.

Inasmuch as a volume control of this type is shunted directly across the "B" supply, a switch should be included, to disconnect it from one terminal of the "B" battery when it is not being used; for otherwise it wastes current. See Fig. 2.

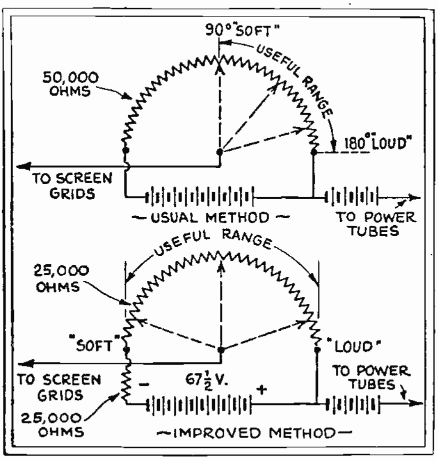


Fig. 2

Just as tuning is spread by adding another condenser, so volume control may be made less critical by a series fixed resistor.

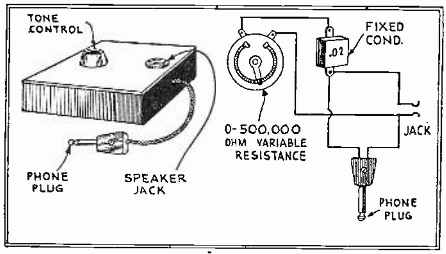


Fig. 3

TONE CONTROL BOX

THIS may be made as illustrated in Fig. 3. The pictorial schematic indicates a fixed condenser of .02 mf. capacity in series with a variable resistance. This resistance must be noiseless.

Many dynamic loudspeakers sound harsh, due to the presence of very strong high frequencies. The modern dynamics have this tendency the least, as they ordinarily have a high frequency cut-off obtained either mechanically or electrically. The Tone Control Box illustrates one way of doing it electrically when the loudspeaker does not contain such compensation.

The exact dimensions of the completed unit will depend upon the particular parts used.

As the resistance is lowered, the high notes are by-passed more and more, with the final result,—very drummy reproduction.

The unit connects between the radio set and the loudspeaker. The loudspeaker plugs into the jack and the Tone Control Box plug is plugged into the jack on the radio set; of course, the plug is not necessary if the receiver has binding post provision for the loudspeaker cord tips. Two binding posts may be used on the Tone Control Box in lieu of a jack.

CHAPTER 6

Amplifiers and Phonograph Reproducers

A MOVIE ADDRESS SYSTEM

By Russell L. Woolley

A "TALKIE" operator uses the method shown herewith, to make short announcements over his Western Electric sound equipment without cutting into, or breaking the seals of the theatre apparatus. The only equipment needed to do this is a portable broadcast set, with a double-circuit jack connected across the grid-circuit of the first audio stage of the receiver; a good "mike," a center-tapped transformer; and four dry-cell batteries. Two old audio transformers, with their windings connected in series, may be used in place of the microphone transformer. The broadcast receiver acts as a speech amplifier; the speaker—a magnetic one—is mounted near the pick-up unit of the "talkie" system. **When it is desired to make an announcement, the needle of the pick-up is centered on the diaphragm of the speaker unit.** (Fig. 1.)

IMPROVING AUDIO QUALITY

By George H. Ohmer

SOME experimenters claim that, when the secondary of an A.F. transformer is used as an audio impedance, it is better to use one having a burnt-out primary. Their contention is that the inductance of the unused primary winding will set up stray, out of phase, currents which will cause distortion.

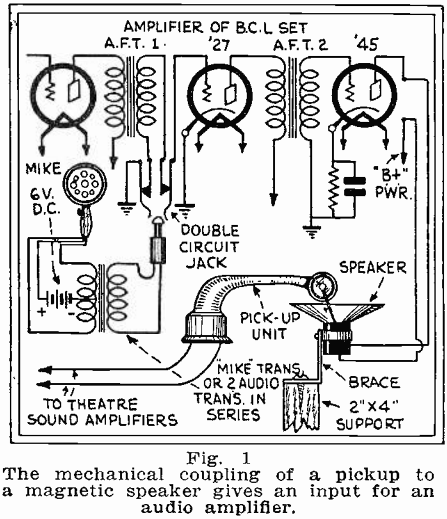


Fig. 1
The mechanical coupling of a pickup to a magnetic speaker gives an input for an audio amplifier.

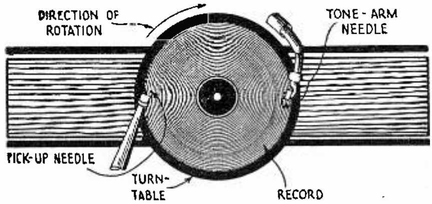


Fig. 2
This use of the same disc for radio and phonograph at once is not only amusing, but a test of quality.

The author built an audio amplifier of the impedance-capacity coupled type, using the secondary of an A.F transformer of 6-to-1 ratio whose primary was still perfect. On loud volume the signals were distorted.

Shunting the unused primary with a .001-mf. condenser reduced the distortion slightly; and a .005-mf. capacity greatly reduced the distortion. Shorting the primary connections ("B+" and "P") was best.

However, still further improvement was effected by the use of a R.F. choke, the condenser C, and a variable resistor R with a value of 0 to 200,000 ohms.

A RADIO-PHONOGRAPH KINK

By Louis B. Sklar

HERE is a very novel scheme of playing the radio and phonograph simultaneously. Anyone having an electric pick-up and a phonograph can perform this stunt without difficulty, as shown above. (Fig. 2.)

Looking at the layout, you see that the pick-up needle is at one side of the record; while the tone-arm needle is exactly opposite. When the record starts to rotate, music will be heard coming from the phonograph as well as from the radio speaker. The music from the two speakers will be slightly out of synchronism, because the two needles are not on the same point of the record; even though they are placed in the same groove. This produces an effect as if one instrument were playing and the other accompanying it.

CHAPTER 7

Power Supply Equipment

CONNECTIONS FOR 110 V., D.C.

By Oscar Block

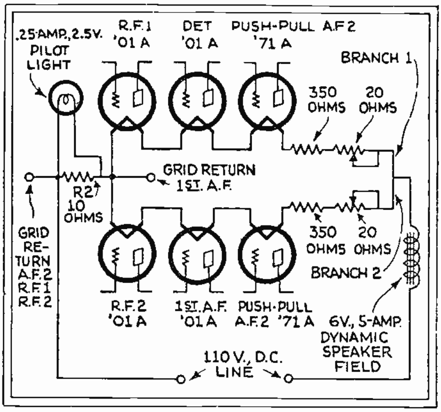


Fig. 2

Final connection of the series-parallel circuit C, Fig. 1. Resistors R1, 350 ohms; R3, 20 ohms.

IN those districts where the "Ham" is accursed with D.C. mains and at the same time uses '01A tubes(or other .25-amp. types) either one of two methods of connecting the filaments may be used, as shown in A and B, Fig. 1.

Circuit A has the advantage of low current consumption, but has the disadvantage that the "B" battery potential on each tube will be low. It is also not adaptable to push-pull circuits since this type of hookup requires a parallel connection of the filaments in order to use conventional push-pull transformers.

Circuit B illustrates a series-parallel connection of filaments. This mode of connection has none of the disadvantages inherent in the connections of Fig. 1A, although the current drain is greater. It has the distinct disadvantage that if one of the tubes are removed, the increase of current through the tube with which it is in parallel is apt to burn it out. Figure 1C shows a circuit that eliminates this latter difficulty and at the same time retains all of the advantages offered by the connections of Fig. 1B.

In this case, since each branch of the filament circuit and its regulating resistance is independant of the other branch, any fluctuation in one will not manifest itself in the other. A suggested layout for the power unit of a D.C. set is depicted in Fig. 2. This layout is designed for .25-amp. tubes and is intended for those of '71A type. The pilot light should consume .25-ampere at 2.5 V.

If tubes are used with characteristics other than those assumed, then the values of R1, R3, and the grid returns of the various tubes, must be changed. The variable 20 ohm resistor R3 is placed in the circuit to compensate for line voltage irregularities. It is to be adjusted until the voltage across the tubes is at its rated value.

It would be interesting to determine just how the various values of resistance used in this connection are determined.

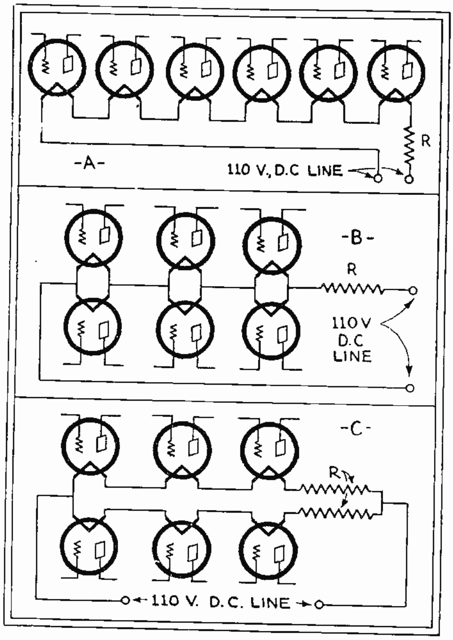


Fig. 1

"DC"-type filament connections. Circuit A consumes little filament current, but "B" potential is low; that of B, results in high "A" current and "B" potential, and; C, a safer arrangement.

First, it is known that the line voltage is 110, and second, that the terminal voltage of each tube is 5.0. The pilot lamp requires 2.5 volts for operation. Each branch of the circuit has three tubes in series, and since each tube requires 5.0 volts, the three tubes must have 15 volts. This voltage, when added to the 2.5 volts of the Pilot lamp, gives a total of 17.5 volts, which, when subtracted from the 110 volts of the supply line, leaves a remainder of 92.5 volts across both R1 and R3.

Now the current through either branch 1 or 2 is the filament current of the tubes, which in this case is .25-ampere. The resistance of both R1 and R3 is then computed from the formula

$R = \frac{E}{I} = \frac{92.5}{.25} = 370$ ohms. In order to provide a means of adjusting the filament voltage, 350 of the 370 ohms are made fixed and the remaining 20 ohms variable. The computation is exactly the same for either branch.

CHEAP HOMEMADE "C" BATTERIES

By L. B. Robbins

THE radio fan can build his own "C" batteries for about half the price of the commercial kind by using flashlight cells, a piece of mailing tube and odds and ends lying about the bench.

Cut off a piece of heavy mailing tube about eight and one-half inches long and just large enough to take a flashlight battery cell inside without too much play. Then procure two large corks to fit in the tube. Drill a hole down through the center of each. Push a flat headed brass bolt through one so the head bears against the small end. Fit a Fahnestock clip over the projecting end and thread on a nut. This is the positive plug. Wind three or four turns of stiff brass wire as a spiral spring and fasten under the head of the bolt in the second cork and a Fahnestock under the nut of this bolt for the

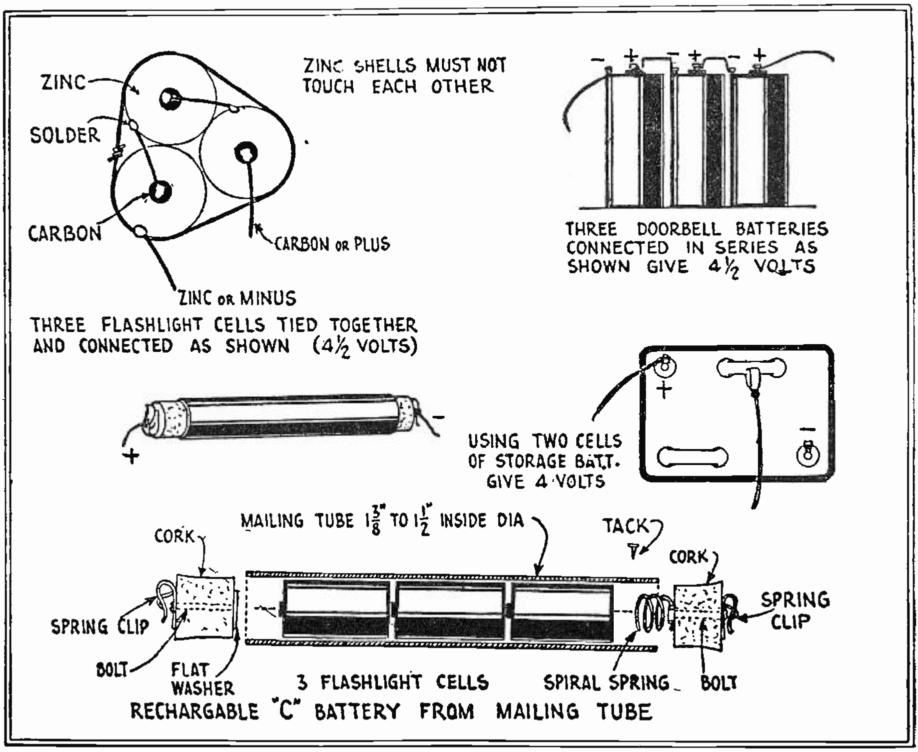


Fig. 3

These sketches remove any doubts which may have existed as to the correct way to connect individual cells to form a battery having a potential of 4½ volts.

