MRL No. 2
Long Distance
Crystal Set

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HB-2

by Elmer G. Osterhoudt

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CONTENTS

Building the Set ..... page 3
The Antenna System 9
Operation and Testing 14
Theory of Circuit 18
Records, by Locations 20

FOREWORD

MRL No. 2 Crystal set was originated in 1933 from a combination of several circuit principles. It has been built by thousands of men and women of all ages from 9 to 90 years---by beginners and Engineers alike—from all walks of life. Hundreds of testimonials attest these facts and its performance. I hope you will also build one for yourself or some member of your family.

"With Radio Since 1915"

including

Radio Operator, R. C. A. Marine Service.
Radio Mechanic, Maximum, U. S. N.
Technician, Electrical Products Corporation.
Manchester Radio Electric Shop.
Modern Radio Laboratories.
Amateur and Radio Service.

Printed in U. S. A.

INTRODUCTION

To my knowledge, no Crystal set ad appeared for any length of time, prior to our insertion of a trial ad in "Short Wave Craft" in 1932. At that time we sold one circuit, our "MRL No. 1"—which gave such good results that we figured others would want to use it. Soon thereafter, we "pieced together" what was later to be called the "MRL No. 2 Crystal Set" circuit. It went over big from the start. It was a two-dial set, very similar to our present No. 2. Then, we added the SEL-BRD switch for more selectivity. Later, as we found the condensers tracked pretty well, we started building the "MRL No. 2-A"—or single dial set.

As an old Crystal set operator from 1915 to 1920, and later using a Crystal as emergency equipment at Sea from 1920 to 1923—we knew of but two or three good crystal circuits. We weren't interested then in developing new ones, as the Audiotron made its appearance and Radio being comparatively new, we had lots to occupy our time in other lines. However, the writer has assembled a lot of Crystal circuits since, from here and there—adding to, or taking away certain features.

Considering what was accomplished in earlier days with "poor" transmitters,—you can readily see the possibilities with modern powerful transmitters. In Crystal set days Mr. E. M. Sargent used to receive VKT, Australia, at Goat Island (Yerba Buena) in San Francisco Bay at 2 a.m. on a Crystal set on 2000 meters, a distance of 7000 miles. Ships in the China Sea in my time, used to receive old KPH (S. F.) on a Crystal Set, some 6000 miles distant. Lots of old records could be dug up. Our best record at this writing is 5300 miles on several occasions, as per testimonials in the back. We know other good records can still be made.

In World War 2 the Crystal set came into its own in the camps. A good part of our customers from overseas put them to use in reception of foreign stations during rest periods. This is attested by our A. P. O. and F. P. O files, and by requests for Crystal sets in the newspapers. Because it requires no heavy batteries, but only a pair of light phones and about 100 ft. of insulated fixture or leadin wire for an aerial, it makes a compact outfit for transport. Very little upkeep outside of a fresh crystal every six months, makes it ideal for this type of work.

To our knowledge, a Crystal set will receive I. C. W. (intermittent continuous wave) signals and Modulated C. W. (voice). We have found no records of a Crystal receiving pure C. W. (code) unless with a decoherer or tone wheel. To those annoyed by code reception, this is an advantage, as Broadcast stations come in without interference from code stations, unless close to a transmitter when "key clicks" may sometimes be heard. Also on Short Wave reception, the Crystal doesn't receive the sidebands (squeals) but tends to broaden the signal so it is more easily tuned in. Short Wave reception is a certainty with Crystal sets, as all our best DX records have been made on the higher frequencies. Crystal detectors (mostly Iron Pyrites) have been used in recent Microwave work.

We still find Fans and Dealers who discredit the Crystal set—who think it is beneath their dignity to "mess" with them. However, we can show a file of over 35,000 interested Crystal set Fans, as the result of our ads of over 12 years. As always happens, other firms have climbed aboard the "band-wagon" and are now selling Crystal set parts. Well—that's fine, they are welcome, and we hope others will follow in this interesting and inexpensive hobby. We know you are anxious to get along with the construction of one of these units, so we will proceed.

Building the Set

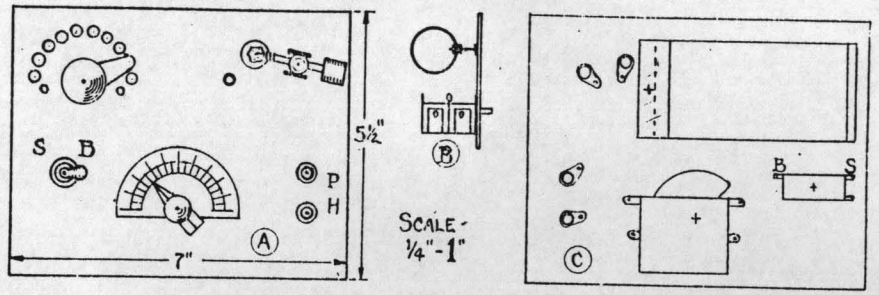

Fig. 1. No. 2-A Panel Layout. Single-dial Circuit.

LIST OF PARTS. 2-A.

1 Panel 1/8" (or 3/16") x 5½" x 7". Bakelite, Compo., or wood.
1 .00035 2-gang Variable Condenser, semi-midget.
1 Switch lever.
10 Switch Points or rivets and 2 stops.
1 S. P. D. T. Toggle or rotary Panel switch.
1 Crystal stand.
1 Steel Galena Crystal and catwhiskers.
2 Phone tip jacks or Binding posts.
1 Bar knob and scale.
1 .00025 mica condenser.
2 ft. Stranded, tinned aerial wire or busbar.
3 ft. Stranded hookup wire.
8" Spaghetti, #14 size.
6" Rosin core solder.
2 1" Fahnstock clips.
1 #6 x 1¼" flat head machine screw with 3 nuts.
4 Soldering lugs; 6 lock washers.
1 #2 Celluloid coil, or parts as follows:
1 Celluloid, Bakelite or Cardboard form 2" dia. x 4½" long.
50 ft. #22 or #24 D. C. C. Magnet wire.
Adhesive and friction tape.

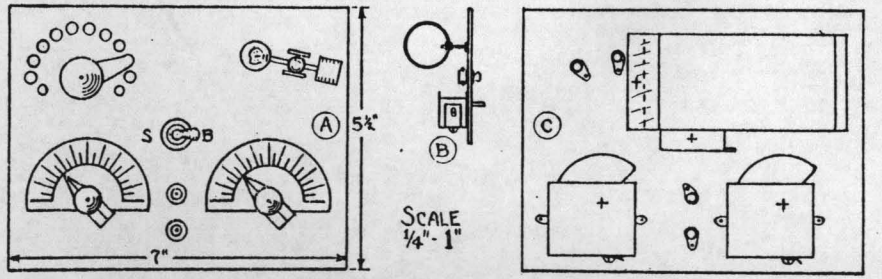

Fig. 2. No. 2 Panel Layout. 2-dial Circuit.

LIST OF PARTS. #2.

Parts all the same, as #2-A, with the exception of:

2 .00035, or other size, semi-midget Variable condensers, instead of the 2-gang for the 2-A set.
2 Bar knobs and scales instead of one of each for the 2-A set. Hookup wire, etc. about the same amount.

PANEL LAYOUT.

Using ¼" to 1" scale—the layouts shown are the best we have found from experience. However, much depends on the size of your variable condensers, so parts may have to be shifted a little one way or another. We prefer the standard semi-midget, which is the smallest obtainable at this time in the .00035 size. Due to using taps on the coil, a larger or smaller capacity may be used if desired.

In laying out the panel we prefer to center punch all holes and then drill with a #50 (or fine drill)—then later enlarging each hole to proper size. By using this method your drill doesn't "crawl" and make your work off-center. When drilling in a vise, put two blocks of wood in it—one in front and one at the back of your work, the latter extending up so you can drill into it to make a clean job. The little extra time spent in doing all mechanical jobs is always well repaid.

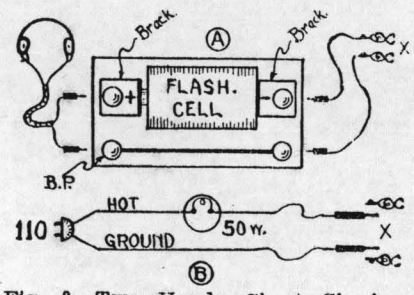

Fig. 3. Two Handy Short Checkers.

CHECKING PARTS.

It is much easier to check parts befor they are assembled, than to disconnect them later. If you have an Ohmmeter, you are in luck. If not hook a pair of phones in series with a Flashlight battery and a couple of 3 ft. test leads with clips on the ends as at (A), fig. 3. Preferably, build a short checker as shown above. This will come in handy on many occasions for checking, or using the two top binding posts as an "A" battery for a tube set.

1. In (A), touch clips together. If a good "husky" click is heard in the phones, the phones are Ok. If no click is heard, the phones are open in the windings or cord, or there is a short circuit. If you get a good click, hook the clips together and shake the cord around. If there is a raspy sound, the cord is partly broken and needs to be replaced. The cord is made from tinsel and if broken in one place, it is probably badly worn all over and should not be repaired, but replaced.

2. Clip on the frame of the variable condenser and on one stator lug. Rotate condenser. If no click is heard, that section of condenser is OK. If testing double condenser, move stator clip over to other stator lug and rotate again. If a click is heard on rotating, bend the shorting plate very slightly to clear, or this will harm reception later. At (B) is shown a 50 watt test lamp in series with the 110 v. line and test clips. This makes a better checker for variable condensers, for in addition to finding the shorts, it will "burn out" any loose filings or metal left between the plates. When hooking up the test lamp, test the clip from the lamp to ground to see if it lights. If so, this is the "hot" side, and you don't need to worry about burning out fuses. If you have an air hose around, it is a good idea to blow in between the plates to clear out lint, metal, etc.

