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RADIO AGE

The Magazine of the Hour

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April, 1923

IN THIS NUMBER

The Koppasch Circuit—A
Hair Raiser

How to Make a One-Tube
Loop Aerial Set

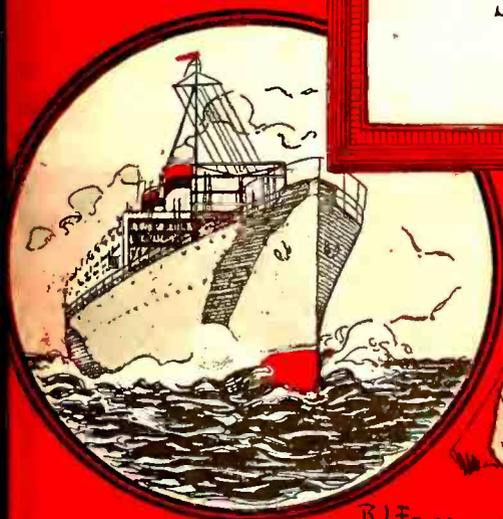
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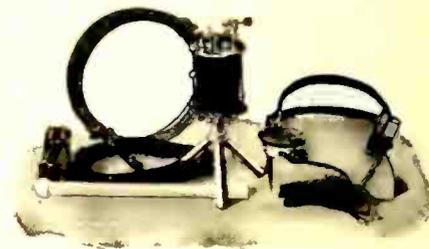
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RADIO AGE

The Magazine of the Hour

Volume 2

APRIL, 1923

Number 3

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Saying "No" to an Advertiser

IT IS a pleasure to have a genuine high class radio article exploited in our advertising columns. It would be far from a pleasure to learn that we had permitted the advertisement of equipment that was manufactured for sale and not for use. Magazines, like men, are known by the company they keep.

Sometimes it is necessary to reject an advertising contract proffered by a manufacturer or dealer who is a bootlegger at heart. He puts a lovely label on his goods but the goods are poison.

This magazine wants advertisers. It wants a lot of advertisers. But it is not likely to sell out its great family of readers and their generous support. It, therefore, has been necessary to reject some advertising business. But in the long run we shall have all the more advertising by thus playing fair with our readers.

In that connection let us say that we know a lot about the goods that are advertised in Radio Age. We know personally. We vouch for them.

The products of the United Manufacturing & Distributing Co. are standard. This company's transformers and condensers have been advertised in our columns for a year and the approving verdict has been unanimous.

We KNOW that the Million Point Mineral Crystal is far and away better than the average crystal. We knew this before our readers began to tell us about them.

We KNOW that the Sensitone receiving set is a corker. We have tested one for months with but one result—successful reception. This outfit eats up distance and brings in the nearer stations like a glorified Victrola.

We KNOW that Mr. Pfanstiehl of the Pfanstiehl Radio Service Co. is a distinguished radio research man of high standing among radio engineers and when he offers inductance coils he is offering 100 per cent coils.

We are proud to have the company of the Rauland Manufacturing Co. of Chicago and the Franklin Institute of Rochester, N. Y., and the Chicago Engineering Works and of the Mitchell Blair Company of Chicago and any and all other good concerns which are OR WILL BE represented in the advertising columns of this magazine.

Does this policy pay?

Well, our circulation doubled in March and we have just started.

—The Editor.

KOPPRASCH CIRCUIT FOR W-D-11 TUBES.