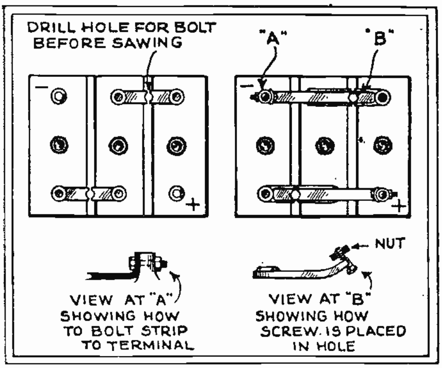


Fig. 4

A conversion that certainly makes for economy. Old 6-volt storage batteries may be rebuilt as described by the author for use with new 2-volt battery tubes.

negative plug. Wind wire on the tube ends to prevent it expanding.

Fill the tube with three cells (4½ volts) laid top to bottom in series. Push the spring plug in against the zinc bottom of one end cell and the bolt head against the carbon contact of the other. Then push a small tack through the tube into each cork to hold them in place and the battery is finished. Connect the lead wires to the clips. This can be refilled for thirty cents when run down.

An emergency 4½ volt "C" battery can also be made from three flashlight cells as shown. Tie three insulated cells together with stout cord, reversing the ends of one of them. Then solder a wire to the center tap of one to the zinc bottom of the second and another wire from the center tap of the second to the zinc bottom of the third. Two lead wires can then be soldered from the remaining opposite faces of the first and third.

Three ordinary dry cells can be connected in series to act as a "C" battery in the manner also shown. (Fig. 3.)

A 6-VOLT BATTERY FOR 2-VOLT TUBES

By Audie Roberson

NO doubt the best way to furnish power for the 2-volt tubes is by using the Air-Cell battery, but a great many people have an old 6-volt storage battery and are reluctant to throw it away. They may easily be converted to 2-volt batteries and I believe that it is economical to do so.

The first operation is to saw the connecting bars as shown in Fig. 4. The center cell is then raised and its position reversed; when placed back, it will appear as shown. Now procure two strips of lead connectors that will just reach across the battery and bend one end so that it will fit as shown. A hole is then drilled through the connector and the battery post so they may be securely fastened.

Now as near as possible to the ends of each cut connector bars, drill a hole. The bars are then bent upward until a bolt can be inserted and then bent down with the end of the connector bar fastened to the battery post as shown in the sketch. Two more holes are drilled to correspond with the holes in the cut connectors which are then bolted securely as shown. It is well to sandpaper each connection before tightening so that the very best connections can be obtained.

D.C. FROM YOUR AUTO

By Joseph Riley

A RECENT news item stated that a young man interested in radio had married a young woman also interested in radio. They made a special five-tube set, for use during their honeymoon, to be operated by the storage

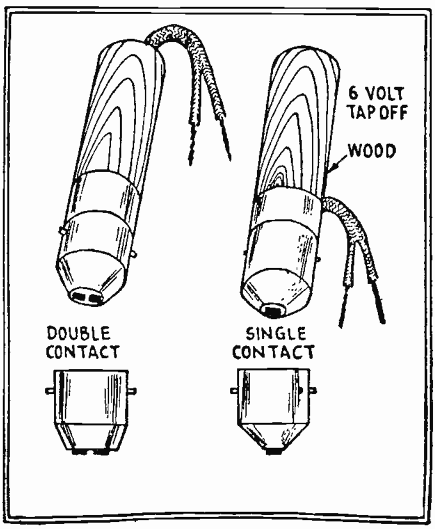


Fig. 5

A simple tap to the automobile storage battery will operate a receiver efficiently.

"A" battery in the automobile they owned.

Anyone can operate their receiver this way by following the idea illustrated in Fig. 5. Any burnt-out "bayonet-base" lamp may be used. The glass part is broken out and two leads are soldered to the contact points. There are two types of base; single-contact and double-contact; use one which properly fits the particular outlet you want to take the six-volt supply from. **Caution:** Examine one of the auto lamps and make certain that the D.C. supply is not 12 volts.

A wooden handle is fastened to the lamp shell; this makes it easy to remove the current tap and replace the lamp. It is usually most convenient to tap the current at the instrument board.

The amount of current consumed by the average five-tube set in an hour is about one and one-half amperes; the automobile lamps probably consume three to ten amperes. So, the comparison indicates, there is no objection on the score of undue battery drain. In fact, the starting motor will probably draw as high as 300 amperes (instantaneous value) for the few seconds it is on during starting.

If a two-color cord is used for connecting, it will be easy to distinguish "A" positive from "A" negative, by using a red lead for the former and a black wire for the latter.

Of course, it is necessary to have the right connection when the plug is made up; but, as the sockets will probably all be connected the same way, the "A" polarities to the set will not be reversed if another socket should be tapped at another time. Usually, the shell of the single-contact base will be negative and the contact positive; a simple test for the double-contact base is to connect the plug "A" leads to the set. If it works, the connections are correct; if it doesn't, the "A" connections are reversed.

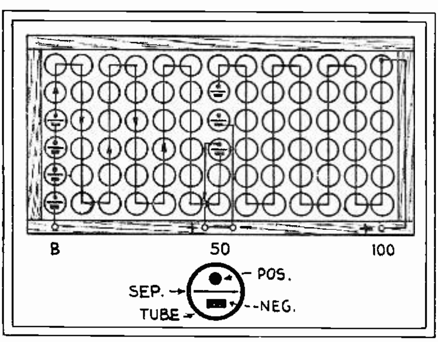


Fig. 6

The storage "B" battery is much favored in Europe still. Many old ones may be picked up here.

A clever arrangement would be to install a set of "B" batteries in the car and wire them to an outlet on the instrument board, to be tapped with another plug. Be sure these "B" voltages are by-passed inside the set.

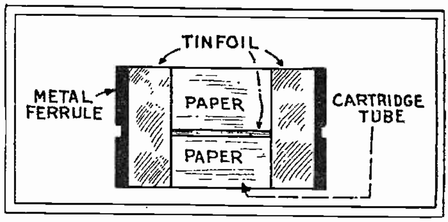


Fig. 7

A way to renew an old fuse.

EDISON "B" BATTERIES

By Chester Rector, W9BFW

REBUILDING a storage "B" battery of the Edison type has several advantages: first, the investment is small; second, no destructive acid to spill; third, the nickel steel elements are non-sulphating and last indefinitely; and, fourth, the Edison type is lighter than most others. These batteries hold the charge for a long time when not in use. If one is not at hand, it can be obtained from a radio store very cheap; and can be made to give very good service by the following method:

Carefully remove all of the elements and test tubes from the rack, and clean thoroughly. After they are completely cleaned, lay them out to dry. From the drug store purchase two pounds of potassium hydroxide, 5 lbs. distilled water, and 1 oz. mineral oil.

Mix in an earthenware or glass bowl the distilled water and potassium hydroxide until there is a reading of 1,250 in a clean hydrometer, one that has not been used for testing acid batteries. At this stage the solution will become quite warm; so it should sit until cool, being tested again for correct reading. If the reading is higher or lower than 1,250, distilled water or potassium hydroxide should be added as required. Leave the solution to settle, and then filter.

Next assemble the battery, as in Fig. 6. Fill each cell to within one inch of the top, by using the hydrometer. The plates will soak up some of the solution; so the process should be repeated. With a clean medicine dropper, place about three to four drops of the mineral oil (liquid paraffin) upon the top of the solution in each cell.

The charging can be done from a 110-volt A.C. line, by the use of a trickle charger. However, if a 32-volt D.C. lighting system is available, the battery can be charged this way, after it is divided into 25-volt sections; of course, no rectifier is necessary.

The battery must be tested with a volt-meter since the specific gravity remains the same whether it is charged or discharged. The solution should be changed about once every year when in use; and the level should be kept up by adding distilled water.

Two of these units make a very good plate supply for the beginner's amateur transmitter. Also, this type of battery works very well on any radio receiver.

A TEMPORARY FUSE

By J. B. McGirt

THE writer ran across this "kink" when the new Crosley screen-grid models first came out. The sets were equipped with a 1-amp. fuse and frequently, when the radio was first put in use, the fuse would blow; whereas the fuse would hold if the heater-type tubes could be brought up to operating temperature. To keep from blowing so many fuses, I resorted to a tinfoil fuse.

Take a piece of tinfoil on paper (such as you find around chewing gum and cigarettes) and cut it to a size that will just about go around the old fuse tube. Next, cut away a portion of the paper and tinfoil; and your fuse then should look like the one illustrated. (Fig. 7)

Ordinarily, the least amount of tinfoil that can be used is about right; although it can be made to fuse at higher current levels by making the conducting strip wider.

"MODERNIZING" WITH A TRICKLE CHARGER

By John J. Nothelfer

READERS of **Radio-Kinks** may be interested to learn how I adapted the transformer of an old Philco trickle charger as the filament supply unit for a type '45 power tube. Naturally, any tube having a 2½-volt filament may be heated in the same manner; and, by changing the number of secondary turns, a 1½- or 5-volt filament.

The case is removed from the transformer and the laminations pulled out. The secondary windings are then removed, and the core rewound with No. 16 S.C.C. wire. (As different makes of transformers vary in wattage output it is difficult to state the exact number of turns to be wound.)

A simple test of correct number of secondary turns is as follows: after winding what is thought to be the correct number of turns for the secondary, (perhaps 10 to 15 turns, for a 2½-volt winding; other sizes in the roughly approximate ratio of 5 turns per volt), replace the laminations and connect the transformer primary to the 110-volt A.C., line. Now, connect an A.C. voltmeter across the new secondary, and note the output.

If an A.C. voltmeter is not available, an old '99-type tube may be brought into service as a visual indicator of the approximate output of the supposed 2½-volt secondary. If it glows dull red when shunted across the secondary

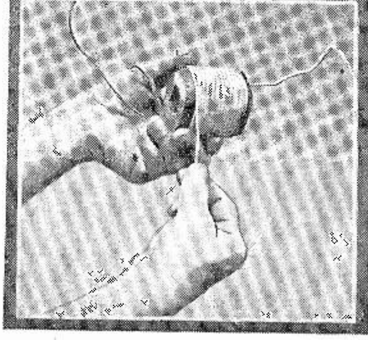


Fig. A

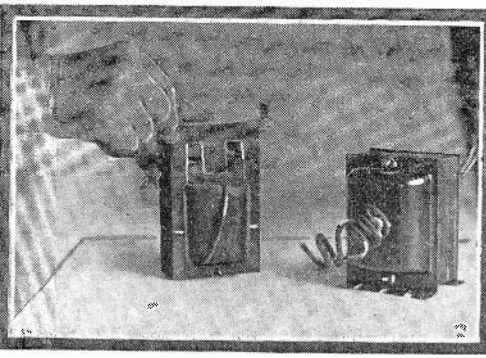


Fig. B

At the left, rewinding a power transformer; at the right, first, replacing the laminations, and finally, the completed instrument, looking as good as new.

leads, add turns; if very bright, remove turns. The '45 tube filament burns with a dull red glow on 2½ volts.