3. Test the S. P. D. T. switch to see if it makes a contact on both sides. Sometimes new switches get past the inspector and are "open" on one side. In this case, you must take the switch to pieces and bend the contacts over to "make" the circuit.

MOUNTING CONDENSERS.

Mount condensers as low on the panel as possible, in positions shown. If you have condensers with a single-hole mounting you are lucky. If not, we prefer to mount condensers by flat headed screws directly on the panel. If condensers have holes in the bottom for base mounting, ignore them, as it would necessitate making a bracket. Drill a ¼" hole in the panel for the shaft.

If the condenser does not have holes drilled in the front, you may drill thru from front of panel into the frame of condenser, making the holes in condenser small enough so a 6-32 tap may be used on the condenser frame. This takes a #36 drill.

If condensers have holes already drilled, it is sometimes possible to scribe thru them onto back of panel. However, usually the plates are too close to the frame and this is impossible. It is then necessary to make a template.

Take a stiff piece of paper and make a ¼" hole in it for the shaft. Push shaft thru and mark the outline of condenser frame, and trim off. Slip paper back on again and center the holes on the paper. Remove the template and push shaft thru hole of panel from rear; push template over the shaft; arrange in correct position; mark holes on the panel. Center punch; drill with #50 drill; then #28 drill and countersink. Before permanently mounting the condenser you may have to enlarge the hole for condenser shaft to make it turn easily. Mount condenser solidly. Next cut and glue on the Dial scale, holding it off at a distance to get it on level. Mount Bar knob, which will protect the scale if panel is turned over on its face. This template business may seem a long process, but it is the only "sure-fire" method. At one time one could buy condenser templates that were self-adjusting.

MOUNTING THE SWITCH LEVER

A 1" radius is preferable. Draw a circle of 1" radius on a sheet of paper. Lay switch points, or rivets, around the perimeter to get the exact distance apart. Then, lightly scribe a 1" radius half-circle on the panel, and center punch for points the same distance as on trial sheet. Be sure to use a fine drill here first, because if points are off the least bit they may short or look badly from the front. Mount switch lever in the center, adjusting the arm to work easily by smoothing with a fine file and later greasing lightly with vaseline. Mark points for two switch stops; drill and mount. It is better to cut a small piece of tin about ¾" in diameter with a hole to fit under locknut, to solder onto. Solder flows very freely on tin. Adjust lever so contact is easy but firm. Do not hook the lead to moving shaft as wire will soon break off. Solder onto tin lug or bearing only.

MOUNT ALL OTHER PARTS

except coil in any convenient position. Mount the coil after wiring the balance of the set. Be sure to mount "SEL-BRD" switch in correct position to avoid trouble later. Terminal connections for the phones may be single Binding posts or tip jacks, as desired. If binding posts, place lugs and lock washers behind for soldering. Mount the crystal stand conveniently as shown with soldering lugs and lock washers at rear. It is more practical to solder the spring wire to the arm, then wrap the fine catwhisker around this arm to make a contact with the crystal. The heavy wire doesn't make a good catwhisker contact. It takes about a #36 wire for a good c/w for a Steel Galena crystal for best reception. It is always preferable to use a lockwasher on top of the lug before putting on the nut, so connections won't get loose in operation. In other words, make everything there to stay and set will work much better.

SOLDERING.

Use a good hot iron, preferably 100 watt electric if you have it. A gas iron is OK if you can get it hot enough. Keep iron away from celluloid coil. After heating the iron, file it a little —making a point similar to a thick screw-driver. Dip in soldering paste and apply solder to tin it. Wipe off with a rag. If not tinned good now, file a little back and forth, working solder into the surface of the point. As you work, dip the iron in paste now and then, and wiping off on a rag. Some keep the tip clean by rubbing over a Sal Ammoniac block or firebrick. When soldering, heat your work with the iron, and applying solder slowly with the other hand. Use plenty of solder; but not too much. You will soon get used to it and be able to do a good clean job. NEVER use Acid solder around a radio, as high-frequency currents will "crawl" from one connection to the other. It makes a neater job if you wipe the rosin off the joint when solder has set and joint is still warm.

WIRING NO. 2-A.

It is convenient to make a little "X" on the wire on your diagram as soon as you have wired a certain lead. This applies to wiring any kind of radio, as it saves time in re-checking. Use heavy stranded aerial wire (or busbar) for all wiring except coil leads and Aerial and Ground leads.

1. Run heavy bare wire from lug back of crystal cup to nearest phone binding post, keeping close to panel.
2. Another heavy bare wire from other phone B. P. to frame of condenser.
3. A bare, heavy wire from switch

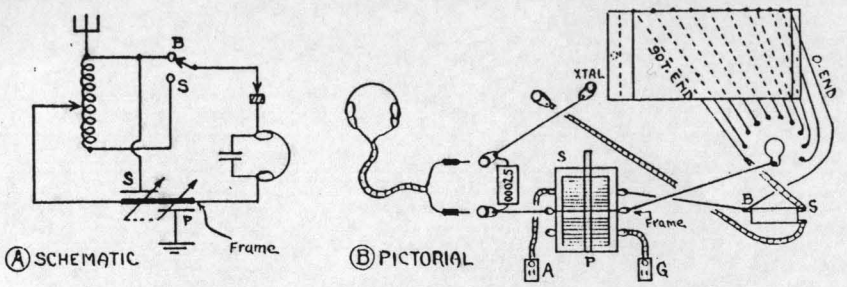

Fig. 4. #2-A Schematic and Pictorial Wiring Diagrams.

lever lug to frame of condenser on other side, keeping close to panel.

4. A spaghetti-covered heavy wire from crystal stand lug, and close to panel, to center tap of S. P. D. T. switch.
5. A heavy, bare lead from front stator lug of secondary condenser to BRD side of S. P. D. T. switch.
6. A spaghetti-covered heavy lead from SEL side of S. P. D. T. to #10 switch point.
7. A flexible, covered hookup wire about 6" long from other stator lug of secondary condenser to Fahnstock clip for Aerial connection.
8. Another of same kind from stator lug of primary condenser to Fahnstock clip for Ground connection
9. You may connect .00025 mica condenser across phone terminals close to panel.

WIRING NO. 2.

Make an "X" on the wire on diagram, same as #2-A, as soon as you have wired a certain lead. Use heavy stranded aerial wire (or busbar) for all wiring except coil leads and Aerial and Ground leads.

1. Run a heavy, bare lead from lug back of crystal cup to upper tip jack or binding post, keeping close to panel.
2. Run a heavy bare lead from frame of secondary condenser to the other lower phone tip jack, and then up to stator lug of primary variable condenser.
3. Run a heavy, bare lead from lug back of switch lever bearing, close to panel, and down to other stator lug of primary variable condenser.
4. A spaghetti-covered lead from secondary variable condenser stator lug up to BRD side of S. P. D. T. switch, keeping away from condenser plates when they rotate.
5. Run a heavy, bare lead from #10 switch point to SEL side of S. P. D. T. switch, keeping close to panel.
6. Run a spaghetti-covered, heavy lead from lug back of crystal stand, close to panel, and over to center tap of S. P. D. T. switch.
7. Run a 6" piece of flexible hookup wire from the outside stator lug of secondary condenser to a Fahnstock clip for Aerial connection
8. Run another 6" piece of hookup wire from the frame lug of primary condenser out to Fahnstock clip for Ground connection.

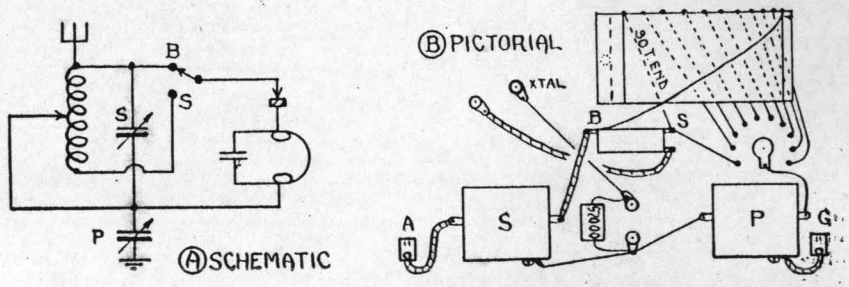

Fig. 5. #2 Schematic and Pictorial Wiring Diagrams.

MOUNTING COIL.

When ready to mount coil (see 2-A) reverse the leads, that is, bring the #90 turn lead down to SEL on S. P. D. T. switch and the beginning turn down to BRD on S. P. D. T. switch Rest of the coil leads same as 2-A.

WINDING THE COIL.

Due to Celluloid having a Hi-G when used in thin sheets, it makes the best form for a Crystal set coil. Our best DX records have been made with this kind of form. A form 2" in diameter by 4½" long is recommended Bakelite or cardboard is alright if you can't get celluloid. We have tried other sizes of wire than #22 and #24 D. C. C. but find them best. A larger wire cuts down the selectivity, while a smaller one increases selectivity but cuts down the volume. This is due to the higher distributed capacity between turns on the smaller wire.

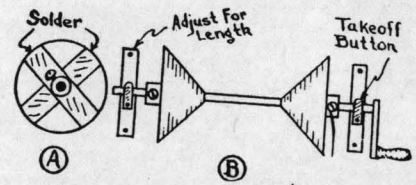

Fig. 6. Handy Coil winder.