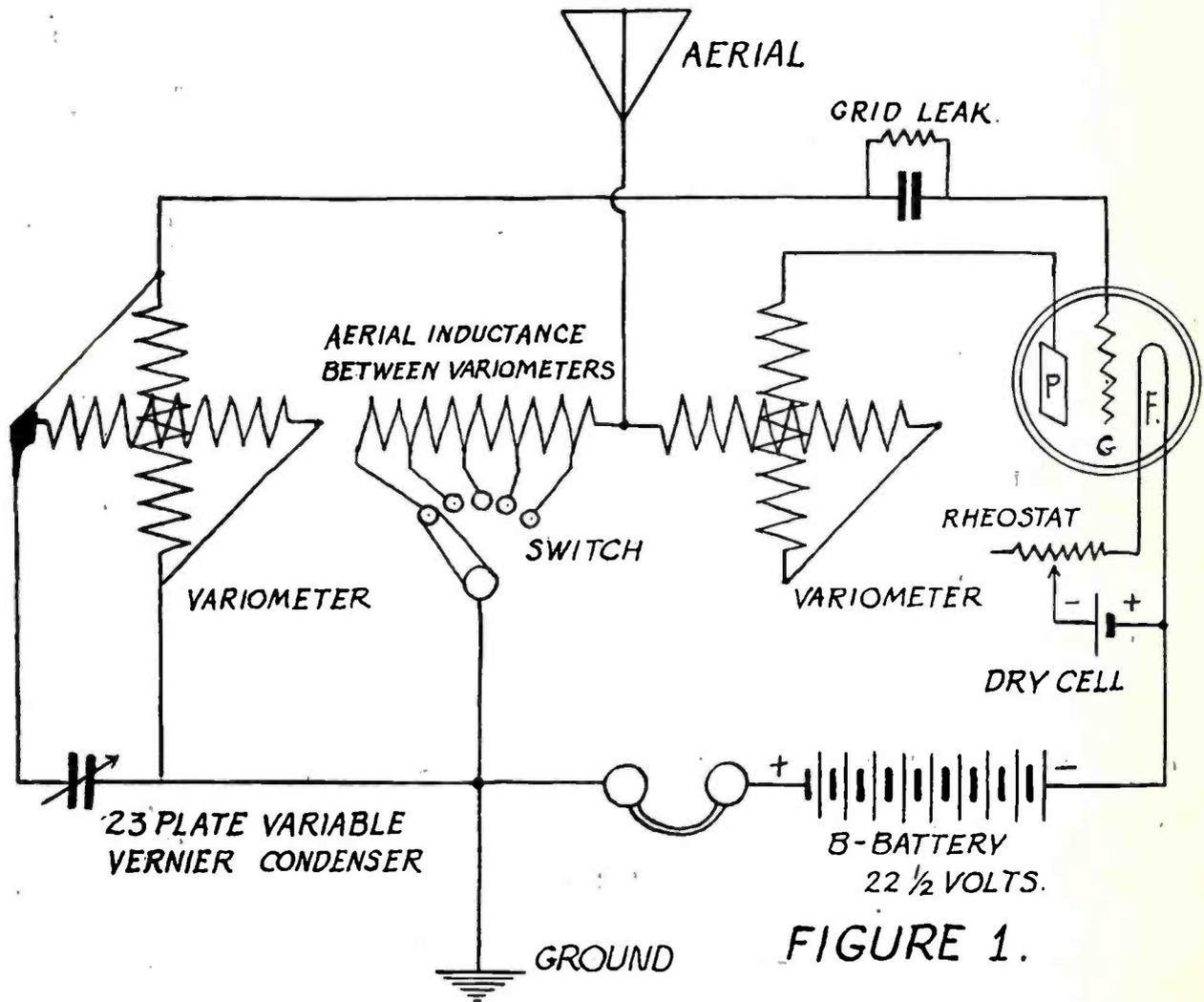


FIGURE 1.

MOUNTING OF VARIOMETERS AND TUBE

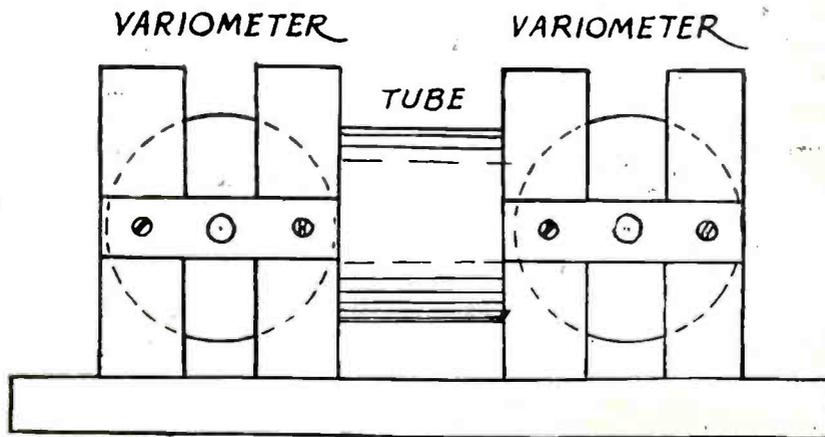


FIGURE 2.

RADIO AGE

"The Magazine of the Hour"

M. B. SMITH
PUBLISHER

PUBLISHED MONTHLY GARRICK BLD'G CHGO.

FREDERICK SMITH
EDITOR

The Kopprasch Circuit for Local and Long Distance Work

By F. D. PEARNE

ONE of the cleverest circuits, which has appeared lately, is the new Kopprasch arrangement, which makes use of two variometers with the aerial coil placed in inductive relation with both. This set was designed by Mr. A. H. Kopprasch of Chicago, who spent many months experimenting before he succeeded in getting the results which he sought for.

The strength of the signals obtained when using W-D-11 tubes in this circuit is much greater than those of the other standard circuits and when the 6-volt tubes are used the volume is still more pronounced.

One of the best features of a set of this type is the fact that no tube noises of any kind are noticed, once the set is adjusted and the music comes in, very clear and distinct. Stations KGW, Portland, Oregon, and KHJ, of Los Angeles, California, have been clearly and distinctly heard in Chicago with a Kopprasch circuit, using one W-D-11 tube. These stations were not only heard, but were held as long as desired without the usual fading away which is so common with reception at such great distances.

Figure 1 shows the arrangement of the circuit, which is quite simple and easy to construct. The outstanding feature is the peculiar arrangement of the variometers, one of which is connected in parallel and the other in series. The aerial inductance is wound on a paper tube which is placed between the variometers and in inductive relation to them.

Figure 2 shows how this is accomplished. The tube is made of any heavy cardboard tube, 1 5-8 inches long and of sufficient diameter to allow the rotors of both variometers to clear it. 40 turns of No. 22 cotton covered magnet wire is first

wound on the tube, taps being taken off at the completion of the eighth turn and each following eighth turn. These taps are connected to the switch points as shown. This coil should be wound in the opposite direction to the winding of the stators of the variometers. The starting end of the winding is connected to the series variometer shown on the right, with the aerial connected to the junction between them.

The variometer on the left is

Answered

By Raymond E. Miller

THE glow from the tubes illuminating the walls in fantastic patches of light and dark, the thrilling growling and squealing from the loud-speaker, making the room resound with exotic sound. The faces eager with anticipation, half in shadow would make a fitting etching for Gustave Dore.