Before connecting the transformer into the operating circuit, check both primary and secondary for shorts and, more particularly, grounds to each other and to the core. The latter should be

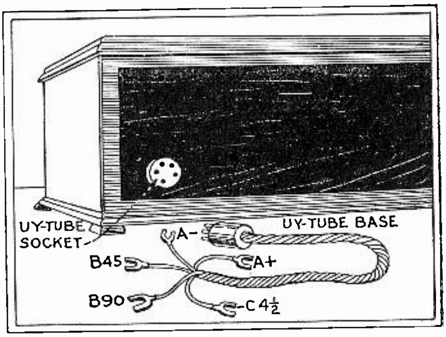


Fig. 8

The set builder who is working over an old battery set can use the connecting method shown to provide a 5-lead cable which will facilitate connecting and disconnecting.

insulated from the secondaries and grounded.

Three of the stages, winding the secondary, replacing the laminations, and the finished assembly, are illustrated in Figs. A and B.

HOME-MADE BATTERY CABLE

By M. W. Johnson

MOST battery sets employ for the battery leads a cable, one end of which is soldered to the receiver. This arrangement therefore presents several disadvantages.

For one thing, it is not convenient to move the set to a position beyond the limit of the cable's slack, without first removing all the battery connections. Also, it is inconvenient to make tests on the receiver without the battery potentials, unless it is desired to remove battery connections.

Electric sets and the more expensive battery sets overcome this situation by arranging the current-supply cable to plug into a receptacle on the receiver.

This idea may be applied to any receiver requiring not more than five leads in a single cable, as shown by Fig. 8. A 5-prong UY socket is mounted on the rear of the set cabinet, the cabinet ends are soldered to the prongs of the old tube-base. The cable may be held in place with sealing wax poured into the ex-base. If desired, another plug and socket may be "rigged up" for the opposite end of the cable.

AN EMERGENCY BATTERY

By John J. Nothelfer

RECENTLY, the writer was called out of town to service a battery-model console radio set. Upon arriving, a day ahead of the promised date, I found that the storage battery had been taken away to be recharged, and it would be returned early the next day. The idea of coming back the next day over the rough country road was unpleasant; and that of using the car battery seemed the solution.

Upon trying to loosen the clamps on the battery, it was found that they were too tight; the pliers would never loosen them, and the required wrench had been left home. Having a roll of No. 14 rubber covered lead-in wire, I drove the car as close as possible to the window nearest the set; and the wires were connected to the battery terminals. In this manner six-volt direct current was obtained, and the set was tested and repaired in the usual manner.

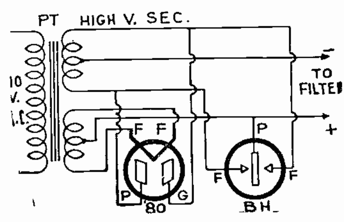


Fig. 9

Two different types of rectifier tubes can be used in this way.

CHOICE OF RECTIFIERS

By Edward J. Arnold

HAVING use in the shop for a power-supply unit capable of using either an '80 or a "BH" gaseous rectifier tube, the writer evolved the circuit shown in Fig. 9. It may be of interest to others who can utilize the idea.

The sockets should be labeled plainly; as it will be exceedingly deleterious to an '80 tube in insert it in the socket intended for the Raytheon.

CHAPTER 8

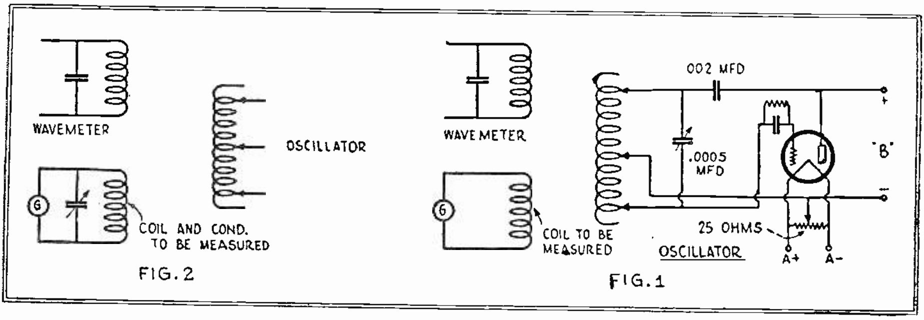
Coils and Tuning Circuits

MEASURING THE FUNDAMENTAL WAVELENGTH OF A COIL OR A COIL AND CONDENSER

By Melvern H. Berry

EVERY Radio Fan has known of a time when he would give a portion of his anatomy to have some means to test the fundamental wavelength of galvanometer. The indication may be very slight. The amount of deflection of the galvanometer depends upon its sensitivity and the coupling of the two coils. If your oscillator is calibrated the fundamental wavelength can be read right from the curve.

If your oscillator is not calibrated it will be necessary to employ a wavemeter to get the wavelength of your



The two schematic arrangements above indicate the proper connections and coil relations to be observed when determining the wavelength range of a particular coil, or coil-and-condenser.

his coils before placing them in his set to see what they would do. Of course, some approximate idea can be obtained from tables and the use of formulas, but for real accurate results it is impossible to obtain the information without some laboratory testing apparatus.

Most every radio fan has an oscillator and a wave meter. If you have a calibrated oscillator, it will be much better.

A neat and accurate galvanometer can be made for a few cents by winding a few turns of fine wire on a form one inch square. Hang this solenoid between the poles of a horseshoe magnet, allowing the ends of the coil to support it.

Place the galvanometer across the ends of the coil to be measured, Fig. 1, and bring the coil in close proximity to the coil of the oscillator. Rotate the dial of the oscillator until there is resonance between the two coils. When the wavelength of the oscillator is the same as that of the coil to be measured a current will be noted to flow in the coil. This can be done by bringing your wavemeter (absorption type) close to the coil to be measured, and when the resonance of the meter is adjusted to coincide with the frequency of the oscillator there will be a second deflection of the galvanometer towards zero. The actual maximum fundamental can be read directly from the meter or from the curve.

When using as a test for the wavelength of a coil and condenser combination, refer to Fig. 2.

It will be necessary to put a radio frequency choke coil in the lead from "B" plus to plate. Otherwise, the battery resistance would probably be so low there would not be sufficient radio frequency voltage drop to cause circuit oscillation. This choke may be of any convenient size. On an ordinary thread spool, 250 turns of 30 to 36 gauge wire with almost any kind of insulation would work well.

It must be noted that incorrect coupling of the absorption circuit to the cir-

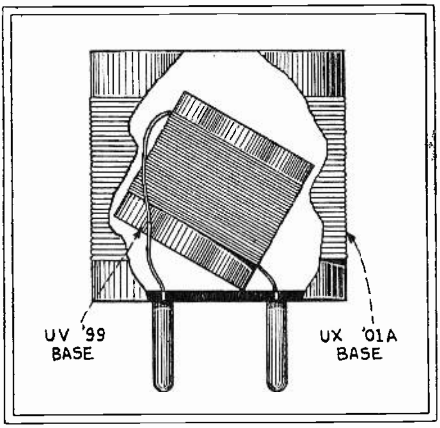


Fig. 3

A tickler for a UX tube-base coil, with fixed coupling, is obtained with a smaller (UV) base.

cuit under test will result in double hump resonance,—the indicating device will register at two different wave lengths quite close together. To remedy this it is only necessary to loosen the coupling until the two resonance points merge into one. (It might be of interest to point out that this phenomenon is harnessed to furnish the circuit selectivity of the Hammarlund Hi-Q29 receiver, where the coupling has been reduced to one per cent.)

Instead of the 25-ohm potentiometer diagrammed, it is suggested that a 300- or 400-ohm one be used if a battery type tube is used rather than one of the A.C. type.

Also, the oscillator may work more smoothly if the grid leak connects to filament of the tube. The negative "A" is the correct side for an oscillator.

The .002 mf. fixed condenser must be of high grade as the "B" potential is impressed on it at all times.

It must be remembered that loose coupling must be maintained between coils, if maximum accuracy is to be realized. As it is necessary to have a frequency or wavelength standard from which to work, such a standard must be built or purchased. A simple method for calibrating a home-constructed unit is to use the tuned circuit as an absorption trap in conjunction with a regular radio set, setting the eventual wavemeter so that it "tunes out" the carrier of a broadcast station using crystal control; these stations can be depended upon to be adjusted to their assigned frequency. Once the dial readings for these frequencies have been determined, the rough calibration of a "wavemeter" has been accomplished. Plotting these values on graph paper will supply intermediate values.

TUBE-BASE TICKLER COIL

By Louis E. Fay

IN winding tube-base coils for 80 meters or above, it is impossible to wind both secondary and tickler on the outside. A method that I use is to wind the tickler on an old V 199 instead of the usual jumble wound coil.

Wind the secondary on the X base as usual. Then take an old V 199 and remove the tube, contacts, and pin. This base will fit inside the large X base nicely. Wind the approximate number of turns on the V 199 base and solder leads to X base contacts. Then vary either number of turns or coupling until proper regeneration is obtained. Then pour in melted wax or paraffin to hold tickler in place. See Fig. 3.

SELECTIVITY UNIT

A CONVENIENT mounting for the variable condenser (Fig. 4) in series with the antenna, may serve a great many purposes. In the average receiver, it acts as volume, selectivity, and dial balancing unit.

Its size is determined by individual

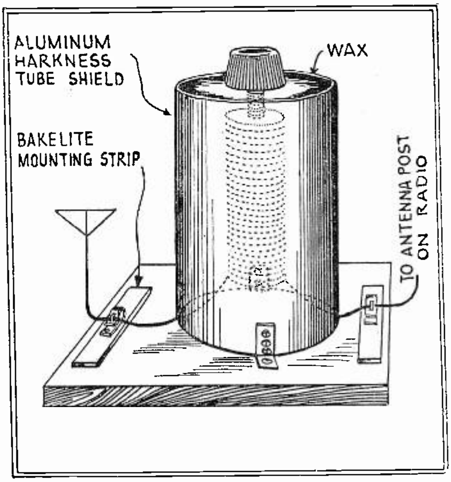


Fig. 4

Mounting the antenna series condenser.

conditions. In the particular instance recorded it was a Precise Midget of 135 mmf. capacity, maximum.

Arrow on knob top indicates relative maximum to minimum capacity settings in relation to two black dots put on the aluminum shell.

If desired, a switch may be mounted on the same base and wired to short out the variable condenser with one throw of the blade and put it in operation with the other.

The wires from the variable condenser are led through V-shaped grooves clipped in the aluminum with pliers.

HOW TO MAKE FORMS FOR WINDING YOUR OWN COILS

By Charles P. Hansen

THE tyro, the fellow just breaking into the game, can seldom find the information as to just what to do to obtain a certain result, in the best way. It is obtainable only in the "School of Hard Knocks." Occasionally, a bit of data will be found which lightens the work of becoming an experienced technician.

For example, below is described the manner in which the writer fabricates his own coils (generally referred to as being of the "solenoid, low-loss" type). Ten "forms," of various standard sizes, comprise the kit of the author.

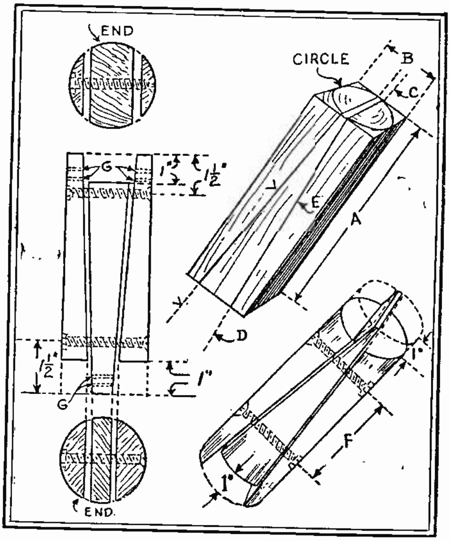


Fig. 5, 6 & 7
The various steps for form making are evident in this drawing.