While coil may be wound by hand. we prefer making a small coil winder as shown above. You always use it in Radio work later. NOTE: Always let cotton-covered wire slip thru a cloth or handkerchief when winding to keep it clean.

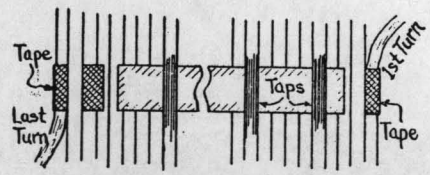

Fig. 7. Steps in Winding Coil.

MAKING TAPS.

Cut a strip of heavy paper, or light cardboard, ½" wide by 4" long for making taps. Also 2 pieces of friction tape 1" long and set aside. Take a piece of tape and form it over into a loop around the wire 6" from the starting end. Wrap first turn on and around over the end of tape—and continue for 5 turns; slipping paper strip under the 5th turn. After the 5th turn slip the paper strip up so turns can go under it, until you get to #10 turn Then, slip paper under again. Continue additional taps at 16, 23, 31, 40, 50, 61, 73 and ending at 90. Leave about 6" of wire for lead and cut off. SECURING LAST TURN. Holding the coil firmly, take off 1 turn. Make a loop of other piece of tape, and lay ends under turn #89. Then continue around again to #90—running wire thru loop in tape. Pull the wire with one hand and the tape ends with the other, until secured. Long-nosed pliers will help. For a final finishing, cut a piece of ½" adhesive tape 3" long and place over the tape ends and paper ends that stick up, and pull down on coil. Paint starting and finishing edges with a light coil cement. (Do not use Shellac under any circumstances). Varnish may do, but we prefer coil cement.

MOUNTING THE COIL.

When the coil is dry, drill a 6-32 hole in the heavy ring, or near the 90 turn end if wound on Bakelite or Cardboard. Drill it so that taps will come to the top of the set for easy wiring to the switch points or rivets. Run a piece of light sandpaper over the tapped leads to remove the cotton insulation. Tin the coil taps lightly before mounting the coil. Also, tin the switch points, using rosin-core solder only, as this is a vital part of the set, and a bad place for leakage. Do not use an excess of solder when soldering onto the points.

When coil is ready, push the 6-32 x 1¼" F. H. machine screw thru the hole for mounting coil and put on a nut. Then, fasten a similar nut up so coil will be raised above the switch lever, etc. Then, a lock washer and a smaller nut inside the coil. Screw them down well to keep coil from slipping later.

Take the #90 turn end and solder to #10 switch point, cutting off any excess wire. Pull it around the coil in the direction of winding before soldering to switch point. Next, solder the beginning turn to BRD side of the S. P. D. T. switch (NOTE: for #2 set, see "Wiring #2 set") for coil end leads.

Run the flexible wire from #9 switch point to #73 tap, allowing plenty of "dress" so it won't pull on the coil. Always solder to the switch

point first, not the tap. Hold the wire down with a small screwdriver and also feed the solder with the same hand. A little practice will do it. Hold the soldering iron with the other hand until you get a good globule of solder. Hold screwdriver until solder changes color. Then, attempt to pull off the lead. If secure, go to next one—wiping off the excess rosin, etc., from each joint. When soldering onto taps, pull the insulation back a little and tin the wire, and solder it lightly alongside the turns. Not necessary to wind it around for a good connection. Also, try these to see if they will pull off.

Then, solder from #8 switch point to #60 turn the same way, and so on.

MOUNTING THE SET.

After wiring up the coil, the set is finished. You may mount the set in a box or cabinet to keep the dust out of the condenser plates and the set clean generally. You may use an ordinary box with panel screwed on the front and Antenna and Ground leads fastened to binding posts on the back. If you wish, you may build a cabinet like we used to do, by halving the joints. Make a slot on the inside front edge and slip panel up from bottom and screw on bottom so it will hold panel in place. Temporarily the panel may be screwed onto a 1" board and held upright.

A good finish for the cabinet is to sandpaper it all over, making corners rounded on the top. Fill all holes with plastic wood and sandpaper again. Apply a flat white coat and let dry. Sandpaper again with a light sandpaper. Then, paint with one coat of Nu-enamel, which will dry thoroughly in a couple of days, to a glossy finish.

The Antenna System

No crystal set will work right without a good Aerial and Ground system. We have lots of reports of sets working on 6 ft. of aerial, bedsprings, etc., but it isn't recommended. If you get strong signals near a B. C. station, you will find lots of things that will give enough pickup. But usually too much aerial is better than not enough with a Crystal set. E. M. Sargent ("Radio" Feb. 1934) tells how in every case of extreme distance reception on a crystal set, was accomplished only with a large, high Antenna. Byrd in the Antarctic, used 1800 ft. of Aerial for better reception on short waves. This is contrary to short wave procedure, but the added pickup he got more than offset the frequency fundamental of the aerial. For country reception we prefer 100 to 150 ft. of wire, and as high as possible. Height makes more difference than length in distance reception. For city use, close to B. C. stations, use about 50 feet. It may be necessary to omit the ground connection if the ground wave of nearby stations is too strong. Also, if you are on the second floor, or higher, from the ground, it may be better not to use a ground connection.

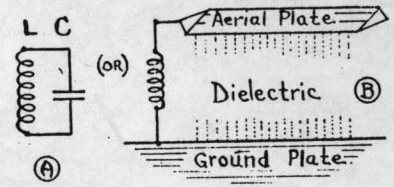

Fig. 8. Antenna system as LC circuit.

THEORY.

An aerial leadin and ground, together termed the Antenna System, is really a large condenser. The aerial acts as one plate and the ground the other. In Radio signals, the aerial is first positive and then negative, changing millions of times per second. In between the aerial and ground is called the di-electric. the same as a condenser, which in this case is air. The coil, which must be used in some form, is the inductance. If you draw it schematically as at (A) we will have a coil with a condenser in series, which makes it a standard oscillatory circuit. An aerial 30 feet high or less changes capacity very rapidly, the same as turning a lot of plates farther into your variable condenser. From 30 to 120 feet high the change in capacity is less pronounced, being only about 7%. For instance, an aerial 40 ft. high and 60 ft. long on the flat top gives about 178 mmfd. (.000178 mfd) capacity.

DIRECTIONAL EFFECTS.

On Short Waves the directional effect is more pronounced than on longer waves as the Broadcast band. There isn't much directional effect unless 100 ft. or more of aerial is used. The direction of best reception is from the leadin end. A "V" aerial, that is, one that has two wires running in an angle from the leadin, is derectional at the leadin also. A vertical aerial receives in all directions, if it receives at all. In the Bahamas one of our Fans (see "Reports by locations") reports on a vertical aerial 200 ft. high suspended by a lighthouse, and with the best of ground—salt water. He got nothing on a #2 set. However, when using a horizontal wire near there he sent in a good report on stations all over the U. S. A., and surprising the natives. A "T" aerial, with leadin from the center, receives in two directions best, from each end of the aerial. An Umbrella aerial receives in all directions well. It is a good idea to have a switch lever with several points, each running to different aerials. In this way you may see the difference in the reception of different stations.

PLACING THE AERIAL.

Keep the aerial above the ground as much as possible. Put one mast on the house and another on another building in order to have the wire run over the ground. Keep it away from buildings, trees, chimneys, etc., as much as possible. If you want, use a tree for the other mast, then run a guy wire out about 5 ft. from the tree foliage before fastening on the strain insulator. If tree sways in the wind,

you must use an aerial take-up spring, or a pulley and weight to allow for it. Aerials running over houses are OK if placed at least 10 ft. above the roof or chimneys. We have made extensive experiments with the old Harkness Reflex using a crystal detector, and found there was a great decrease in signal strength when aerials were placed closer than 10 feet from the roof. One mast may be used if desired, but we prefer to place it higher in order to get an average height.

AERIAL WIRE.

The higher the frequency (Short Waves) the more the radio signals travel on the surface of the wire. Low frequency (Broadcast or lower) penetrate the wire more. This is the so-called "skin effect" which is often mentioned in Radio theory. Therefore, it is necessary to have a good clean surface as large as possible for the signals to travel upon. Corrosion is detrimental to a good electrical surface. For this reason tinned or enameled wire is best. A tinned surface prevents the wire from corroding as quickly and forming Copper oxide, which is the black substance on bare copper. Enameled wire prevents corrosion by encasing the wire with a layer of shellac. If you scrape the enamel off wire that has been in the air for a considerable time, the wire surface will still be bright.

Getting more surface may be accomplished by using stranded wire. In this type the sum of all surfaces is taken as the final figure. On short waves stranded wire shouldn't be used unless of a pretty good size, due to the high resistance of the smaller wires. If you ever used Litzendraht wire, which is usually about 32 strands of #36 enameled wire, you will know that stranded wire is bad for short waves. So, if you are going to work on short waves, it is best to use about #12 or #14 solid enameled wire. If you prefer Broadcast or the lower frequencies, then stick to large stranded wire. As a compromise, it is alright to use 7/22 enamel or tinned wire for all bands, in preference to the 7/26 or 7/27 that is often sold.

INSULATORS.

While we prefer Pyrex glass for insulators, porcelain may be used. The regular strain insulators may be used for the aerial wires, as well as porcelain cleats. However, for strain insulators on the guys, be sure to use the Aeroplane type so if insulator breaks it won't let your aerial down.

ERECTING THE AERIAL.