A melodious Southern voice, vibrant, rich in feeling, sings a ballad which has an exquisite appeal. A slight turn of the little dial mounted in the face of the cabinet brings another station from out of the air; a piano solo is being rendered from the subtle fingers of a master; there is no contact with grim realities, only the delicate music. One drinks it in with great relief, free from the distracting influences of the concert hall.

Station after station is tuned in at one's pleasure, opera, speeches, songs, great symphony orchestras, the light music of Terpsichore. Space is annihilated.

God has answered, not only for Job the great question that he asked, "Who shall make the lightning go and say, 'I am here?'" but He has answered all of us.

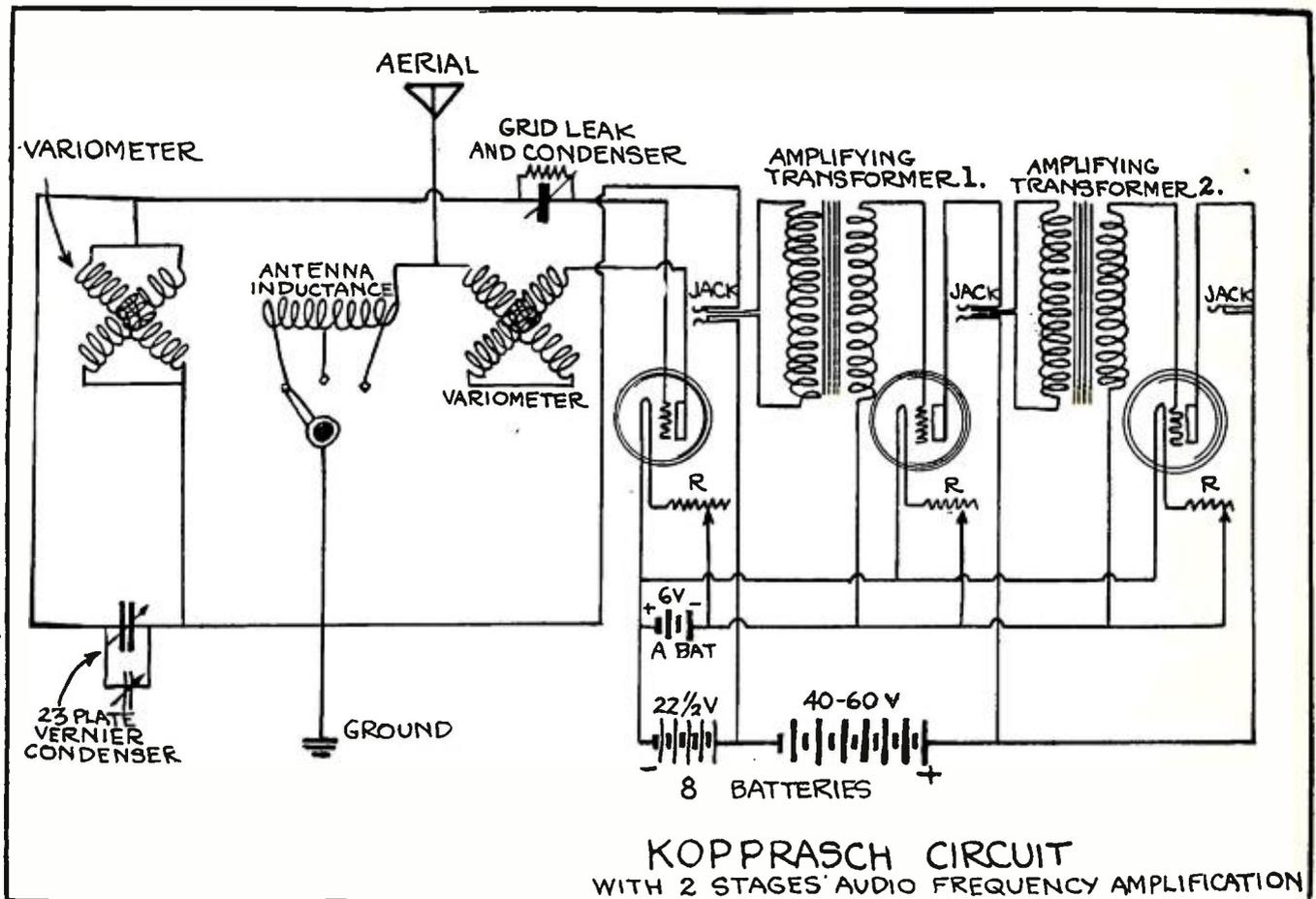


connected in parallel, that is, one end of the rotor winding is connected to one end of the stator, and the other end of the rotor is connected to the other end of the stator and the connections to the circuit are made to the junctions so formed. A 23 Vernier, variable condenser is connected across the terminals of this variometer, one terminal of which makes contact with the ground, switch and head phones.

The rest of the apparatus used is all standard. The grid leak is of the ordinary pencil type and the grid condenser is of the ordinary .00025 fixed type. The battery used for the filament supply will be determined by the kind of tube used. For the W-D-11, one cell of dry battery will suffice, but if a Radiotron, or Cunningham tube is desired, the current should be supplied by a six-volt storage battery. A 22 1-2 volt "B" battery should be used to energize the plate circuit no matter which kind of a tube is used.