Shaping the Wood

When making coil forms the first requirement is a rectangular piece of wood (Fig. 5). On each end of this block a circle is scribed. Just how much oversize this should be, depends upon the wood-working ability of the constructor; because these two circles determine the resultant size of the form, since the wood is to be worked down to the diameter these circles indicate. Sandpaper the form to the final size.

All sharp corners are rounded off with knife and sandpaper.

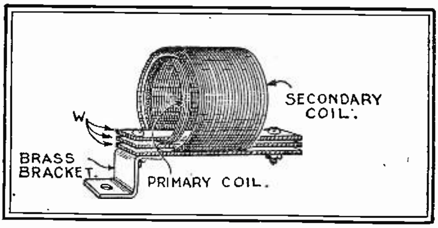


Fig. 8
A convenient way of mounting "low loss" coils constructed with the aid of the forms.

Dimension **a** is two inches longer than the desired length of the winding space of the form; and dimension **b** is, approximately, the desired diameter of the form. Lines **c** are drawn across one end of the block, to show the smallest thickness of the wedge which will result (as described below); dimension **d** is the largest thickness of this wedge. Lines **e** are then drawn; these being the lines to follow with a saw, to produce the wedge. Holes **f**, for machine screws, are drilled now. At this point, saw, knife and sandpaper are called into use to obtain the shape shown in Fig. 6.

Fig. 7 illustrates the end and side appearance of the finished form. Flat-head machine screws drop flush with the surface, and thread into nuts sunk in the form.

Making the Coil

To start the coil, wind a piece of writing paper twice around the form. Hold with rubber bands. Press thumb tacks at desired start and finish points of coil. Fasten wire by threading through holes g, and wind.

When wound, coat with collodion, (being careful not to slop it on the wood form). When dry, remove the two screws, tap wedge with hammer, and disassemble; and finish by gently pulling the writing paper from the inside of the coil.

Coils may be mounted on paraffin-dipped wood strips (w) as illustrated in Fig. 8.

The photograph shows an almost-completed space-wound short-wave coil, with holding strips cemented across the outside. One at a time, duplicate strips are cemented to the inside when the coil is removed. Use of too much cement at this time will cause the coil to come apart. The "5-and-10" stores stock tubes of this (transparent) cement.

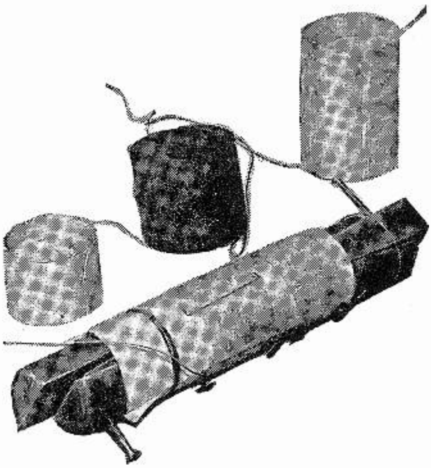


Fig. A

Coils completed and in the course of construction are illustrated above.

A UY PLUG-IN COIL

By W. G. Ruppenthal

PERHAPS this method for constructing a UY plug-in coil will interest other readers.

The base is cut as indicated in Fig. 9 so that it is a tight fit in the fiber tube used for the coil form. A circle with a ⅜-in. radius is drawn in the center. A horizontal diameter is then drawn, and where it intersects each side of the circumference of this circle, a mark is made. From each of these two points, arcs are drawn with ⅜-in. radii in order to intersect the circle above the diameter.

From the center, a vertical line (90 degrees from the horizontal diameter) is dropped until it also intersects the circle. These five points of intersection are drilled for either 6/32 or 4/32 machine screws; if 6/32 screws are used, the threads will have to be filed off a little where they go into the socket. The manner of winding the forms is left to the constructor.

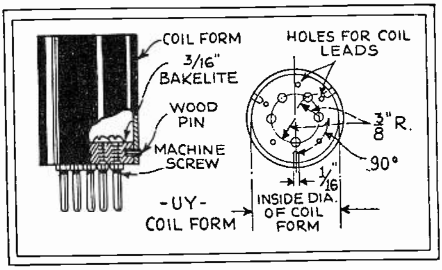


Fig. 9

Mounting coil-tubes to a plug-in base.

Small holes are drilled in the base to let the coil leads out. Holes 1/16-in. in diameter are drilled through the fiber into the base, and wooden pins are then driven in and cut off flush to hold the base and coil rigid if there should be any tendency for them to separate.

GANGING AN OLD SET

By E. E. Meeker

MULTI-DIAL receivers may be converted to single-dial control in the manner shown. Four hard-rubber discs (cut from an old panel) are turned 1¼ inches in diameter, with a 15/64-inch hole in the center, so that they may be driven tightly upon the ¼-inch shafts of the condensers. Then two discs are fitted to the central condenser's shaft; and each is fastened to a disc, on one of the outside condensers, by a strong fish line, which will grip the discs where they have been grooved in the centers of their rims. The condensers may then be aligned, by slipping the belts until a good adjustment is obtained. (Fig. 10)

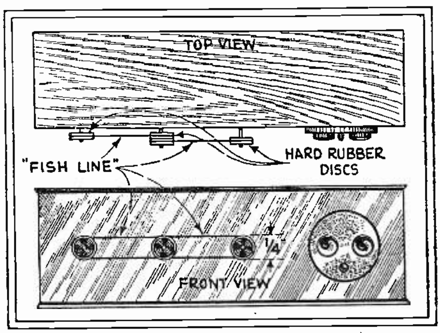


Fig. 10

An old, three-dial set may be converted to single control in this manner. The dial is then replaced on the center shaft.

A SEMI-BAND PASS FILTER FOR THE BROAD TUNING RECEIVER

By R. William Tanner

MANY times the Service Man is confronted with the problem of increasing the selectivity of a receiver and, particularly, of one which was manufactured a year or more ago, when distance was the main qualification of a set. He, generally, either cuts

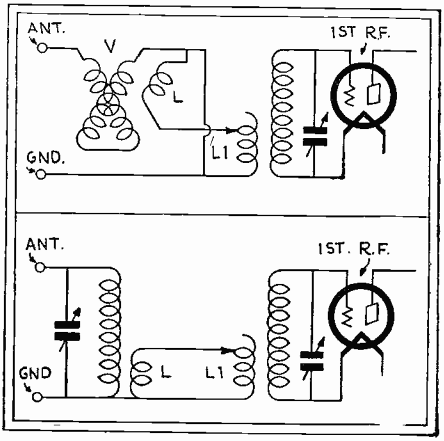


Fig. 11

Two band-pass arrangements which may be applied to give selectivity to a receiver.

down the length of the antenna system or installs a small-capacity condenser in the antenna lead. Both of these methods increase the selectivity but reduce the strength of signals as well.

It was at a time when the writer was working as a Service Man that he devised a rather unique means of increasing selectivity and at the same time, improving the quality. This was applied in the form of a semi-band pass filter. No tiresome mathematics are required to determine inductance and capacity values. The only parts needed are a few feet of No. 26 to 20 cotton-covered wire, a small battery clip, and one of the old style variometers (200 to 600-meter types).

Referring to Fig. 11-A, it will be seen that the variometer is connected in series with the antenna and ground. A coil L, coupled to the grounded end of the variometer, and another coil L1 coupled to the filament end of the first R.F. transformer, compose a link circuit through which the antenna currents are applied to the grid of the R.F. or detector tube, whichever the case may be. L consists of 6 turns, fastened in place in any manner which comes to mind. L1 should have 10 turns, tapped every turn down to 3 (less than three turns will result in poor quality due to clipping of side bands). This is what the clip is needed for; to vary the number of turns in order to secure a satisfactory band-pass action. Before L1 is wound, the regular primary or antenna coil (if one is used) should be removed, to eliminate the loss which would result from the "dead" coil being in close inductive relation to the grid coil.

In operation, the number of turns in L1 is decreased until selectivity is at its best with a good quality of reproduction; always remembering that, the more turns in circuit, the less will be the selectivity and the better the quality; and vice versa. If no shielding is employed in the receiver, the band-pass effect will not be very pronounced.

If the variometer is not available, a coil and a variable condenser similar to those used in the receiver may be employed; this arrangement is depicted in Fig. 11-B. A variometer is recommended; as then the tuning is not so critical as with a coil and condenser. However, when tuning, either may be set at minimum and, after the signal has been regularly tuned in, varied for best results.

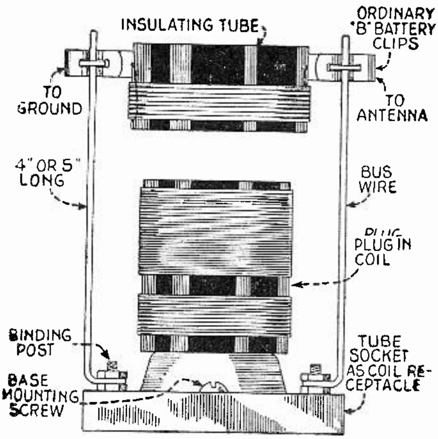


Fig. 12

A tube-base plug-in coil is easily equipped with an adjustable winding in this way.

A NOVEL COUPLING IDEA

By Alan Hamilton

THE problem of adding an antenna winding to a single-winding short-wave coil of the "tube-base" type has been "solved" by most amateurs, who do without this coil; with consequent loss of the qualities obtained by this arrangement.

Another solution of the problem is illustrated in Fig. 12; a coil, larger than the "tube-base" coil, is mounted slidably on two vertical rods, which may be bus bar. The two clips are of the "Fahnestock" type and may be loosened from the rods by pressing; the coil thus being easily adjusted to any position. As the experimenter may desire to use this newly-applied coil as a regenerative (tickler) winding instead of an antenna coil, the desirability of easy adjustment is apparent.

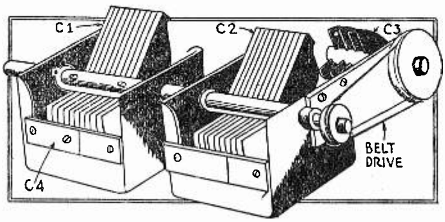


Fig. 13
The simple arrangement thus illustrated makes it possible for the set constructor to gang his tuning condensers much more effectively. The pulleys are readily made by a skillful worker; though some experiment may be necessary to determine the exact ratio.

The coil when used as a tickler is wired into circuit with an external control of circuit oscillation.

SIMPLIFYING THE TUNING

By L. F. Carter

THIS idea is submitted to the careful set builder who wishes to reduce the number of panel controls to a minimum.

Compensation for variation in circuit capacities, at various points in the tuning range, is usually made by means of a condenser of the "set and leave alone" variety. However, this type of compensation is of value only when the remainder of the set has been very carefully designed and constructed. It is more convenient for the average set builder to arrange a small variable condenser as shown in Fig. 13 in order to obtain good circuit balance.

The trimmer generally requires only partial rotation, in relation to the full-scale rotation of the main tuning condenser with which it is made integral by means of a pulley of predetermined diameter.

The trick is to determine this ratio of movement.

First, tune in a station near the lowest point on the tuning dial, and note the position taken by the trimmer when maximum volume is obtained. Next, tune in a station at the other extreme of the tuning dial, and again note the position of C3 at maximum volume.

Considering that, in the instance above, the two stations are 96 dial-divisions apart on the main tuning dial, and the trimmer has been turned through 24 dial-divisions, there must be a rotational ratio of four to one between the main and trimmer shafts. Therefore, proportional variation of the main and trimmer units will result when, say, a ½-in. pulley is put on the main shaft and a 2-in. pulley on the trimmer shaft, and the two are belted together.

To bring the minimum capacity of C1 to a balance with the minimum of C2 and C3, a small variable condenser C4 is connected in shunt with C1.

The pulleys may be made of any convenient material; the writer used some scrap bakelite.