Get a couple of 2x3 poles, or even 2x2 clear is OK, about 22 to 24 ft. long. Drill two holes in each. One about 3" from the end to hold the strain insulator, and another down 2 or 3 ft. to hold the three guy wires. Fasten the strain insulator on a wire about 2 ft. from the pole, and secure the other end thru the top hole. Cut three pieces of guy wire about 2 ft. long. Put the end of each securely thru the lower hole in correct position, so two will go to back corners of pole and the other one to the front. Secure an aeroplane strain insulator at the end of each wire. Then, fasten more guy wire on each, to run about half again as long as to end of the pole and cut off. Next, pull the aerial wire

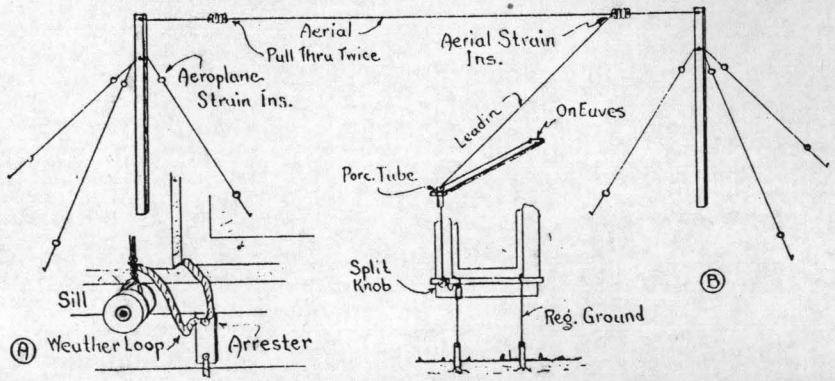

Fig. 9. Proper Installation of the Antenna System.

thru the other hole in the strain insulator and wrap all wires around the bottom of the pole. Have someone hold the pole up while you tack the guys down temporarily. When pole is up straight, go back and loosen one guy at a time, and up about 2 ft. fasten in another Aeroplane strain insulator. Then, fasten down the guy permanently with several nails or a large screw-eye. Do this with the other two, also.

Next, fix the other mast the same way, and fasten the aerial wire to the strain insulator. When this mast is secure, then go back to first mast and pull the wire taut and fasten down to split knob at the edge of building, or preferably, suspend out from the building as shown.

LEADIN.

Keep the leadin away from gutters, eaves, chimneys, etc. It is a good idea to use a piece of 1x2 about 4 ft. long with a leadin tube at the end to keep the leadin away from the building. Pull the leadin thru this tube and fasten down to a split knob at the window sill. Cut the wire off. If the leadin is too close to other objects, it tends to lose some of its collected energy.

Cut a length of leadin, or rubber-covered fixture wire, and solder the end above the split knob, making a good solid joint. Then, wrap with rubber tape and then friction tape to keep out the moisture, as soldered joints seem to corrode first. Bend a "V" just below the knob for a weather loop, enabling water to drip off that comes down the leadin wire. Run the leadin wire thru a notch under the window, or thru a feedthru insulator into the house. Staple it down to the baseboard to make it neat.

A shielded leadin may be used at certain times, if located in a building where elevators, etc., tend to cause interference. Of course, if you use a shielded leadin, the setting on your dial will be less due to the added capacity between the wire and the shield.

MULTI-WIRE AERIALS.

Many Fans wonder if several wires are better than one. We definitely say "yes," especially on a crystal set where all the pick-up necessary is required. Several wires give the benefit of more pickup, i.e., stronger sig-

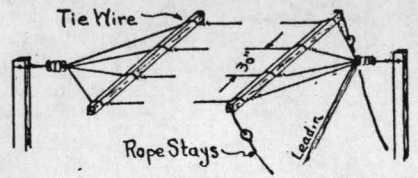

Fig. 10. Multi-wire Aerial.

nals, without adding more electrical length to the aerial. It must be remembered, however, that two wires don't give twice as much energy as one; nor 3 give 50% more than 2, but the difference is very noticeable, especially on DX. If I had my preference, I'd take the larger aerial and worry about selectivity, etc., on the lower end, rather than to have a small Antenna system without any energy to spare. Multi-wire aerials are the answer to a Crystal Fan's prayer on a small lot where he can't get a good line up high and long.

When you use Multi-wire aerials you will have to use spreaders. One time I saw a single wire aerial with a spreader at each end—why, nobody knows. Use a rigid, dry stick and arrange to have the wires at least 30" apart. Lay it out on the ground first. Drill holes thru the spreader and fasten them altogether at the strain insulator on each end. Serve a wire around the spreader at each hole to hold the spreader in place. It may be necessary to run a stay line at each end of spreader, insulated with an aeroplane strain insulator, to keep the spreader level. As many wires may be used as desired, but the usual number is about 4 wires. When using multi-wire aerials, be sure to use a heavy leadin wire—or several twisted together, or you defeat your purpose, as the energy collected can't easily get to your receiver.

TEMPORARY AERIALS.

An inside aerial may be strung around the picture moulding of a room if the signals are strong enough, or more selectivity is desired. This may be bare or covered wire as the room is dry and insulates well. Other temporary aerials may be a telephone box, lighting fixture, clothesline, wire fence, gas stove, switch plate, etc.

You may wrap a good length of insulated fixture wire around a lamp cord, that is in use, for several feet

to get a good pickup from the 110 volt line. Another method is to take an attachment plug and connect a .001 to .01—600 volt fixed condenser to one side. To the other end of condenser, run a wire to your aerial connection. Try the attachment plug first on one side of the 110 and then the other, as one side of 110 is grounded.

A copper or brass screen about 3 or 4 ft. square may be hung up for a temporary aerial. Hang it outside if possible. Ball antennas may be used, but with them, it was more of a selling stunt, as the short leadin was more effective in controlling selectivity than the pickup derived from the ball. Radiators or bedsprings may be used temporarily if signals are strong.

A loop may be used if large enough. Use only one end connected to the Aerial clip, as the use of the other to the ground clip will disturb the tuning. Swing it around until signals are strongest.

GROUND LEADIN.

For this part of the system, run another piece of leadin, or bare wire is alright, out under the window, keeping it away from the aerial leadin wire. No need to insulate it from the ground so it may be stapled directly to the house. If it touches metal, be sure to make a good connection, and not a noisy one. Fasten leadin to water pipe by means of a ground strap or clamp. The main thing about a ground leadin is that it should be as short as possible. If located on the upper floor of an apartment, or higher, it will be better to eliminate the ground altogether with this set. You know the signal starts from the far end of the aerial and oscillates down thru the set to the ground and back, millions of times per second. So, if you make the ground lead too long, it is the same as lengthening the aerial, and the set won't be as selective as desired, if near a high-powered station. Try the set with the ground off if near interference.

Years ago, with weak receivers and transmitters, it was customary to use a large, heavy ground leadin wire, about #8 copper. However, as the #2 set often works without a ground, the regular leadin, or fixture wire is just as good.

GROUND.

A nearby waterpipe is a pretty good ground, with a very little effort outside of clamping a ground strap or clamp around it. If using a strap be sure to clean the pipe good, and solder leadin wire to the strap. If the distance is too great to the waterpipe, drive a galvanized iron pipe several feet into moist ground near the set, and attach to this the same as the waterpipe. In dry weather it is a good idea to pour a little water around the pipe occasionally to keep a good connection.

A buried bucket, radiator or other metal may be used for grounds, provided a good soldered connection is made to the leadin. If the ground is noisy it will cause more trouble than no ground at all. Lots of the frying noise in a set is traced to this cause. If you think that is the trouble, remove the ground wire and see if it continues.

A well makes a good connection, but here again, the leadin may be too long. Years ago, when transmitters and receivers were less efficient, the Wireless stations ran grounds for miles out from the stations in different directions.

It is a good idea to have a switch lever hooked up with several points—each running to a different ground. Try one at a time on DX nights and you will readily see the difference. Some Fans prefer to connect all the grounds together. Of course, if the ground doesn't help, there is no need of experimenting with it on the No. 2. This may be a good idea, tho, on a set that does require a good ground.

A gas pipe usually makes a poor ground as it is made of plain iron pipe that is usually rusted or painted at joints, which isn't a perfect electrical connection.

COUNTERPOISE.

If located in rocky territory or on a desert, you may not be able to get a good ground connection, especially in dry weather. You may then try a counterpoise. There are several types. One type is just a wire thrown under the rug or around the baseboard, for a ground connection. Another type is a wire suspended a few feet above ground on stakes directly underneath the regular aerial. Some have laid it on the ground, using both insulated and bare wire. Some counterpoises run out in all directions made up of #16 copper wire or larger. Others bury insulated, some bare, wire just under the surface for this ground connection. There is a big variation in experiments along this line. A wire fence or clothesline may also be used as a counterpoise.

LIGHTNING ARRESTER.

In localities where lightning is prevalent, the Fire Underwriters require a lightning arrester installed on an aerial. Considering the very little trouble ever experienced by the average Radio Fan, they might just as well not be there. If in the city, the metal frames of buildings, towers, etc., will draw the static to the ground. In the country more attention must be paid to this problem, as most buildings are wood and very little metal in them. An aerial will not draw a strike of lightning, but on the contrary, will let the static leak off gradually to the ground, and may help to prevent a strike instead.

A lightning arrester is made up of two, or several points facing each other in a porcelain mounting. If you could see the inside of one of these during a hail storm you would see little sparks jumping across. However, the same effect can be noted by watching the sparks jump across the Primary condenser of the #2 during a hail storm, or if lightning is in the vicinity. It takes about 500 volts to jump an arrester. Unless heavy surges appear, the static goes thru the receiver.