The head phones may be of any standard make having from 2,000 to 3,000 ohms of resistance. In mounting the variometers and tube, it is a good plan to fasten them securely to a wooden base, in such a way that the tube can be forced tightly between them. If this can not be done, then the tube may be supported by means of sealing wax applied to the sides of the variometers.

Most all the causes for trouble in this set are found in one of two places. Either the winding on the tube is in the wrong direction, or the grid leak resistance is not correct. By carefully examining the stators, it is easy to find the direction of winding and when the two variometers are placed side by side, these windings should appear to be a continuation of winding in the same



direction, then they are separated and the coil forced in between them. As stated before this coil is wound in the opposite direction. The other case of trouble which may occur is a beat noise in the phones. This may sound like a hum or a series of slow pulsations and is caused by too high resistance of the grid leak. This may be corrected by increasing the size of the lead pencil mark which forms the leak. It should be done carefully and with a very sharp pencil. Once this is right no further trouble will be noticed.

Deaf Hear Radio

London, England, reports that a 77-year-old man, deaf for thirty years, listened successfully to a radio concert at a friend's home. In a series of experiments at Marconi House Harry Shwer, aged 13, deaf from birth, heard music and the human voice for the first time in his life. It was found he could hear through one ear, but not the other.

Two of his companions from a deaf institution were tested. One heard a fox trot, but the other could hear nothing.

This Is the Life

The greatest American steamship, Leviathan, which has been refurbished and rehabilitated by the United States government at a cost of \$8,000,000, has radio equipment connected with private telephones in each of the private rooms. Passengers may talk to their friends ashore without leaving their state-rooms.

Amplifying the Kopprasch

THOSE interested in amplification of the Kopprasch circuit will find the method clearly pointed out in the cut. Excellent results may be obtained from audio frequency transformers having ratios of ten to one and five to one.

If WD-II tubes are used the extra tubes will require a filament current of .5 amperes added to the .25 ampere used by the detector. The filament battery, therefore, should

consist of three dry cells connected in parallel, that is all of the carbon terminals connected together and to one side of the filament and all of the zinc, or negative terminals connected together and to the rheostats.

Care should be taken lest these cells be connected in series as such an arrangement would burn out all the filaments.

Reprinted by courtesy of the Chicago Herald and Examiner.

Radio Exports Fall Off

Radio exports shipped out of the country in December totaled \$163,236 in value, less than the total for November which was \$223,180. The decrease is explained by officials of the Department of Commerce as due to large shipments of apparatus to Argentine in November. In December, Canada took the largest amount valued at \$74,344.

Total exports of radio apparatus for 1922 amounted to \$2,897,799 being more than a thirtieth of the total electrical exports for the year, which amounted to over \$63,000,000. In 1921 radio exports were not separated from line telegraph and telephone apparatus so no comparison for the two years can be shown.

The Westinghouse Electric & Manufacturing Company on February 26 filed a suit in the District Court of New Jersey against the Radiocraft Company, Inc., and the DeForest Radio Telephone and Telegraph Company for infringement of the Armstrong patent.

The Westinghouse Company, one of the five organizations in the Radio Corporation, claims that the Armstrong license, one of which is held by the Radiocraft Company, a subsidiary of DeForest, does not permit the sale of Armstrong circuit sets through the regular trade channels of jobbers and dealers, but only direct to the amateur. The suit evidently seeks to prevent the seventeen independent manufacturers licensed under the Armstrong patent from doing business except as mail order houses, that is, direct to the fan.

How to Make a One Tube, Loop Aerial Receiving Set

By F. D. PEARNE

A RADIO SET, using very little apparatus and operating well on a loop aerial, is something which will interest many amateurs who find it difficult to construct an outside aerial. Everybody knows that much interference can be eliminated by the use of a loop aerial and while it will be necessary to move the loop around to find the best point of reception, on account of its directional characteristics, still this slight objection, if it is an objection, is more than offset by the quiet reception obtained.

Such a set has been designed by Raymond Chassevent, who no doubt had in mind the hard-hearted landlords who seem to have so many objections to allowing an aerial to be placed on their buildings. Any way Mr. Chassevent has given us something that will help us dodge the static when summer changes the atmospheric conditions.

One of the principal claims for this set is the fact that when built according to specifications, a complete elimination of interference may be obtained when several stations are broadcasting on nearly the same wave length at the same time. The set described will oper-

ate efficiently on wave lengths between 300 and 600 meters and will cut out all interference from amateurs who are working on wave lengths below 300 meters.

The entire outfit is made up of very few parts and is quite inexpensive, is very compact and may be mounted in any way desired, so long as the parts are not crowded. A space of about 3 inches should be left between the different parts and all connections should be as short as possible.