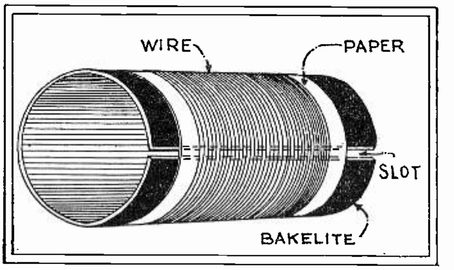


Fig. 14
The method shown makes it possible to prepare coils with lessened dielectric losses.

A FORM OF COILS

WITH a hack-saw, cut lengthwise through a piece of bakelite of the desired diameter, as shown in Fig. 14.

The next step is to wind a piece of stout paper around the (now slotted) tube, and paste it firmly, using care to prevent the paste from sticking the paper to the tube. (The paper should be spaced about 1½ inches from each end of the tube.)

Wind the wire on the paper, under which is the bakelite tube, being careful not to wind so tightly as to cause the slot in the tube to close completely.

Coat the finished winding with the usual mixture of acetone and celluloid.

When dry, the coil is easily removed

by sliding it off the bakelite tube after pressing the tube until the slot has closed.

The finished coil may be mounted in any convenient manner; the writer usually bolts two strips together, one inside and one out, and then fastens the mounting in the position dictated by the circuit.

NOVEL 3-CIRCUIT TUNER

By Louis B. Sklar

A DESIGN for a coil of the tuned radio-frequency type and having an adjustable primary to compensate for various lengths of aerials.

That single sentence tells almost the entire story.

For those who want details it may be mentioned that the construction of the coil is extremely simple and it may easily be made from odds and ends about the work-shop. The sketch shows the coil assembly, but it does not show any specific dimensions, as they are not necessary. It is only necessary that the primary coil be small enough in size to slip easily into and out of the secondary.

The number of turns on the secondary depends of course on the size of the tube on which it is wound and the frequencies which it is desired to cover; these data may be obtained from various sources. Usually, with these data for the secondary, the number of turns for the primary is also given where the primary is to be wound on the same tube. In this case, however, the primary is wound on a smaller sized tube and may also be moved away from the secondary, both conditions reducing the inductive coupling between primary and secondary. To offset these conditions it is therefore recommended that about twice as many turns be wound on the primary as would be the case if the primary were wound on the same tube as the secondary. (Fig. 15)

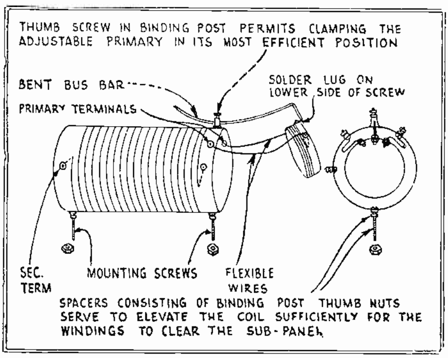


Fig. 15
A novel coupling arrangement.

The primary coil is supported as shown by a piece of ordinary bus-bar, which is bent into the shape of a curve and operates through a binding post of the thumb-screw type. When the primary is moved as far as possible away from the secondary it is also then at right angles to the secondary, because of the curve in the bus-bar. Thus it is adjustable through the entire range from maximum to minimum coupling, and provides a gradual variation in coupling impossible to obtain with primaries of the tapped variety.

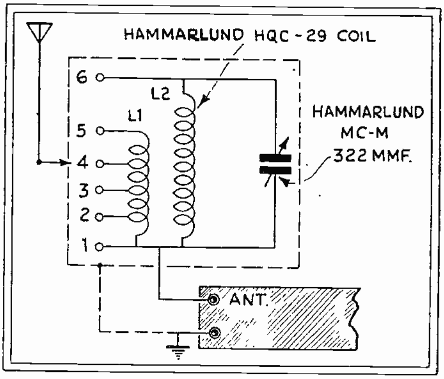


Fig. 16
The combination of low-loss tapped inductance and variable condenser makes this wavetrap adjustable for varying conditions.

The author worked out this design, about a month ago, winding the secondary on a 2-inch tube for the broadcast frequencies. A coil similar to the primary was mounted on the opposite end of the secondary as a tickler coil, the feed-back control being a midget condenser. The result was a home-made 3-circuit tuner which, in tests, proved to be superior to a high priced and well known factory made tuner.

A SIMPLE WAVETRAP

By C. H. W. Nason

SERVICE MEN at times face the necessity of providing a **wavetrap** of simple but effective characteristics. Although in years past many such devices were on the market, they have now ceased to be a standard commodity; and the radio fan or the Service Man must shift for himself in the construction of a suitable circuit arrangement.

"Just anything" will not serve this purpose. It is often desirable to eliminate the signal from a station which is but a few kilocycles removed from a desired carrier. If this is to be done it is essential that the losses in the wavetrap be small, so that a sharp effect may be obtained. Figure 16 shows the schematic circuit of a simple wavetrap employing a Hammarlund "MC-M" Midget condenser in conjunction with a "Type HQC-29" antenna coupling coil. The degree of effectiveness of the device is determined by the tapped connection to which the antenna is connected; it is necessary to find the best arrangement in each case.

If the entire winding is connected in the circuit, the maximum effect is obtained; but with the possibility of removing the desired signal also, if the interference is from a station on an adjacent channel. With the antenna connected so that but a small portion of the wavetrap winding is in series with the antenna lead, the sharpness of the effect is greatly increased; although its magnitude is somewhat reduced. This will allow us to separate stations having dial readings quite close together.

In some localities it may be desirable (to prevent picking up the signals of powerful locals) to shield this wavetrap; and perhaps ground the shield, as indicated in dotted lines.

When the selector switch is set on tap 1, the wavetrap is entirely out of the circuit—except for a slight "dead-end" effect (which cannot be detected unless the wavetrap is in close inductive relation to unshielded coils in the radio set). When the switch is on tap 2, only one turn is in use and the wavetrap action is very slight; a good condition when trying for "distance," with just a little cross-talk observable between two weak, distant stations.

The maximum effect in the use of the wavetrap is observed when the switch is placed on tap 6; in which position primary L1 is not in use and has a practically negligible action on the circuit.

Although the coil in Fig. 16 may be used with the old 350-mmf. Hammarlund variable condenser, it may be used to even greater advantage with the more efficient "Type MC-M" 322-mmf. unit recommended. This tuning capacity shunts a coil L2 having 60 turns of No. 22 D.C.C. wire, spaced 36 turns to the inch, on a form 3 in. in diameter; while in inductive relation to it (inside and at the filament end) is the primary winding L1, consisting of 15 turns of No. 24 D.C.C. wire, spaced 39 turns to the inch, on a form of $2\frac{13}{16}$ inches in diameter. The leads are brought from the 1st, 4th, 8th, and 15th turns. (Of course, these coil and condenser proportions may be varied to suit individual preference as to parts or connections).

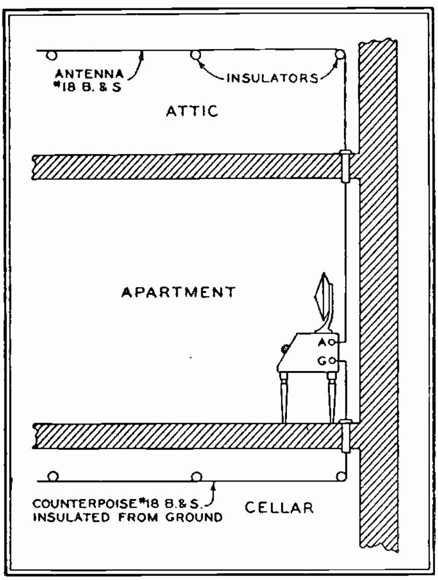


Fig. 17

The counterpoise, used in this manner, might be styled an "indoor ground"; aerial and counterpoise form the "Hertzian antenna." Good results are often thus obtained.

USE OF COUNTERPOISE IN PLACE OF GROUND

By Paul L. Welker

IT sometimes happens that the set owner finds it impossible to obtain a good ground connection of low resistance and free from noise pickup. If an efficient installation is to be made, it will be best to use the device, familiar to transmitting amateurs and experimenters, known as a counterpoise; this is a second (and preferably larger) aerial placed beneath the regular one, and connected to the ground binding post of the set. In places where the soil is sandy and dry, or is composed largely of rock, a counterpoise will give much better results than any ground.

Excellent results can be obtained from a single-wire horizontal counterpoise, stretched beneath the single-wire horizontal aerial. An installation made in a large rooming house, which eliminated outside pick-up, is shown in Fig. 17. For maximum efficiency and where space permits, a more elaborate counterpoise system can be adopted as illustrated in Fig. 18.

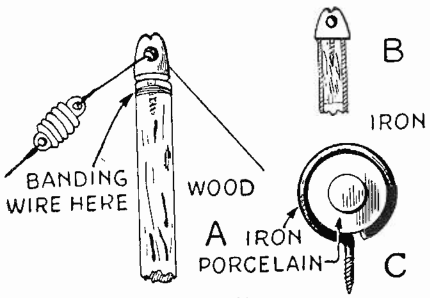


Fig. 19
This stunt is a good one to apply in many different ways besides the one shown above.

IMPROVED ANTENNA RIGGING

By A. B. Clark

HOW many times have you had trouble with pulleys and wires, or possibly ropes on aerial supporting poles? Here is the way to get away from all this difficulty on the ones you erect.

Instead of using a pulley, use a porcelain house bracket insulator. This has a screw moulded into it and a perfectly smooth hole through it. Screw this into the ton of the wooden pole (A);, or if an iron pipe is used put in a plug, bore a hole in the plug and screw in the insulator (B). At (C) is shown another form of screw insulator which may be used. You can now run a small wire (which usually lasts a lot longer in the weather than one of the stranded ones) through this for the pull-up wire. It cannot get out; runs through the insulator freely; and will never rust. (Fig. 19)

A HOT AERIAL—OZARKAS

By N. W. Smith

ONE morning a service call was received from a man who wanted to know if we could fix a radio that had caught fire inside the cabinet. I thought that fire inside a battery set was unusual; so I immediately went to his home. He lived alone, in one room, and the aerial of bare wire was strung about the place on porcelain nail-knobs; an A.C. extension cord, from a light fixture in the center of the room, was supported by one of the knobs. The "B" eliminator was turned on and off at the light socket and, each time, the cord was moved a little until the insulation was frayed. On the night of the fire the A.C. cord had touched the bare aerial wire and shorted to ground through the set; and the first radio-frequency coil started to burn before the fuse in the building blew out.

An Ozarka "89 A.C." had a hum above the usual level, and other Service Men had found no success in reducing it; so the owner had packed the chassis to return it to the manufacturer. After agreeing to charge nothing if the hum was not reduced, we tried bypassing, filtering, etc., with no luck. Finally, we removed a terminal strip, to trace the leads, and found a 28,000-ohm resistor connected to the 1.5-volt center tap but no lead from the other side. Putting a wire on it, we tried ground and other connections; when it was connected to the first-audio and radio frequency "B+" terminal, the hum almost disappeared without decrease in set volume. The owner was well pleased.

Heater elements of the electric-bowl type make good A.C. current ballasts for reducing motor current drain. They pass about 6 amps.

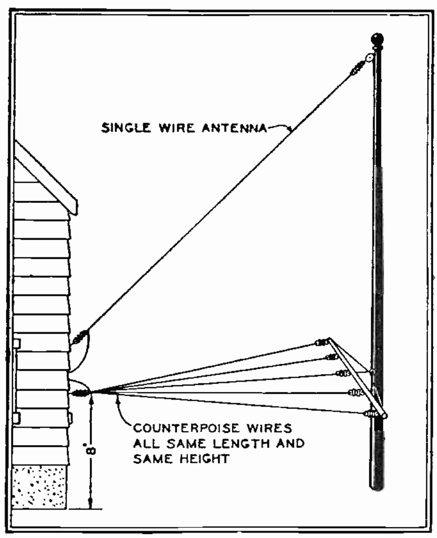


Fig. 18
Another form of the counterpoise, this time with an outdoor aerial. For those who have an ample yard or areaway, this will be found even more efficient than Fig. 17.