When installing an arrester, place it under the split knob and run a large wire, well soldered to the aerial. Then, run a heavy wire direct to the ground from the arrester. When lightning strikes, it takes the shortest path to the ground. Considering the small number of accidents, there is very little danger.

Operation and Testing

If wired correctly, and crystal, aerial, ground and phones are in good condition, the set will work. Hook Antenna and Ground to back of set at clips. Hook phones in front. Place S. P. D. T. switch to BRD side. Run switch lever about 9 or 10 from left. Place catwhisker on crystal. Rotate condenser until a signal is heard. Readjust the c/w for sensitivity. When very sensitive, try a different switch setting and condenser adjustment You will find a particular setting best for each station. Make up a log card or log book as follows:

Call. Location	Mls.	Date	SEL-BRD	Sw. Pt.	Dial	Remarks
KSFO S. F.	15	11/1/44	S	9	80	Low volume

DAYTIME RECEPTION.

If you get a faint click when you touch the c/w to crystal, the set is probably in good working order, but you may be too far away from a station of high power. You must remember that at night reception is several times greater than that obtained in the daytime. If you are in a canyon and remotely situated from high-powered stations, you may not get anything in the daytime. At night when you start picking up stations, make a note in your log book, then try them the next day. It is possible you "slid" over them during the day. If you are located in a broad, flat valley you will be surprised at the daytime reception However, if located in and around hills or mountains, the signal may be absorbed before it gets to your set.

FADING.

All sets fade in and out on distant stations. This is more noticeable at night because of the distance covered. However, there is also fading in the day, but if you are fairly close, say 150 miles from a transmitter, you probably won't notice any fading during the day. Fading is no fault of the set, but is a reflection of the transmitted signals on the ionosphere, which is above the Stratosphere, and running to some 750 miles above the earth's surface. Short waves are reflected up to 175 miles high; Broadcast up to about 60. As this layer of gas moves up and down it changes the angle of reflection, so that your location may be strong one time—a few miles away it may be strong the next instant.

At night you will notice different degrees of fading from different directions. Around S. F. Bay, Salt Lake (700 miles) to the East of here fades out twice as long as does Los Angeles (400) to the South. The fading in highpowered sets is taken care of by means of the Automatic volume control which changes the bias on the set when signals are weak. When signals come in and out slowly, this is fading. When they click in and out sharply, you have a broken joint in your aerial that is being swayed by the wind. Different locations, conditions, soil, moisture, time of year and day, all make a difference in reception. This is too big a subject to be covered here.

NO SIGNAL

1. Be sure to test phones as described in "Checking Parts," as phones are the greatest sources of trouble, especially if they havent' been used for some time.
2. Be sure the S.P.D.T. switch is positioned right on the panel, because if turned around it will break connection between the tuning circuit and the Crystal.
3. A shorted variable condenser will stop signals only at point of contact.
4. If set is wired improperly it will result in a variety of troubles.
5. If switch lever doesn't make contack.
6. If no click is heard when c/w is touched to crystal when set is all connected up to Aerial and Ground, this usually shows a poor crystal or poor connections or phone trouble.
7. Reversing the leads to the coil will let the set work, but reception will be erratic.
8. A broken aerial connection near set will also cause no signal, as it usually needs 25 to 150 ft. of wire to work properly.
9. Move c/w around on crystal — some crystals are better than others.
10. Did you get phones in front; and Aerial and Ground at rear?

FREAKS

Anything that is unusual is usually called a freak, altho each has its scientific explanation. At one of our locations we found that by lifting the c/w off the crystal we could hear the nearest B. C. station coming in. I wasn't 'hearing things' as others heard it on several occasions at this location. There was either a loose joint in the Antenna system, that had become corroded, or a similar joint on the Radio panel board above the test bench. This is the principle of a razor blade working on carbon rods, or a needle across two carbon edges. It is the principle of "imperfect contact detectors"—which we hope to discuss in other booklets.

.00025 FIXED CONDENSER.

Adding the .00025 fixed condenser across the phones may not give much more volume, but may help in operation. If too large, it will lower the tone and bypass too much Audio (low) frequency across the phones. A .00025 will smooth out the "hills and valleys" of the received signal and make it more near to the transmitted signal. You may try a larger size up to .006 mfd. etc. and see how it changes the tone.

PHONES.

Many Fans ask what kind of phones are best. Any kind of good, sensitive phone is alright. The more sensitive the phones, the better the reception. While some prefer to use a single phone on account of its light welght, I believe a double headset is preferable as other noises are shut out, and you can listen with your good ear as well as the other!

As to resistance of phones, the higher the resistance, the more sensitive. A 4000 ohm headset isn't twice as noticeable as a 2000 ohm, altho there is considerable difference. It means more turns of finer wire — giving a stronger magnetic field to pull down the diaphragm. Many are confused by resistance and impedance rating of a phone. Impedance is a value of opposition to the flow of alternating current where the circuit contains resistance, inductance and capacity. Phones of 24,000 ohms impedance are about 5000 ohms D. C. resistance. Phones of 20,000 ohms impedance average about 3000 ohms D. C. resistance. This is only comparative, but is close enough. Standard 24,000 ohm impedance phones are about the best that can be used on a crystal set. However, if you can get a set of Baldwin mica diaphragm phones that were manufactured several years ago, we believe they are of equal sensitivity.

When phones are connected to the output tube of a strong set in the wrong direction, they will often become de-magnetized, especially if the magnets don't contain the right kind of steel. These phones, if used on a crystal set, will produce very poor results, which are often blamed on the set. If your phones produce a good, healthy click when touched to a dry cell you can be assured of their performance. Reversing polarity of phones is rarely noticeable, altho it may be tried. This is just a matter of switching the tips.

Another good point is thin diaphragms. If you use diaphragms of thick steel — your phones will be less sensitive to weak signals.

Some Fans have asked about Crystal ear phones, which contain a quartz oscillating crystal. They may be used if an output transformer is matched to the crystal phones, and the primary connected where the phones are now.

Several phones may be connected in series. Do not connect in parallel or the signals are diminished in volume.

SPEAKERS

A large, old-fashioned, horn-type speaker is the best, in case you want to try it out on loud signals. We have reports of 500 miles on a speaker. On certain clear nights some DX stations may come in loud enough for a speaker, but we can't say that in every location you will get speaker reception. If signals are loud enough in your phones to lay them on the table and hear music about the room, you can operate a magnetic speaker. Phones may also be placed in a bucket or dishpan for amplification. Magnetic cone speakers usually dissipate too much energy in the paper cone to be good for crystal set reception. "PM" or Permanent magnet speakers may be used if

the correct output transformer is used, but generally too much loss in the transformer to get loud signals. Dynamic speakers must have an outside D.C. source to energize the field coil, and may also be used if the proper output transformer is used to match the voice coil of speaker. A sensitive earphone may be placed in a horn for good operation, or inside a box so that the sound is reflected out.

SHORT WAVE RECEPTION.

All the real D. X. records of the #2 have been made on Short Waves, as from London, Berlin, Paris, Rome, etc. They have been reported for hours, so they aren't re-broadcasts, which seldom occupy over 15 minutes' time. You will find the S.W. stations down around the lower switch points, and we prefer to use the regular #2 with two variable condensers. It is probable that the S.W. reception can be had on the 2-A but we haven't had it out long enough to get a lot of reports.

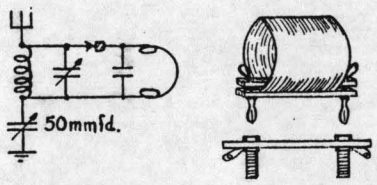

Fig. 11. A Short Wave Experimental Circuit

A variation of the #2 for Short Wave reception is shown. If you use large plug-in coils, using Banana plugs on each end, which fit into jacks, you should get S. W. alright. 2" celluloid forms are OK for Broadcast band. For 160 and 80 meter bands, about 1½" in diameter is preferred. For 40 meter about 1" in diameter; 20 meters about ¾" in diameter. Use wire as large as possible, preferably cotton-covered, close together. If you can make a collapsible form and reinforce coils with celluloid strips, you can make a very nice and efficient coil. Clamp coil with bakelite or celluloid strips to Banana plugs. The idea of the tapless coil is the elimination of the dead-end effect caused by unused turns in Short wave circuits. An iron pyrites crystal is preferred for S. W. reception, altho very good results may be obtained with Steel Galena.

CRYSTAL & CATWHISKER.

For best operation we prefer a good sensitive Steel Galena and fine catwhisker, about #36 wire to go with it for contact. Steel galena has the same chemical nature as plain Galena, but it is formed differently, — looking like a steel rod that has been snapped off. If it particularly efficient because it is usually active over its entire surface. A small piece is usually more sensitive than a large one.

Plain Galena, on the other hand, may be more sensitive in spots near the edge than Steel Galena. However, there are other spots a short distance away that are dead. Plain Galena is made up in cubical layers that may be easily broken apart. This takes a very light touch for efficient operation. However, a click of an electric light, or heavy static, or a slight jar may easily knock it out of adjustment.

Iron pyrites is good for Short wave work, according to reports of Fans. It isn't critical in adjustment, altho not as sensitive as Steel galena. It is used for most fixed detectors because it may be fixed with a heavy brass spring wire for catwhisker.