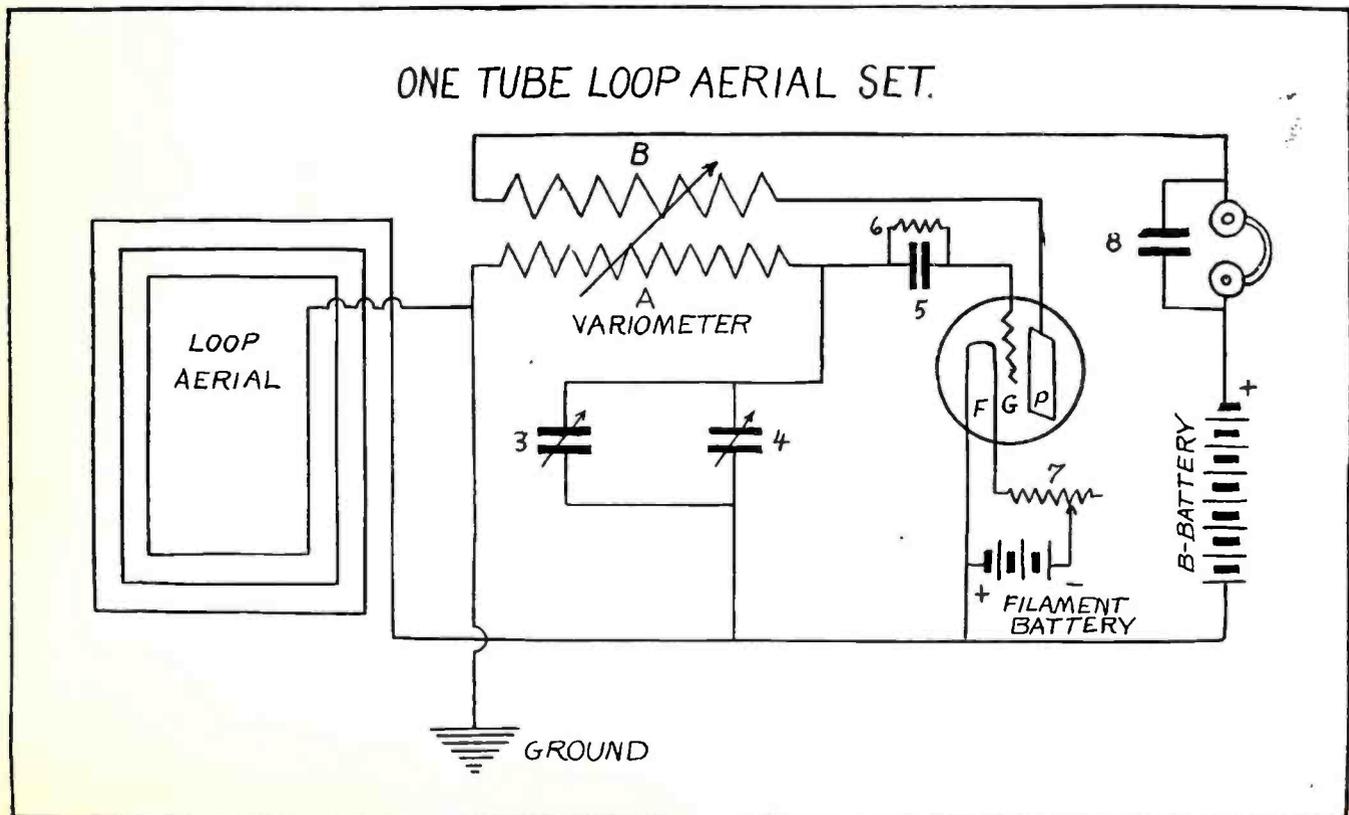
The loop aerial should be 3 feet square and wound in a vertical plane. The wire used for this purpose is No. 24 double cotton covered copper and the turns should be about one inch apart. Ten turns will be all that will be required to give the best results, although a little experimenting may help in determining just the right amount for any particular set.

The winding on the variometer consists of 40 turns on the rotor and 30 turns on the stator. When purchasing an ordinary variometer, it is usually found to be connected in series. The connection between the rotor

and the stator should be broken, so that they form separate circuits. The terminals of the stator should then be brought out to 2 Fanstock clips at the back of the variometer. The two terminals of the rotor are also brought out to two clips on the back of the stator blocks.

The winding on the stator, as shown at "A" on the drawing, forms the tuning inductance and the winding on the rotor is used as a variable plate inductance. The condenser shown at "3" is an eleven plate variable, having a capacity of .00025 M. F. and "4" is a vernier arrangement which consists of a 3 plate variable condenser. This small condenser acts as a vernier adjustment for the eleven plate condenser.

The grid condenser shown at "5" can be of any capacity ranging from .00025 to .0005 M. F. and the grid leak," 6" should be of the variable type so that it may be varied to suit the characteristics of the tube used. By the careful adjustment of the grid leak, the strength of the signals may be greatly increased. The rheostat used by Mr. Chassevent and shown at "7" on the drawing is a Bradleystat. Any of the standard
(Continued on page 10.)



Construction and Operation of a Two-Circuit Radio Receiving Equipment with Crystal Detector

(By the U. S. Bureau of Standards)

Introduction.

THIS pamphlet describes the construction and operation of a simple receiving set which has about the same receiving range as the one described in the first pamphlet and will respond to the same wave frequencies (wave lengths). The advantage of this set is that it is more "selective," which means that it is easier to distinguish the message from one of two radio transmitting stations when both of the transmitting stations are using wave frequencies (wave lengths) that are nearly the same. This greater selectivity is brought about through the use of two complete electric circuits, both of which are tuned to the incoming waves. This is in contrast to the single-circuit equipment.

The total cost of this equipment can be kept down to about \$15.00. Most of the equipment mentioned in Circular No. 120 can also be used with this set, and the cost of the additional apparatus will be about \$5.00.

Essential Parts of Receiving Station.