CHAPTER 9

Short Waves

TUNING IN SHORT WAVES

By John C. Heberger

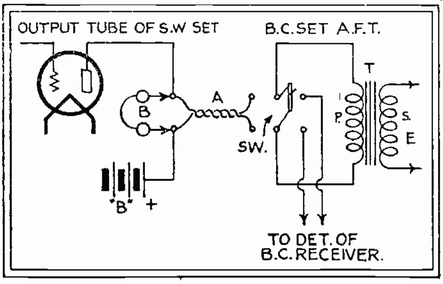


Fig. 1

Short or broadcast waves on the L. S. by switching the S. W. set to the A.F. of the B. C. set.

IF one has a modern broadcast receiver equipped with a power amplifier tube and a short-wave set with at least one stage of audio amplification, foreign short-wave broadcast stations can be tuned in on the loudspeaker of the broadcast receiver if the two receivers are connected together according to the simple diagram shown in Fig. 1.

The writer tunes in daily, by means of this combination, the afternoon programs from G5SW at Chelmsford, England, with volume and quality equal to a local station. Three stages of amplification are none too many because the level of background noise is usually very low on the short waves. Howling caused by mechanical feed-back from the speaker may be avoided by using a longer speaker cord or, if necessary, placing the speaker in another room.

Referring to Fig. 1, the lamp cord "A" joining the two receivers can be of any length, and if the sets are located in different rooms the phones "B," which are left connected all the time, can be used to find the station before putting it on the speaker.

The switch SW is placed inside the cabinet of the broadcast receiver in any convenient position. One side of the switch connects the output of the short-wave set to the audio amplifier of the broadcast set; the other side is used for normal operation of the broadcast receiver. Care should be taken in connecting the leads to the switch so that the connections to the transformer are not reversed when reconnected to the detector of the broadcast receiver through the switch.

A HINT TO SHORT-WAVE FANS

By Wayne Starch

MANY short-wave fans, like myself, may have short-wave sets which tune up to about 150 meters. Probably, at times, they wished that they could tune a little higher in order that they might receive broadcasts when the short-wave stations are not on the air.

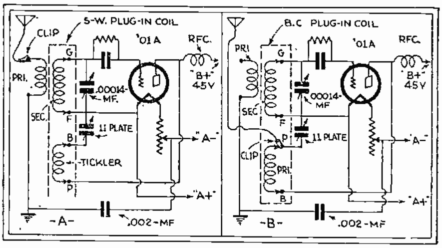


Fig. 2

At A, a standard short-wave connection. At B, circuit changes for longer wave reception.

In my case, it happened that I wanted a friend of mine to hear the dynamic speaker that I was using, but was unable to do so in view of the lack of short-wave stations at the time. I decided then and there to fix up my receiver so that I would be able to tune in a few of the higher wave broadcast stations.

Instead of winding a new R.F. coil, I obtained an old one from my junk box (most radio experimenters have junk boxes) and used its secondary as the secondary of a new plug-in coil, and the primary as the tickler. This idea is shown in Fig. 2. I found it necessary to reverse the tickler connections on the new coil in order that regeneration might be secured. The antenna was connected to the P terminal of the tickler rather than the antenna coil as shown.

The type of plug-in system to use depends on the type that the short-wave receiver uses, and obviously should be made so as to fit.

With the size tuning condensers as shown and using a standard R.F. coil, the range of the set was extended up to 345 meters.

ELIMINATING PLUG-IN-COILS

By M. D. Rubin

MOST short-wave radio fans dislike plugging coils in and pulling them out, every time they wish to change to a different waveband. Several complicated arrangements have already been devised to obviate this; but, as a rule, they are too difficult for the average set constructor to build. These complications are usually in the switching arrangements; but here is a switching method which is not complicated.

Get two miniature four-pole double-throw switches, either knife or jack. Mount these on the panel near the bottom; then mount four sockets for the coils directly behind the panel, and the detector tube socket directly behind these. When this is done connect as shown in the diagram (Fig. 3) which is self-explanatory. It would be a good idea to label each side of each switch with the waveband of the coil that side controls. Also, label the neutral position, as in the diagram.

To operate, close switch to side wanted, leaving other switch at neutral; i.e., if the 15-25 meter band is wanted, turn switch 1 to that side, and leave switch 2 at neutral. If a jack switch is used, no condenser effect should be present; because there is always a disconnected plate between any two sections of the jack switch. In addition, the leads should not be lengthened much; for the switch is quite close to the coil sockets.

ADAPTER FOR POLICE BROADCASTS

By P. L. Pennock

MANY set owners have asked me, time again, if it were possible to get the short-wave broadcasts of the local police stations on their present

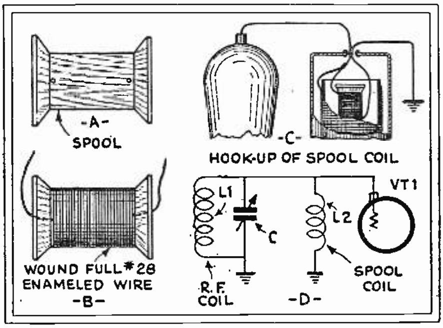


Fig. 4
An additional inductance in shunt across a coil lowers the wavelength, if there is not too much self-capacity.

broadcast receivers. This may be done sometimes, when the receiver is very close to the transmitter, which works only a little ways below the broadcast band; but, as a rule, a short-wave converter or adapter will be required. However, the method described here involves practically no cost and very little time; though it is true that the arrangement is not very efficient.

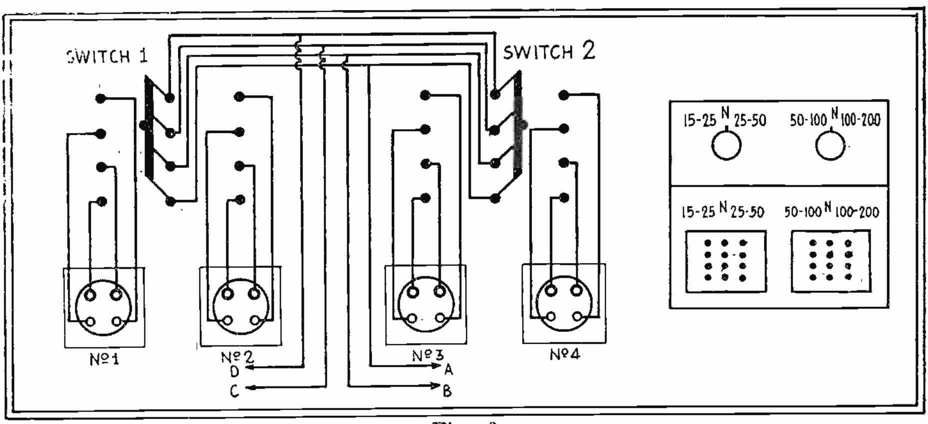


Fig. 3
The switching system shown makes possible fixed R.F. coils for short-wave work. The switches may be arranged on the panel as shown at the right; jacks as above, or blades as below.

Procure some empty thread spools (of the ordinary type) and, at each end, drill a small hole to the center, just inside the flange. (Fig. 4A.) Then insert one end of a No. 28 enamelled wire through this hole, leaving at least three inches for a lead; and wind a layer completely to the other end, passing the lead through the other hole (as at Fig. 4B). One of these inductors will be needed for each tuned R.F. circuit in the broadcast receiver, whether R.F. or detector; but none for the antenna coupler, if it is untuned.

If the receiver has screen-grid stages, lift the cap of the connecting lead from each tube until you can slip a terminal lead, from one of these chokes, under the cap and make an electrical contact with both tube and grid lead. Connect the other lead to some grounded point on the chassis or tube shields (See Fig. 4C) and set the spool on top of the regular coil; do this with each tuned stage. In any stage which does not use a screen-grid tube, the spool is connected between the grid prong of the tube socket and the filament side of the tuned circuit. These terminal wires should be polished with very fine sandpaper, until they will make good metallic contacts.

It will be found, when this has been done, that broadcast stations will tune much higher on the dial; and the short-wave stations on police, amateur, television and experimental waves will have come up among the lower readings of the scale. On a Crosley "42S" located here (Canton, Ohio), Louisville, Cincinnati, Akron, Cleveland, Richmond, Youngstown, Detroit and Buffalo have been heard. I would suggest that the local station be expected, but the distant ones merely hoped for.

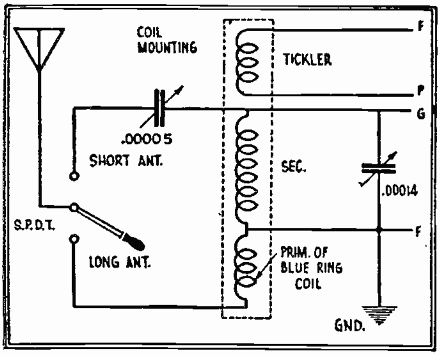


Fig. 6

With a set covering several wavebands, this switch makes it more convenient to change the aerial coupling.

(The principle of this kink, shown schematically in Fig. 4D, is that two inductances in parallel with each other have an effective value lower than that of either. Our readers may find other ingenious adaptations of the same principle.—*Editor*)

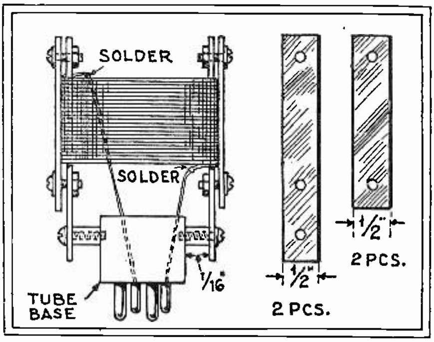


Fig. 5

Another version of the home-made plug-in coil, with low-loss construction.

A SHORT-WAVE COIL FORM

By Herbert L. DeWolf

HAVING built a number of short-wave coils and giving them a thorough test, the writer is of the opinion that coils made in accordance with the arrangement shown in Fig. 5 work better than any others.

The idea is to hack-saw supporting strips from an old coil; and fasten them with machine-screws to a tube-base, and to the R.F. coil by means of top clamps.

The wire for the tuned coil should be about No. 16 enameled, spaced 1/16-in.; on the regular celluloid-acetone form. The tickler may be wound at the bottom end of the tuned coil; outside of the straps; or formed first and cemented inside the coil.

INCREASING "WASPS" EFFICIENCY

By W. H. Nilsson

SINCE last August the writer has been using the simple switching circuit illustrated in Fig. 6 for changing from a long aerial to a short one to obtain better results with a Pilot "Wasp" short-wave receiver, the long aerial being used only with the "blue ring" coil.

This arrangement has the merit of convenience. It may be used with the "Super-Wasp" also.

CHAPTER 10

Loudspeakers and Phonograph Pickups

MULTIPLE SPEAKERS

By Victor Trad

A SIMPLE and economical method of wiring every room for a radio-speaker, illustrated here, obviates drilling holes through the ceiling or floor; because one wire may be taken upstairs or downstairs from the outside of the building. I have used the idea quite successfully in making such installations in my neighborhood, and they are working quite well. The arrangement shown lessens losses caused by the use of two wires. (Fig. 1)

A volume control, and a switch also, may be used in each room, if desired by the set owner; convenience outlets are obtainable, or ordinary electric wall receptacles may be made to serve. The condensers used are of 2-mf. capacity. That attached to the receiver's output is connected to the ground post of the set, when the latter runs directly to the radiator.

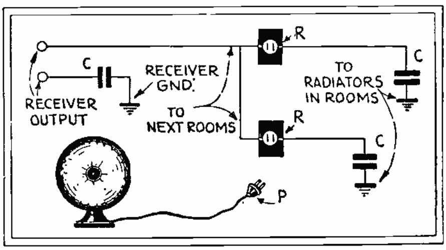


Fig. 1
Mr. Trad finds this method of wiring several speakers to a receiver simple and profitable.