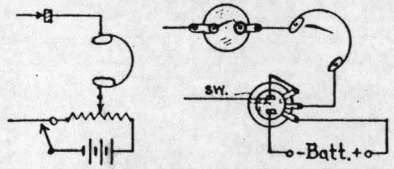

Fig. 12. Carborundum Crystal Circuit.

Carborundum may be used when a battery is used in conjunction with it. The battery is adjusted for voltage by means of the volume control, which may be a 1000 or 5000 ohm control with a switch to cut off the battery when not in use. Reverse polarity of crystal to see which side works best. From 1½ to 10 volts of battery may be used satisfactorily. As far as we know Carborundum and Iron pyrites are the only crystals now used for fixed detectors. Sometimes Carborundum may receive signals without a battery, but the extra current is preferred.

WAVE TRAPS.

There are several ways to use wave traps with the No. 2. Trap may be made on a form 1" diameter and 1½" long covered by 110 Turns #32 enameled wire. Over this about 15 turns of #24 D.C.C. space-wound. They are used for extreme cases of interference. At (A) one is in the primary circuit — several may be used in series if desired. At (B) it is used in the secondary circuit. Both of these operate by setting the condenser on the station not wanted and it will fade down or cut out, and are called rejector traps. Then, tune rest of set as usual. At (C) is a booster trap which is coupled loosely to leadin and tends to boost the signals when condenser is tuned to signal. Condenser is changed for each signal. This type is called an acceptor trap.

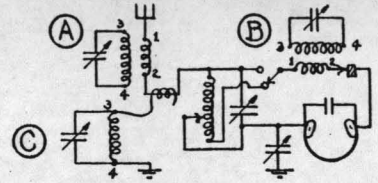

Fig. 13. Use of Wave Traps with the No. 2.

Theory of Circuit

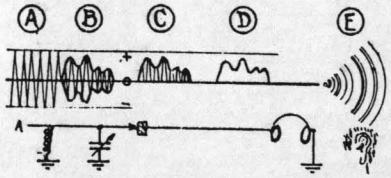

Fig. 14. The Received Radio Signal.

THE RADIO SIGNAL.

A transmitter, by using tubes similar to ones in a standard receiver except much larger, generates a carrier wave of high frequency (A). This is what we have to tune to in our receiver. Upon this carrier wave (which it really is) is generated sounds of an Audio or voice frequency which are 'carried' along on this carrier wave (B). It is tuned by our taps and condeners to the same frequency as the transmitter of this signal. At the transmitter the carrier is modulated by voice frequency, while the crystal detector demodulates the carrier (C) as we have no further use for the carrier after it reaches the detector. A crystal detector is no different, fundamentally, than a tube detector as both are rectifiers, which let the oscillation pass in one direction only. So, it cuts off one-half of the modulated wave and uses either the positive or negative side. When we have cut off one-half of the modulated carrier, the resulting signal energizes the diaphragm of the phones (D) and it can be heard as audio (audible) or voice frequency. (E).

The crystal set uses no outside power, other than that coming from the aerial and ground. The signal is so minute that no instrument will measure it directly, — being in millionths of a volt.

APERIODIC CIRCUITS.

"Aperiodic" means not resonant to any particular frequency. An Aperiodic circuit is said to be untuned. When another tuned circuit is placed near it, or in inductive relation to it, the tuned circuit will influence, or tune the Aperiodic circuit.

At (A) we have an untuned, or Aperiodic primary, — the circuit being tuned by the secondary. This is the conventional tube set layout to the first Radio frequency tube or first detector in a Superheterodyne. In an AC-DC midget set, where very little aerial is required, this is made up in the set by using an unusually large primary winding. While the larger primary increases the fundamental frequency of the Antenna system, it is still considered to be Aperiodic. By tuning the primary of a tube set we will overload the grid of the first tube. Consequently, set manufacturers prefer to add more amplification later and keep the input load light. In a crystal set, however, the more energy the better Therefore, this is not an efficient circuit for a crystal set.

At (B) we have a tuned primary, which influences the secondary which is Aperiodic. There are several ways of tuning the primary. In the 1920's a tap switch was used on the primary to partly tune it, and it helped a lot in selectivity. Another method is to have a variometer in series with the primary coil, which also tunes it. Also a fixed condenser may be used, with a variometer in series with it and primary coil. In the old Honeycomb coil circuits a primary was used the same as the secondary — and both tuned in parallel with a .001 (43 plate) variable condenser. This was most efficient on the long waves. As said above, a tuned primary will increase the response of any set, and this is particularly desired in a crystal set.

In (C) we have a tuned circuit in-

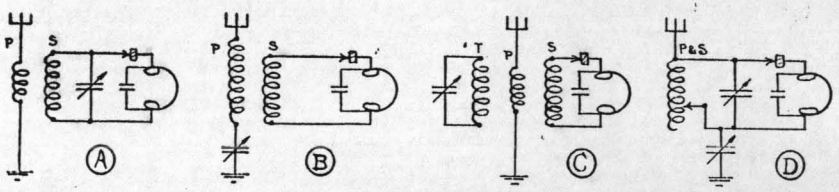

Fig. 15. Tuned and Un-tuned Crystal Circuits.

fluencing a primary and secondary, both of which are Aperiodic. This is given just as a variation. This is also the princple used in Fig. 13 (C). This was used in the old German Telefunken circuits in the early days of Radio.

In (D) we have the tuned primary and secondary as used in #2 circuit.

COUPLING.

Coupling is another feature of a circuit that influences operation. When two coils are placed close to each other, or one winding over the other, they are said to be 'close-coupled.' This gives the greatest transference of energy, naturally, from one circuit to the other. Close-coupled circuits transfer the most energy, but tend to broaden the tuning. Loose-coupled circuits transfer less energy but make the set more selective. As in a tuned primary circuit, — close coupling is desired in order to give the greatest transference of energy.

AUTO TRANSFORMER.

Auto means 'self.' A coupler of primary and secondray circuits may not necessarily consist of two coils, each separate from the other. It may be wound of one continuous coil as in the #2 circuit. In an auto transformer part of the winding is the Primary and part the Secondary. You will notice this feature in a crystal set having two or more sliders — how the primary slider will tune differently than the secondary one. The only difference in the #2 circuit is that we use the whole coil for the primary and the secondary.

NO 2 CIRCUIT.

Therefore, in the #2 we use the circuit of (D) — which gives us a tuned primary. This is evident in the sharpness of the primary condenser tuning. If it didn't tune the primary circuit, there would be no relative change over the entire range of condenser. As explained above, a tuned primary allows more energy to transfer to the secondary than an untuned one.

Also, we get close coupling between the primary and secondary because the circuit uses an Auto-transformer which is 100% in close coupling. The greatest transference of energy of a coupled circuit.

You will also notice as you tune the secondary condenser in the regular 2-dial #2 the primary follows along with it. Therefore, we have ganged them up in the 2-A circuit. To a certain extent they are in series — that is, the tuned secondary is in series with the primary condenser. We have tried trimmers on the 2-A cicuit, but find them of no use, as the changing of one condenser automatically changes the other, so there is no apparent reason for using two condensers singly operated.

PRIMARY CONDENSER.

The cut shows the theoretical variations of the primary condenser circuit. At (A) we have the condenser tuning and with a ground connected. We have a tiny bit of capacity between the aerial and ground across both tuning circuits.

In (B) we have the primary condenser cut out — by just taking off the ground connection. This gives us an Aperiodic primary, which in most cases, makes the set more selective. as no ground wave is picked up.

At (C) we have the ground condenser shorted — shorting the circuit to ground. We have a partly Aperiodic primary and partly tuned, or influenced by the secondary tuning. In this case you will notice a great variation in setting on your dials, due to the changing of the primary circuit. You have taken out your condenser, which cuts the Antenna system in two, and added all this length to your primary circuit. Therefore, your settings should be lower on the dial, the same as adding more plates to secondary variable condenser. Shorting the primary condenser may be done by bending the tip of one rotor plate so it shorts condenser when it is turned clear in. This may help in the country if away from high-powered stations, but near them it will make your set extremely broad tuning.

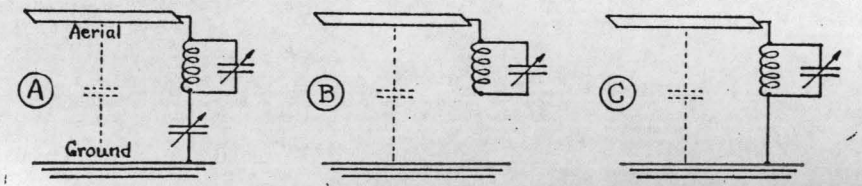

Fig. 16. Use of Primary Condenser.

Records by Locations

The following reports are taken from testimonial letters on file. Our letter file on this set is over 6" thick. Due to lack of space, there are hundreds of reports not shown — but following are the best distances for these specific locations. Numbers in parentheses are approximate air mile distances. Also many that report exceptional local reception and selectivity are not shown. It must be understood that some spots are ideal receiving locations; while others a short distance away may be worse or even better. Also, some of these reports have been made once, while others have been made nightly. No guarantee of distance is made. Consistent reception is given preference to freak reception.

Some people question the value of testimonials. The best argument is that nobody would boost anything that wasn't satisfactory. If you were disappointed in a set, would you write in boosting it to the ceiling?

OUR BEST RECORDS

(Note: Del Rio is given as name for old XERA, Mexican Station.)

7000 MILES. Ohio, Columbus, A. M.: "Longest DX is PNI, Makassar, Celebes Is., East Indies, at 4 a. m. He was calling PI17 in Java. Also KGU, Honolulu (4500) and long list of U. S." (Reported once, only.)