Antenna, Lightning Switch, Ground Connections, and Telephone Receivers. The other essential part of the equipment is the receiving set, which is made up of the following parts:

Coupler, (Left half of Fig. 1).—This is composed of a fixed section and a movable section. The fixed section is made up of the coil tube P, the upright support J, the contact panel K and the base B. The movable section is composed of the coil tube S, the supporting contact panel M and the base L. The movable section is so arranged that the coil tube S slips inside of the coil tube P when M is pushed to the left. The coil tubes are made by winding wire on cardboard tubing.

This pamphlet tells how to construct a coupler in the home. It is of course possible to purchase a coupler of the type here described at almost any store which handles radio supplies. Another type of device, called a "vario-coupler," has a rotating coil. In purchasing any coupling device, care should be taken to select one which will operate satisfactorily with the condenser available, at the wave frequencies to be received.

Variable Condenser (C, Figs. 1 and 2).—The variable air condenser should have a maximum capacity rating between

0.0004 and 0.0005 microfarads (400 to 500 micromicrofarads).

Crystal Detector, (D, Figs. 1 and 2).—This is essentially the same crystal detector as was described in Circular 120 except that a few improvements have been made in its construction.

Accessories.—Under the heading of accessory equipment may be listed binding posts, switch arms, switch contacts, test-buzzer, dry battery, and boards on which to mount the complete apparatus. The binding posts, switch arms, and switch contacts may be purchased from dealers who handle such goods or they may be readily improvised at home. The pieces of wood on which the equipment is mounted may be obtained from a dry packing box and covered with paraffin to keep out moisture. Care should be taken in melting the paraffin not to get it too hot and it should not be heated beyond the point where it just begins to smoke. The paraffin may be melted in a pan set in boiling water in order to eliminate the possibility of getting it too hot. When the wood parts have been drilled and cut to size the paraffin should be applied quickly with a small brush. When cold, the excess paraffin should be carefully scraped off with a straight piece of metal such as the brass strip in the edge of a ruler.

Details of Coupler Construction.

Movable Coil Tube, Coil Tube Support and Base (S, M. & L, Fig. 1).—The coil tube S is a piece of cardboard tubing, 3 5-8 inches in diameter and 4 inches long. A round cardboard table-salt box which can be obtained at a grocery store is about 3 5-8 inches in diameter and can be used for this purpose. One of the cardboard ends or caps should be securely glued to the box. This tube is wound with No. 24 (or No. 26) double cotton covered copper wire.

Punch two holes in the tube 3-8 inch from the open end, as shown at R., Fig. 2. Weave the end of the wire through these holes so that it is firmly anchored and has one end extending about 10 inches inside the tube. Punch a hole F about 5-8 inch from the other end (which has the cardboard cover secured to it) in line with the holes punched at R. Draw the free end of the wire through the inside of the tube and thread it out through the hole at F. Now wind on 10 turns of wire and take off a 6-inch twisted tap, as described in Circular 120. Hold the turns tight and punch a hole B directly underneath this tap. Insert the end of the tap in the hole and pull it through the inside of the tube so that the turns are held in place. The hole for this tap should be slightly staggered from the first two holes which were punched. Punch another hole L 5-8 inch from the other end of the tube and in line with the hole B. Thread the

twisted tap out through this hole and pull it tight. Wind on 10 more turns and bring out another twisted tap; then 10 more turns and another tap; 15 turns and another tap; 15 more turns and another tap. Finally, wind on 20 more turns and bring out the free end of the wire in the same manner as the taps were brought out. The tube now has 80 turns of wire wound on it and there are 5 twisted taps and two single wires projecting through the row of holes at the closed end of the tube. The position of the wires inside the coil tube is shown by the dotted lines.

The contact panel M (Fig. 1) which supports the coil tube is a piece of dry wood 5 1-2 inches high, 4 inches wide and 1-2 inch thick. The contacts, switch arm and knob, and binding posts are described in Circular No. 120. The end of the switch arm should be wide enough so that it will not drop between the contact points, but not so wide that it cannot be set to touch only a single contact. Having located the hole for the switch-arm bolt, the switch arm should be placed in position and the knob rotated in such a manner that the end of the contact arm will describe an arc upon which the contact points are to be placed. The holes for the contacts should next be drilled, the spacing depending upon the kind of contacts which are to be used.

The movable base L is a square piece of dry wood 4 inches long, 4 inches wide and about 3-4 inch thick. Care should be taken to have the edges of this block cut square with respect to the sides.