(The method shown will be of value to many Service Men who are prepared to add a profitable extra to installation work. It is desirable, perhaps, to add a caution that the use of speakers in parallel reduces the impedance and, thereby, the total effective output of the set to all of them. The new pentode, particularly, requires a large output impedance, as explained elsewhere in this book. However, if more than two speakers are required, the use of a series-parallel connection will restore the matching of the load to the output tubes. On this subject, it will be of interest to refer to the paragraph "Matching Reproducer Impedance," in the article on page 727 of **Radio-Craft** for June, 1931; while a very large installation is described therein, the principle is the same.—Editor)

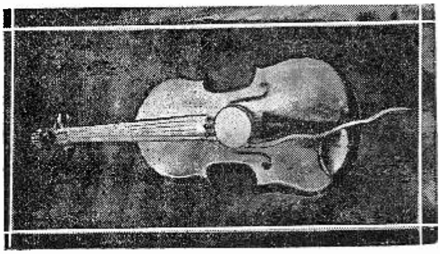


Fig. A
The radio-violin. The improvised speaker unit on the violin bridge, facilitates radio accompaniments.

THE RADIO-VIOLIN

By Fess Christiani

RADIO programs may now be received through the medium of the violin. Find the center of a small magnetic speaker disc, and solder a small wood screw to it at the center. Then cut a wooden violin mute as shown in Fig. 2 and screw it to the speaker diaphragm. The telephone unit is now assembled together with the mute and the entire arrangement attached to the bridge of a violin as shown in Fig. A.

When a program comes over the radio, one may have the novel experience of walking about the room accompanying it. I play an obligato, and the tone is very clear. There is a great "kick" in it for both listener and player.

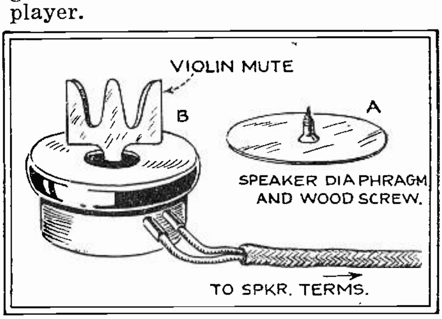


Fig. 2
A home-made mute is screwed to a speaker diaphragm.

REPAIRING SPEAKER CONES

By John J. Nothelfer

HAVING bought several speakers with damaged cones (at a good price and with an idea of reselling at a profit), I learned much to my chagrin, the prices for new cones! The prices were so high that a loss instead of a profit would result.

The speakers were damaged at the centering device; this is the case with nearly all damaged cones. I tried repairs, and with good success, after several attempts.

Cutting out the damaged area, I sandpapered the edges of the cut to a rough finish. Cutting a piece of paper from an old cone, I pasted the patch to the damaged area, with white collodion.

It takes a while to dry, and the patch must be held in place all that while, probably an hour. The ordinary hot iron came to the rescue. After raising it to a good, hot "heat," I pressed the iron over the pasted area. In a few minutes the collodion had dried, and it held as firm as if the patches were metal and soldered! To prevent the collodion from getting to the surface of the iron, a piece of paper is laid over the area to be heated.

A new centering device should be installed and the cone replaced on the speaker. The cone is then as good as new, and no fear should be entertained that the pasted patch will come loose. (Fig. B)

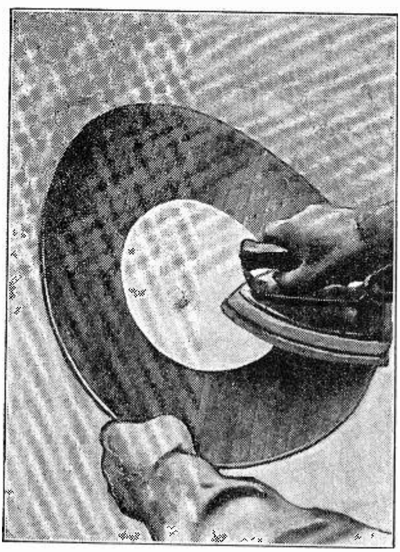


Fig. B
Mr. Nothelfer does a little valet work on an old-fashioned paper cone.

This idea also works very well with dynamic speakers which have been punctured by accidental means; in this case, ordinary typewriter paper is used.

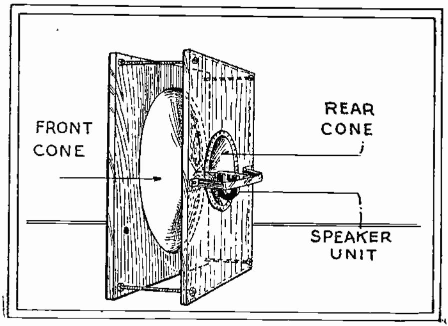


Fig. 3
Round holes in a linen-diaphragm speaker give more even tension; odd ratios in their diameter help to suppress harmonic resonances.

LINEN-DIAPHRAGM SPEAKER DESIGN

AFTER many attempts to obtain good reproduction from a square "airplane-cloth reproducer," "J. L.," writing in a recent issue of **Amateur Wireless**, advises builders to use a circular form, following his most satisfactory mechanical-acoustic design, to obtain even pull on the cloth at all points along the edge. He cut 15- and 20-inch circles out of the centers of laminated boards, 24 inches square; glued the linen tightly to the boards, over all, and then drew it in to the unit in the usual manner. (Fig. 3)

A subscriber of **Radio-Craft** Magazine who recently visited our offices suggests that an **odd** ratio be maintained between the sizes of the large and small diaphragms of airplane-cloth reproducers. For example, instead of using a small cloth, eight inches square, with a standard 24-inch major diaphragm, a dimension for the minor square of 7, 9, 11 or 13 inches is recommended. The purpose is to avoid undesirable resonance points.

CHAPTER 11

Tools and Accessories

KEEPING THE IRON CLEAN

By Luther C. Welden

KEEPING the soldering iron clean is half the job of doing a solder job; so it is a good idea to keep two handy accessories on the work bench for this purpose.

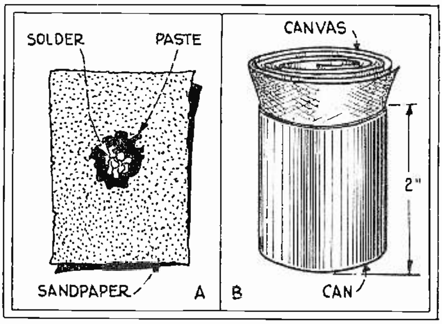


Fig. 1
The two accessories shown make it more convenient to do a good job of soldering.

First, a small sheet of rather fine-grade sandpaper; on which flow a small bit of resin or solder paste and a small amount of solder. Next, procure a small round tin can about 2½ inches in diameter and 2 inches deep. Take a strip of canvas 2¼ inches wide, or ¼-inch wider than the can is deep. Roll the canvas in a tight roll until it will fit snugly into the can, with about ¼-inch extending above the edge; "fuzz" this outer edge. See Fig. 1.

When the iron is hot clean the tip by rubbing on the sandpaper; it will be well "tinned" at the same time, because of the paste and solder on the paper. Then clean off the surplus paste by passing it over the canvas pad.

An iron holder made of a strip of tin may be fastened to the can.

A CONVENIENT HYDROMETER RACK

By Willis W. Futer

FINDING that the hydrometer had a habit of getting into the tool box, against coils and condensers, and into other undesirable places—thus putting sulphuric acid where it wasn't wanted—the writer rigged up a simple rack that nicely solved the problem.

As the illustration shows, a sheet of metal, of the shape shown at B, is bent into arm shape to hold the rubber cap, as at A.

An acid drip-pan, made from a can cover, is fastened below the nozzle.

Both pieces of metal are to be dipped into paraffin (which may be obtained by melting a candle) to prevent the acid from eating through the metal wherever it may touch.

A HOME-MADE ELECTRIC GLUE POT

By C. M. Parks

SOME time ago a glue pot was needed in a hurry. There was none around, so a serviceable one was made as illustrated.

Resistor R may be any unit having the required value, which must be determined by experiment. If the water is too conductive, too much current may flow for the resistor to carry safely, and it will burn out. It is therefore suggested that a lamp bank be used.

The water serves a dual purpose, as the resistor required to develop the requisite heat, and to isolate from direct contact with a localized heat (known as the "water-bath" method) which is

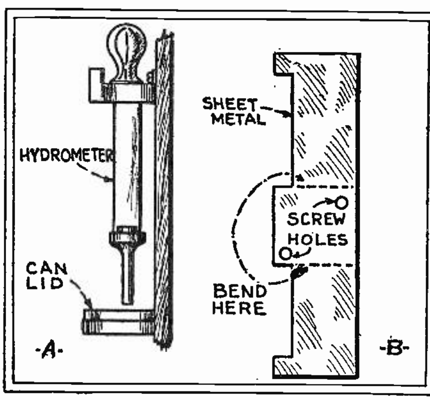


Fig. 2
The hydrometer holder A—made from the strip B—is fitted with wax-covered drip pan which is acid-proof.

a requirement for properly heating glue, sealing wax, paraffin and similar plastics.

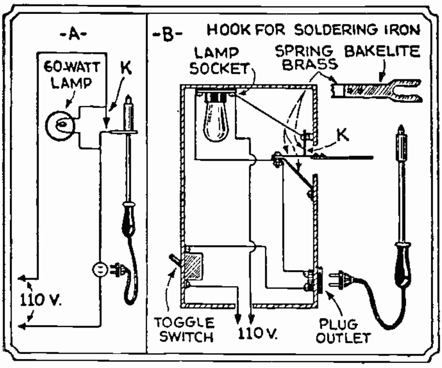


Fig. 5

A novel soldering iron holder. At A, its electrical circuit; at B, the mechanical arrangement.

The rubber washer is required to insulate the inner metal container from the outer metal can. (Fig. 3)

The outer container is an ordinary metal can of convenient dimensions; the inner one is of proportionate size and the top is slit to form two ears which are bent over to rest on the rubber washer.

A SOLDERING AID

IT is often experimenters want to solder loudspeaker jacks and other instruments having soldering lugs arranged in a similar way; some anti-capacity switches have the connection terminals placed close together.

If a piece of cord is temporarily put between adjacent terminals, solder and soldering flux cannot run between the two connections.

If an acid flux is used, the flux can cause considerable leakage by saturating the material insulating the connections, if this material is absorbent; or, by resting on its surface if it is not absorbent. This trouble is eliminated by using the cord. Aside from the electrical considerations, it looks much better sans flux.

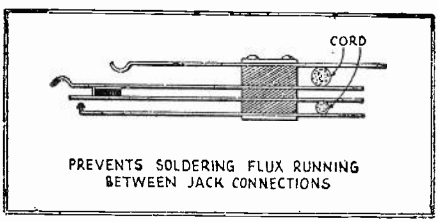


Fig. 4

The good wireman will always clean the connections, after soldering the leads. The most convenient way to do this is to wash the joints with alcohol. (Fig. 4)

A SOLDERING IRON HOLDER

By Louis Rick

THE idea is merely to connect a 60-watt lamp in series with the soldering iron. When the iron is removed from its holder, the contact K closes, short-circuiting the lamp; the full line voltage is then applied to the iron. When not in use the iron is placed on its holder, which opens the contact and connects the lamp in series with the iron; reducing the voltage applied to the iron. With the usual amount of use, the iron is thus kept at a constant temperature.

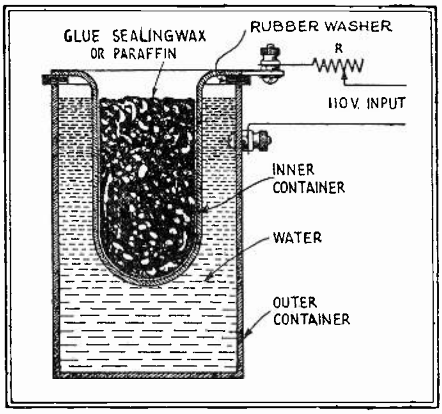


Fig. 3

An easily-constructed glue pot, recommended as an emergency construction design. It may be used regularly for light work.

At A is shown a schematic diagram of the circuit. The arrangement may be housed in a box illustrated in B, Fig. 5, and then mounted in any convenient location.