5800 MILES. Mich., Inkster, C. P.: "Berlin (5800) for 20 min. on 10 meg. London (5300) on 25 m. for 5 min.; in 31 meters for 2 hrs.; 49 m. for 15 min. Every night I get Boston (625) on 31 m."

5500 MILES. Ind., Glezen, W.A.B.: "London (1500); 1 in Cal. (1900); & more."

5500 MILES. Va., Mt. Solon, D.M.C.: "Berlin (5500); Rome (5300). 130 ft. ant. 30 ft. high."

5300 MILES. N. Y., Brooklyn, F. B.: "Berlin (5300); 2RO Rome (5100); London (4800); Paris (4800). Some stations crowded others out, so this shows they were not re-broadcasts."

4700 MILES. Mass., New Bedford, W. D.H.: "London (4700); airplanes, etc."

4250 MILES. Canada, Ont., Hamilton, B. E.: "CP-5 Bolivia (4250); Cuba (1250); W8XAL, W3XAL, W3XAU, W8XK, W3XL, Police in Ohio (400); Amateurs by the hundreds."

OTHER GOOD RECORDS

ALA., Taff, W. S.: "Mexico (1000); Ohio (400) on speaker."

ARIZ., Holbrook, C. S.: "Dallas (800); Okla. City (725); L. A. (450)"

Phoenix, E. S. L.: "Texas (800); L. A. (450)."

Safford, L. M.: "L. A. (600); Salt Lake (600); Mexico (600)."

ARK., Dumas, E.H.B.: "Chicago, Cin., (700); Mexico (650)."

Mt. Ida, C. S.: "Mexico (700)."

AUSTRALIA, N. S. W., South Cardiff, W. N. C.: "Beats all Australian circuits."

BAHAMAS, Nassau, B.H.L.: "300' ant. N. Y. (1600); Cin. (1400); N. Car. (1100); N. Orleans (1000); Also Miami (400) daytime thru static. Created quite a bit of excitement."

CALIF., Alpine, F. W.: "600 miles, including Mexico."

Calexico, C. F. C.: "Texas (1000); Salt Lake (700); S. F. (600)."

Campo, F. C. C.: "S. F. (500); Mexico (200)."

Chico, J. M. N.: "Salt Lake (550)."

Del Paso Heights, A. P.: "Denver (900); L. A. (400). Local on speaker."

Earlimart, C. S.: "Salt Lake (550)."

El Granada, F. F. C.: "Tia Juana (500)."

Eureka, B. R.: "Had 16 phones on #2. L. A., Salt Lake (600); Reno (250)."

Fresno, J. E. L.: "1 mile from KMJ get L. A., S. F. (200) on inside ant."

Grizzly Flats, H. M.: "Salt Lake (500)."

Guerneville, L. B.: "Salt Lake, Seattle, Mexico, San Diego (650); Auto radios must use full volume up here. 130' antenna."

Hanford, Dr. C. C. C.: "Denver (900); Salt Lake (700)! Denver more consistent than on our electric set."

Huntington Park, J. S.: "Del Rio (1100)."

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June Lake, J. H.: "Salt Lake (450); L. A. (300)."

King City, E. G. O.: "Writer played L. A. (250); S. F. (125) with aerial across top of two chairs."

Los Angeles, H. B.: "Denver (850); Salt Lake (600); S. F. (400)."

Miramar, J. Y.: "S. F. (500)."

Oakland, C. H.: "Salt Lake (750); KGEI on S. W." (author played Salt Lake during blackout."

Ramona, B. G. G.: "Denver (850); Salt Lake (600); S. F. (400)."

Roseville, F. A. D.: "Salt Lake, L. A. (750); S. F. anytime."

Sacramento, C. S.: "W6AM (400) on S. W.; S. F. (100)."

San Francisco, J. E. O.: "Seattle (750); Salt Lake (650); Locals Speaker."

Sebastopol, A. O.: "Spokane (750), a 5000 watter."

Smartville, H. A. B.: "L. A., Tia Juana, Salt Lake (750); S. F. (150) days."

Stockton, J. T.: "Denver (900); Salt Lake, Tia Juana (550); Locals, speaker."

Terminal Island, W. A. S.: "Salt Lake (600) at 3:30 a. m."

Yucaipa, L. D.: "Del Rio (1250); Sacramento, Salt Lake (500); S. F. (400)."

CANADA, ALTA., High Prairie, B. M.: "2 in Salt Lake (750); 3 Seattle (500); Portland (550)."

ALTA., Vegreville, M. N.: "S. F. (1250); Denver (1000); Salt Lake (900); Seattle (600); Spokane (525)."

ALTA., Youngstown, F. S. E.: "Del Rio (1800); Cin. (1700); Chicago (1500); Des Moines (1300); S. F., Denver (1100); Salt Lake (900); Winnipeg (850)."

MAN., Treherne, G. B.: "18 BC including Del Rio (1500)."

N. B., Fredericton, D. C. W.: "Cin. (1350); Chicago (1075); Detroit (820); Pitts., Toronto, Roch. (700); N. Y. (500); Montreal (300); S. W. BC to (755)."

ONT., Brower, C. B.: "St. Louis, Des Moines (1200); Chi., Cin. (900); Cleveland (700); Rochester (500)."

ONT., Markham, A. S.: "Del Rio (1600); St. Louis (700); Charlotte (600); Chi. (440)."

ONT., Toronto, T. H. N.: "Del Rio (1600); Des Moines (725); St. Louis (600); Louisville (500)."

SASK., Grayburn, W. G. R.: "Salt Lake, Des Moines (1300); Minn. (1080); Denver (900)."

SASK., Mikado, A. R.: "Toronto (1300) Des Moines (900); Salt Lake, Denver (750)."

SASK., Southey, V. P.: "Toronto (1300); Salt Lake (800); Minn. (700)."

COLO., Brighton, R. K.: "Del Rio (800)."

Grand Junction, M. F.: "L. A. (650); El Paso (550); Salt Lake (200)."

Hale, W. G.: "Chi. (800); Texas (750)."

Timpas, C. R. W.: "St. Paul (800); Tulsa (700)."

Whitewater, R. R.: "Del Rio (800); S. F. (750); L. A. (650)."

CONN., Bridgeport, H. C.: "N. Y. (150)."

Hartford, C. W. B.: "Cleve. (500); Richmond (400); Balt. (275); N. Y. (100)."

Stratford, C. J. C.: "Cin. (700); N. Y. (100)."

Waterbury, T. E. H.: "Chi. (800); Cin. (650); Cleve., Det. (500); Balt. (250)."

FLORIDA, Jacksonville, H. R. K.: "Del Rio (1100); Detroit, Chi. (900); Phily (800) Abilene (800)."

St. Petersburg, J. L. S.: "Cin. (975); Nash. (850); Shreve. (700); Raleigh, New Orleans (625); Atlanta (500)."

HAWAII, Honolulu, V. D.: "S. F. (2400)."

Napoopoo, M. F.: "Honolulu (600)."

IDAHO, Jerome, E. C. B.: "Des Moines (1100); L. A. (650); S. F., Sacramento (500)."

Orofino, J. H.: "Denver, S. F. (750); Salt Lake (500); Calgary (300)."

Sweet, R. W.: "L. A. (700); Salt Lake (300)."

ILLINOIS, Benld, H. H.: "Ft. Worth, New Orleans (650)."

Mt. Carmel, J. H.": Del Rio (1200); San Ant. (850); Ft. Worth (600); Charlotte (500); Tulsa (400)."

Pearl, R. M. D.: "Del Rio (1100); St. Louis (180) days."

Petersburg, L. R.: "Del Rio (1100."

Trenton, R. L. H.: "Del Rio, Reynosa (950); Cin. (400); Nashville (300)."

INDIANA, Fort Wayne, R. H.: "Cin., Detroit, Chi. (300)."

Gary, J. P.: "Del Rio (1200); Schenect., Newark (750); Nashville, Toronto (400); St. Louis (275)."

Hagerstown, A. M.: "Nashville (300)."

Jeffersonville, E. B.: "Reynosa (1000); San Antonio (950); Dallas (800); Newark (610); Detroit (450)."

Michigan City, J. W. E.: "New Orleans (1000)."
Middletown, J. L.: "Havana (1400); Del Rio & Mexicans (1350); San Antonio (1220); Denver (1125); Ft. Worth (900); NY (730); 230' antenna."

IOWA, Colfax, R. D.: "Del Rio (1000) using bedsprings."
Dayton, D. P.: "Stations 3000 miles away." (not specified).
Lineville, A. W.: "Del Rio (1000)."
Soldier, J. C.: "St. Louis (400); St. Paul (250)."
Udell, E. G.: "Boston (1200); Dallas (600)."
Victor, F. R.: "Del Rio (1000); New Orleans (800)."

KANSAS, Thayer, L. G.: "Salt Lake (850); Cin. (750); Del Rio & Reynosa (650); Nashville (600)."
Wilsey, W. B. A.: "Salt Lake (1000); Del Rio, Nueva Laredo, (750); Ft. Worth (500)."

KENTUCKY, Louisville, A. H. E. (W9-NBD): "Salt Lake (1400); Del Rio, Reynosa (1100); Denver (1050); Hartford (800); Newark, N. Y. (650); Pitts., Detroit, Charlotte (350); Atlanta, Chic. (300), on 40 m. Zepp. antenna."