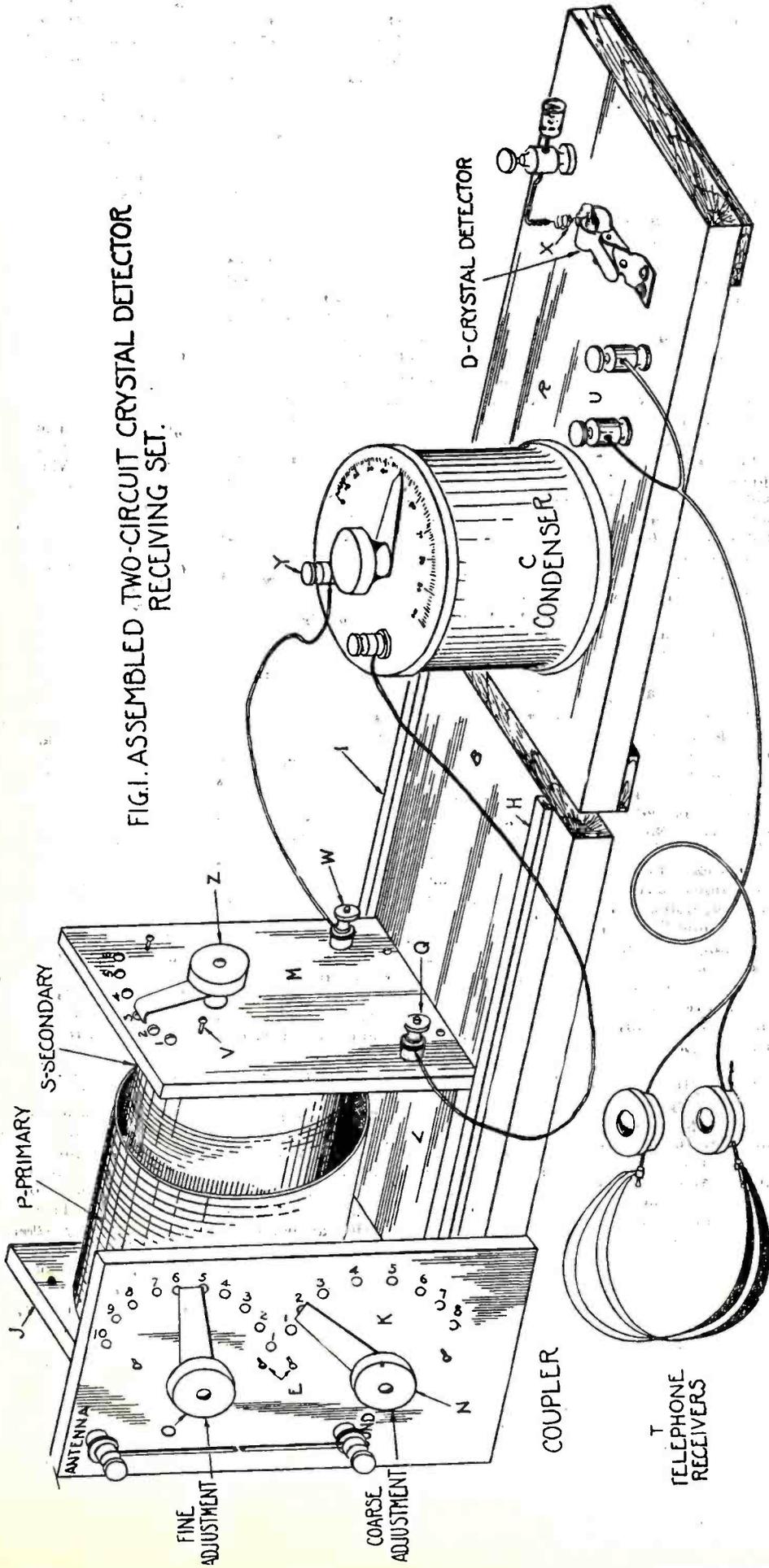
The panel M should now be screwed to the movable base L, as shown in Fig. 1. Care should be taken to have the edges of the blocks M and L evenly lined up so that the two edges of the block L (Fig. 1) which slide along the inside edges of the strips H and I will be smooth continuous surfaces.

Fixed Coil Tube and Panel, (P and K, Fig. 1).—The coil tube P (Fig. 1) is essentially the same as the tuner described in Circular 120, and the tuner used there may be made a part of P, of this set. The cardboard cover should be glued to the end of the tube where the single turn taps are taken off. This tube is 4 1-8 inches in diameter and 4 inches long. If a new coil tube is constructed, it may be improved by using a somewhat different arrangement of the twisted taps. (See coil marked "Tuning Coil" in Fig. 3, Circular 120.) Instead of taking off taps in a line from the upper right corner to the lower left corner of the figure, start at the upper left corner and progress downward to the lower right corner. The end of the coil tube where the 10-turn taps are taken off should have the cardboard cover

(Continued on page 8.)

*This is the second of a series of pamphlets on the construction of radio receiving equipments. Those who expect to construct the set herein described should first obtain a copy of Bureau of Standards Circular, No. 120, "Construction and Operation of a Simple Home-Made Radio Receiving Outfit," by writing the Superintendent of Documents, Government Printing Office, Washington, D. C., and enclosing five cents. Cash may be sent at risk of sender or remittance may be made by money order. Stamps will not be accepted. That Circular was originally issued in mimeographed form as "Bureau of Standards Letter Circular, No. 43."

FIG. 1. ASSEMBLED TWO-CIRCUIT CRYSTAL DETECTOR RECEIVING SET.



glued to it. This is the top of the coil tube as it is shown in the diagram (Fig. 3, Circular 120). In all other respects the tube is wound exactly as described in Circular 120.

The panel which was described in Circular 120 may also be used for the panel K (Fig. 1). If the receiving set described in Circular 120 has not been constructed, this panel may be made from a board 7 1-2 inches long by 4 1-2 inches wide and about 1-2 inch thick. The position of the contacts can be determined by inserting the switch arms in their respective holes and turning the knobs so that the ends of the switch-arms will describe arcs, as previously explained. The contacts, and switch arms and knobs are described in Circular 120.