A LIGHT BLOW TORCH

By J. E. Kitchin

PROBABLY some of you Service Men with the ever-handy power lines have never had to solder without a soldering iron. The following, however, may interest those, who, like myself, are sometimes in a district where power is not available.

Procure an atomizer, of the type used for perfuming, or for spraying the interior of the mouth and nose. Remove the cork, to which are attached the rubber and metal tubes. Cut off the stem, which dips down into the bottle in regular use, and plug this tight with stopper S. Cut the bulb off the rubber tube and, if there is a spray nozzle at the end of the metal tube, remove this. You now have a blowpipe which will direct a flame with needle-like sharpness. Carry this, with a short length of candle, in your kit. (Fig. 6)

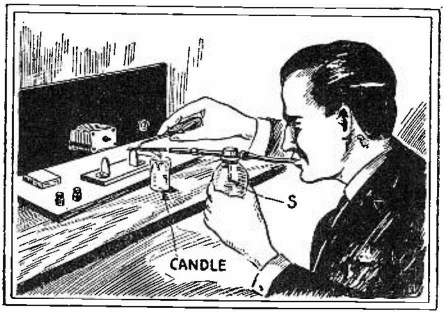


Fig. 6
Blowpipes are obtainable from laboratory supply houses; but Mr. Kitchin takes this ingenious way to make one of light weight. (The bottle may be retained as a handle!)

AN INEXPENSIVE ELECTRIC SOLDERING IRON

By Bernard T. Ring

AN inexpensive, low voltage electric soldering "iron" that will work on a 4, 6, or 12-volt storage battery, or on a toy transformer up to 25 volts can be made by following these constructional details.

The parts required are one screwdriver handle; one piece of brass or copper tubing, ⅜-in. dia., by 6 in. long; three clips; two gas tips; some flashlight battery carbons and a single strand of lamp cord about five feet long.

We may segregate the construction into seven operations, as follows:

(1) Enlarge the hole in the handle of the screwdriver until it is about ⅜-in. dia. and 2 in. deep; then, bore a hole all the way through, 3/16-in. dia.

(2) Thread the brass tube at one end so the gas tip can be screwed on. (Fig. 7A).

(3) Solder one end of the single-conductor lamp cord into the end of the brass tube which is not threaded. If a soldering iron or a torch is not available, a few short pieces of bus bar made into a "V" shape and twisted around the point with the end of the lamp cord and then pulled through the tube will make excellent contact.

(4) Pass the lamp cord through the wide opening of the handle and pull through the small hole (Fig. 7B).

(5) Push the brass tube into the handle tightly.

(6) Leave the brass caps on the battery carbons. Rub the other end back and forth on a file to shape in any manner desired.

Take flame-spreader out of gas tip (Fig. 7C).

(7) Solder one clip to lamp cord and the other two clips to another piece of lamp cord about 2 ft. long.

Operation: Connect the soldering-iron clip to one terminal of battery or transformer, connect one clip on other wire to other terminal. Insert the car-

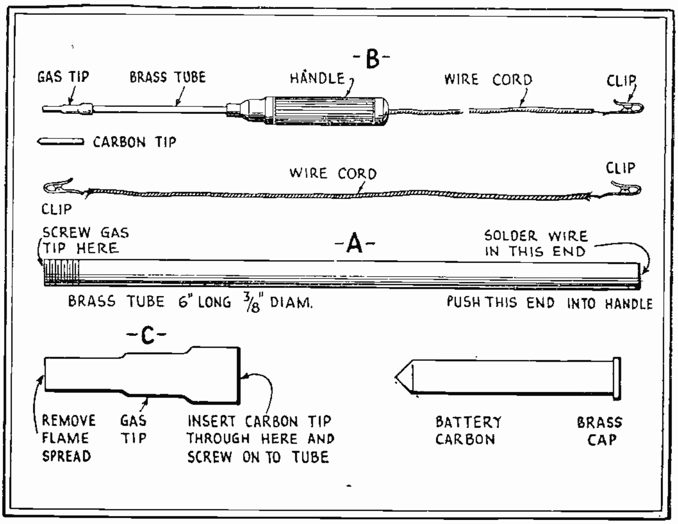


Fig. 7
The electric soldering iron shown will work from either direct or alternating current, up to 25 volts; its construction is simplicity itself. An insulating handle, shown at B, a brass tube A, and a gas tip C are the essentials. It is well to paint the brass tube with insulating compound, or tape it; so it cannot be shorted by other things during the soldering process. Changing tips is done by unscrewing the gas tip, taking out the carbon tip and inserting another.

bon rod into the gas tip through the large end of the tip and screw on to brass tube.

Connect the other clip to object to be soldered; or, if object is small, connect the clip to piece of solder. Hold solder close to object to be soldered and touch with iron.

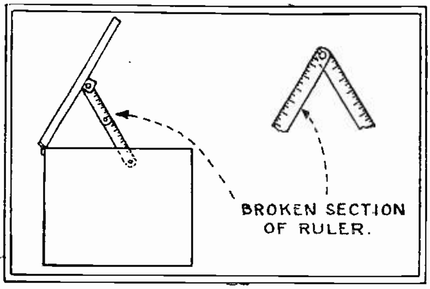


Fig. 8
Mr. Youngkin's ingenious use of a broken rule is explained.

USING THE BROKEN RULE

By E. E. Youngkin

ALMOST every workman has around his shop a "collapsible" rule that has seen better days. In Fig. 8 is shown a double section of such a rule, fastened to the end and lid of a cabinet to hold the lid open. A metal angle is used to pivot one end of the rule-section to the hinged lid.

A CONVENIENT TERMINAL

By Russell L. Woolley

MORE and more, pressed eyelets are being used in the manufacturing of radio parts. Radio-frequency transformers, R.F. choke coils, connector strips, and the ends of the wires of a cable are all parts of a radio receiver where eyelets may be used to advantage. Perhaps the most notable example of the use of punched eyelets is the A. K. terminal strip.

Now then, the point is that the set builder may also use this comparatively simple manufacturing process, with practically no expense; and at the same time, make a really neat job of his experimental home-made apparatus.

The use of the punch and eyelet kit is illustrated in the accompanying drawing. Here the punch pliers is shown, inserted into a hole drilled in the solenoid coil form. To use, without removing punch from hole, put on the eyelet over the punch—small end down—and close tool. (Fig. 9)

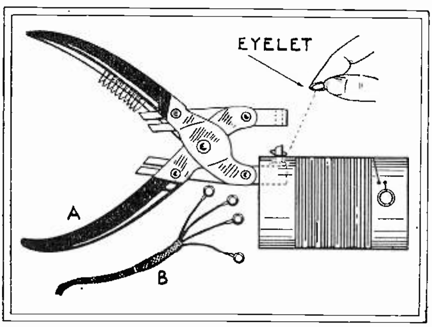


Fig. 9
At A, a simple eyelet punch used to form terminals on a coil; B, a cable with neat eyeletted terminals.

A second illustration, suggesting the use of punched eyelets, shows a dynamic speaker's four-wire cable with eyelet terminals. It is apparent that, when these terminals are put on a 6/32 or 8/32 machine-screw binding post, they cannot come loose.

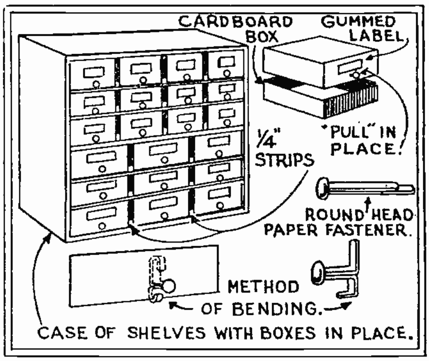


Fig. 10
The cabinet here shown provides a place for everything; yet it is made of paper boxes, etc., which would otherwise be thrown away. Small wooden strips will serve instead of partitions, as shown.

AN INEXPENSIVE SMALL-PARTS STORAGE CABINET FOR THE AMATEUR

By Lester P. Young

MANY experimenters like to "file" their radio small parts. Stationers often throw away convenient-sized boxes of the type illustrated; and the writer finds them handy for this purpose. A couple of dozen of these cardboard boxes of varying depth may be fitted into shelves spaced to fit the tiers, as they are placed in a wooden packing case of correct dimensions.

To prevent the boxes from binding, and insure their sliding in the proper place, dividing strips made of ¼-inch square wood are nailed to each shelf, between each pair of boxes.

Ordinary round-headed brass paper fasteners may be used to make a practical and good-looking "pull" (Fig 10, above).

CORDLESS SOLDERING IRON

By H. R. Wallin

WHEN one is using an electric soldering iron, especially in wiring radio sets, the cord of the iron is usually in the way; yet at times it is not long enough.

To prevent this annoyance, the connection shown in Fig. 11 was used; it is very simple to rig up. A standard 110-volt socket is set into the top of the bench, by cutting a hole to fit. A flat metal-plate cover is set over this hole, to prevent dirt from falling in; a spring should be used on this cover, so that it will close automatically.

Into the handle of the soldering iron, two prongs are fitted and connected to the terminals of the wires.

For heating, the soldering iron is set upright into the socket; and when needed for use, it is pulled out and brought to the work. Where continuous work is necessary two irons may be used. The heat will be retained in the iron for some time.

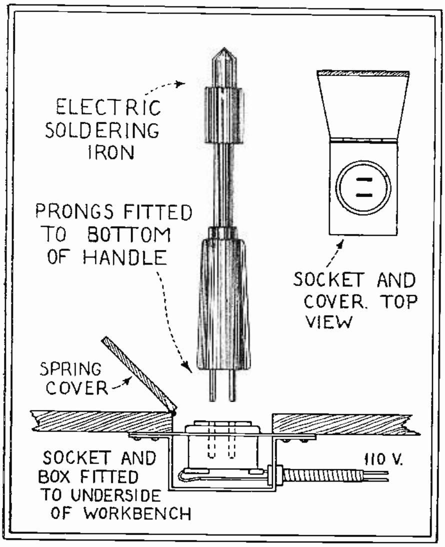


Fig. 11
By inserting the soldering iron into a fixed socket to keep it hot, it may be used without a cord.

PUNCH AND JIG FOR METAL WORK

By Eugene Douglass

EVERY set-builder and experimenter knows of the difficulty encountered in drilling or cutting holes of large

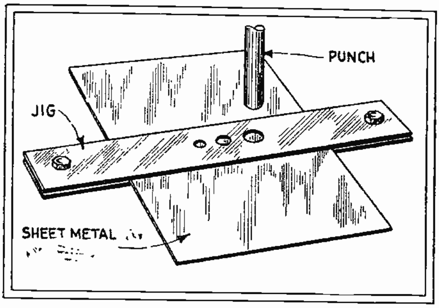


Fig. 12
By means of a set of jigs and punches of this kind, large, clean holes may be punched in fairly stout sheet metal.

diameter in the metal sheet that he uses for a chassis base. Obtaining neat holes was a problem to me until I had made up the outfit illustrated. The method is as follows:

Two pieces of flat iron (about 30 inches long, ¼-inch thick, and two or three inches wide) are obtained and clamped together, one above the other; so that, after drilling, the holes in both, pieces will correspond to size and location. Now, drill a ⅜-inch hole, about 1 inch from each end of the iron strips; and also, near the center of the strips, drill holes of the sizes that will later be required in the chassis base. Next, remove the clamp that holds them together, and bolt them together. Use two ⅜-inch bolts for this, and place a 3/32-inch washer at each end, between the iron strips. See Fig. 12.

This completes the construction of the jig, but you will need punches, to fit the various holes in it; they are made of round steel and should fit neatly into the holes.

RULING PEN HANDY TOOL

By Arthur Bernd

IN putting nuts on bolts in tight corners and down deep in the set, I use a draughtsman's steel ruling pen, which (as you know) is shaped like a pair of tweezers, with a stud running through to tighten it.

By placing the nut in the ends of the pen and screwing down on the stud, it is easy to set the nut on the bolt; after a few turns the pen is withdrawn and the job finished with a "spin-tite" or wrench.