LOUISIANA, Baton Rouge, H. D.: "Cin. (750); Del Rio, Reynosa, N. Lauredo (600); Nashville (500); Dallas, Atlanta (400)."
Houma, B. L.: "Muskegon (1000); Cin. Del Rio, Reynosa (700); St. Louis (600)."
Lafayette, J. W.: "Cin. (750); St. Louis (650); Tulsa, Dallas, San Antonio, Del Rio, Reynosa (500) and 15 others."
Larose, D. E. S.: "Chi. (850); St. Louis (600), on low aerial."

MARYLAND, Baltimore, C. C. T.: "Montreal, Reynosa (1500); Minn. (1000)."

MASS., Chelsea, M. M.: " 200 miles."
Manchester, R. S. M.: "Chi. (850); Charlotte (750); Cleveland (550); N. Y. (200)."
Shirley, G. W. H.: "Cleveland (550); Washington (400)."

MICHIGAN, Caro, J. C.: "L. A. (1875); Nashville (500)."
Hamtramck, H. K.: "Minn. (600); Louisville (300); Chicago (200); Cin. (100)."
Kalamazoo, J. A.; Mexico (1300)."

MINN., Brandon, R. N.: "N. Y., S. F., L. A. (1500); Hot Springs (750); Chi. (450)."
East Grand Forks, P. K.: "Del Rio (1300); S. W. B. C."
Farmington, G. A.: "Mexico (1000); Denver (620); Chi. (300); Hams in S. F."
Forest Lake, C. E.: "Del Rio (1500)."
Hills, J. P.: "Del Rio (1100); Salt Lake (900); Ft. Worth, Pitts. (800); Cin. (700); Denver, Detroit (600)."
Oslo, E. H. M.: "Del Rio (1250); Dallas (950); Rochester (800)."
St. Paul, A. P.: "Mexico (1250)."

MISSOURI, Farmington, F. C.: "Del Rio, Reynosa (900); San Antonio (750); New Orleans (575); Ft. Worth, Dallas, Shreveport (500)."
Jefferson City, W. J. Y.: "Del Rio (1000); Denver (700); Charlotte (600)."
Kansas City, W. G. S.: "Mexico (800); New Orleans (700); Cin. (500)."
Logan, P. V. N.: "Cin., Charlotte (1000); Mexico (800)."
Oregon, M. B.: "Del Rio, Nuevo Laredo (900); San Antonio (800); Ft. Worth (700); Detroit (500); Del Rio on speaker."

MONTANA, Circle, W. D.: "Del Rio (1400); Dallas (1150); S. F. (1100); Chi. (1000); Tulsa (950); Albuquerque (900); Des Moines (750); St. Paul (650); Salt Lake, Ogden, Denver (550)."
Sand Creek, W. D.: "L. A. (1100; Chi. (950); Minn. (725); Des Moines (635)."

NEBRASKA, Blue Hill, L. O.: "Pitts (1000); N. Orleans (900); Cin. (750); Salt Lake (700); Chi. (600); Dallas (550)."
Crofton, D. D. B.: "New Orleans (1000); Salt Lake, Cin. (750); St. Paul (300)."
Fremont, D. S.: "Cin. (700)."
Nelson, D. C.: "L. A. (1200); N. Orleans (900)."
Pawnee City, W. B.: "Del Rio (800); Cin. (700); Dallas (500); Denver (400)."
Springfield, W. R.: "Del Rio (950); Cin. (700); Denver (500)."
Valparaiso, B. J.: "Cin. (700) on bedsprings."

NEVADA, Fallon, E. C.: "Mexico (1250); Denver (600); L. A., S. F. (500), Alameda Police (500)."

NEW JERSEY, Summit, N. C.: "Chi. (750); Des Moines (600); Detroit, Cin. Cleve. (500)."

NEW MEXICO, Alamogordo, C. S.: "San Antonio (450)."
Portales, M. V. D.: "Augusta (1250); Cin (1100); Chi. (1000); L. A. (850); Denver (400); Del Rio (350)."
Santa Fe, E. G.: "New York (1800)."

NEW YORK, Buffalo, S. P.:. "Charlotte (550)."
Cape Vincent, F. S. W.: "Charlotte (675); Chi. (625); Cin. (560); Cleveland, Detroit (325)."
Chelsea, C. M.: "Cleveland (400)."
Pittsford, F. S. H.: "500 miles."
Utica, F. P.: "Richmond (450)."

NORTH CAROLINA, Marion, T. F. J.: "Portland police (2500)."

NORTH DAKOTA, Benedict, O. D.: "Cin. (1000); Chi., Salt Lake (750); Denver (600); Des Moines (500); Minn. (400)."

OHIO, Bettsville, D. Y.: "Cin, Louisville, Toledo, Charlotte (500)."
Bradford, R. W.: "Tulsa (600); Des Moines, N. Y. (500); Cin. Pitts., St. Louis (400); Chi. (300)."
Elyria, C. C.: "Mexico City (2050); Del Rio, Havana (1330); Denver (1250); Ft. Worth (1050)."
Ironton, B. S. B.: "Denver (1200) several times."
Middleport, C. G. S.: "56 U. S.; 7 Canadians; 3 Mexico, 1 in Cuba."
Newark, C. G.: "N. Orleans (900); Richmond (350)."
Russells Point, J. H.: "Richmond (535); Phily. (474); Nashville (468)."
Tiffin, H. D.: "Cuba, Del Rio (1350); Denver (1150); N. Orleans (900); St. Paul, Newark, Des Moines, Atlanta, Charlotte (500)."
Toledo, S. S.: "St. Louis (450)."
Wellston, V. F.: "Charlotte (900) daytime."
Youngstown, M. J. S.: "Louisville (420); Cin. (300)."

OKLAHOMA, Bartlesville, M. L. S.: "Cin. (750)."
El Reno, A. C.: "Del Rio (500)."
N. McAlester, M. O.: "Del Rio (600)."

OREGON, Drain, E. T. C.: "Saskatoon (1000); Vancouver (400)."
Eugene, G. W. F.: "Salt Lake (625)."
Lebanon, J. J. L.; "Cin. (2100); L. A. (800); Salt Lake (700); Seattle (250)."
Scio, J. B.: "L. A. (800); Salt Lake (700); S. F. (500); Sacramento (400)."
Shaniko, C. D. F.: "L. A. (650); S. F. (500)."

PENNSYLVANIA, Easton, K. H. P.: "Chicago (600)."
Joanna, B. P.: "Chicago (500) at 6:30 p. m."
McDonald, A. S.: "Del Rio, Reynosa (1450); St. Louis, Atlanta, Nashville (500)."

PHILIPPINE ISLANDS, Manila, G. M.: "Knocks other sets cold." (also Santa Rosa).

SOUTH CAROLINA, Orangeburg, L. W.: "Raleigh (200)."

SOUTH DAKOTA, Oldham, M. F. T.: "Del Rio, Reynosa (1200)."
Sioux Falls, J. H.: "Del Rio (1100)."

TENNESSEE, Chattanooga, H. M.: "Del Rio (1000); Chicago (500)."
Columbia, W. A. D.: "Denver (1000); Del Rio, Reynosa, Havana, etc. (950)."
Hillsboro, L. E. R.: "El Paso, Del Rio (1000); Ft. Worth (700); Chi. (400)."
Lenoir City, P. M. J.: "4000 miles at night; 1000 days. Am radio man."
Nashville, W. S.: "42 B. C. stations and 14 S. W."

TEXAS, Lubbock, L. K.: "Salt Lake (1000)."
Paradise, V. H. M.: "400 miles."
San Marcos, W. R.: "Cin. (1040) every night. Across U. S. & Mexico."
Vanderpool, J. N.: "Cin. (1500); Salt Lake (1000); 500 miles on speaker."
Wichita Falls, D. G.: "Santa Barbara (1200); Minn. (850); St. Louis (600)."

UTAH, Fillmore, W. B.: "S. F. (600); L. A. (550); Albuquerque (500). 125 ft. Ant."
Tremonton, F. E.: "L. A., S. F. (650) Denver (440)."

VIRGINIA, Bedford, P. L.: "24 stns. including Cuba (1000), Canada & Mexico on inside aerial."
Norfolk, R. R. M.: "Del Rio, Reynosa, etc. (1600); Cuba (1200)."
Schoolfield, T. G.: "New Orleans (900); Atlanta (450); Cin. (400)."
Scottsville, A. V.: "Hartford (500)."

WASHINGTON, Kent, T. F.: "Salt Lake (700); Sacramento (650)."
Port Angeles, H. P.: "Salt Lake, Sacramento (750).
Seaview, F. E. P.: "Salt Lake (700); S. F. (600); Calgary (400)."
Yacolt, C. A. C.: "Denver (1000); L. A. (900); Salt Lake (700). S. L. on Spkr."

WASHINGTON, D. C., H. A. B.: "Cleveland (300) on bedsprings."

WEST VIRGINIA, Charleston, J. K.: "Cin. (380)."

WISCONSIN, Clear Lake, C. S.: "Shreveport, Del Rio, Dallas (1000) Denver, Pitts. (800); Minn. (600)."

Eagle River, A. F. R.: "St. Louis (500) on speaker."
Milwaukee, C. R.: "Milwaukee (500) Cin. (300)."
Sheboygan, A. D.: "Hartford (800); Cleveland (500); Pitts. (400)."
Weyauwega, J. R.: "17 Stations including St. Louis (300)."
WYOMING, Casper, S. C. M. (Commercial Radio Operator): "Del Rio (1000) R-8; Salt Lake (300) R-6; Denver (250), R-9."