Fixed Base and Coil Tube Support, (B and J, Fig. 1).—The fixed base B is a piece of dry wood 5 1-2 inches wide, 11 inches long and between 3-4 and 7-8 inch thick. The support J for the fixed coil tube is 5 1-2 inches wide (the width of the base), 6 inches long and about 1-2 inch thick. This board should be screwed to one end of the base so that it is held securely in a vertical position. It will then project about 5 inches above the base G.

A strip of wood 1, 11 inches long, 5-16 inch wide and about 1-4 inch thick is now fastened to the base by cigar-box nails or small brads so that it is even with the rear edge, as shown in the drawing (Fig. 1). The upright panel M, having been fastened to the movable base L, as previously explained, is placed in position as shown. The next step is to locate the strip H in such a position that the block L will slide easily back and forth the entire length of the fixed base B. Having found this position this strip is secured in the same manner as the trip 1. It is, of course, understood that neither the movable coil tube S nor the switch contacts and binding posts have, up to the present time, been mounted on the upright panel M. The wooden parts for the loose-coupler are now finished and should be covered with paraffin according to instructions given under "Accessories."

It might be advisable after winding the coil tubes P and S to dip them in hot paraffin. This will help to exclude moisture. It is important to have the paraffin heated until it just begins to smoke, as previously explained, so that when the coils are removed they will have only a very thin coating of paraffin.

Variable Condenser and Crystal Detector.

Variable Condenser, (C, Figs. 1 and 2).—The variable air condenser should have a maximum capacity of between 0.0004 and 0.0005 microfarads (400 to 500 micromicrofarads). The type pictured in Fig. 1 is inclosed in a round metal case, but the unmounted type may also be used. A person adept with the use of tools can make the variable air condenser, but a discussion of the method is not within the scope of this pamphlet. The variable condenser is mounted on a board R (Fig. 1) about 10 inches long, 5 1-2 inches wide and 3-4 inch thick.

This board is similar to the baseboard used for the set described in Circular 120. The strips of wood are fastened under the ends so that the wires may be run underneath for connections. After the holes for the detector binding post, and also the holes for the telephone binding posts U have been drilled, the board should be coated with paraffin as previously described.

Crystal Detector, (D, Figs. 1 and 2).—The galena crystal may be mounted as described in Circular 120, or it may be mounted as pictured in Figs. 1 and 2. The holder for the crystal is a metallic pinch-clip such as the ordinary battery test clip or paper clip. This clip should be bent into a convenient shape so that it may be fastened to the base.

The wire X, which makes contact with the crystal, is a piece of fine wire (about No. 30) which is wound into the form of a spring and attached to a heavy piece of copper wire (about No. 14). This heavy wire is bent twice at right angles, passes through the binding post, and has a wood knob or cork fixed to its end as shown. It is desirable to have the fine wire of springy material such as German silver, but copper wire may be used if necessary.

The importance of securing a tested galena crystal can not be emphasized too strongly, and it should be understood that good results can not be obtained by using an insensitive crystal.

Instruction for Assembling and Wiring.

Coupler. The movable portion of the coupler should be assembled first. As shown in Fig. 1, the fittings making up this part of the set are the movable base L, the coil tube support M and the coil tube S. Insert in M the 6 switch contacts (machine screws), the switch-arm, and the binding posts, in the proper holes which have been drilled. Adjust the switch arm until it presses firmly on the contact points (bolt-heads) and fasten the bare end of a No. 24 copper wire between the nuts on the end of the switch-arm bolt 2 (Figs. 1 and 2) which projects through the panel M. Wind this wire into the form of a spiral of two or three turns like a clock-spring, leaving a few inches of the wire for connection. Insert two small screws V (Fig. 1) in the panel M so that the switch-arms will not drop off the row of contact points when the knob is turned too far.

The coil tube S is now ready to be fastened in position on the panel M. Cut a one-inch hole in the cardboard end of the coil tube and place it with the closed end next to the panel M in such a position that it will be just below the row of nuts and washers (switch contacts) and in the center of the panel M with respect to the sides. Fasten it to the panel with short wood screws. The switch-arm bolt with the spiral wire connected to it should project through the hole cut in the end of the coil tube. Thread the end of this wire through a hole punched near the end of the coil tube next to the panel and connect this wire to the back of the binding post W (Figs. 1 and 2). The wire F (Fig. 2) is now connected to the back of the bind-

ing post Q. There now remain 5 twisted taps and 1 wire to be connected to the 6 switch contacts. The taps should be cut off about 1 1-2 inches from the coil tube and the insulation removed from the pairs of wires thus formed. Each pair of wires should be twisted together, as shown at J, (Fig. 2.) The connections are now made by clamping the 5 taps and also the end of the single wire between the nuts and washers on the contact bolts. The connections are clearly shown in the diagram.

We are now ready to assemble and wire the fixed portion of the coupler, composed of the base B, coil support J, panel K and coil tube P. As previously mentioned, the panel K is practically the same as the panel shown in Circular 120 except that for this purpose the original panel is mounted so that the lower edge now becomes the left hand edge. This brings the series of ten contacts at the top of the panel in our present set. When the panel is turned to this position the two binding posts will be at the top. Change the position of the right-hand binding post so that the two are arranged as shown in Fig. 1. Connections between the binding posts and switch-arms are made as described in Circular 120. Two short pieces of wire should now be fastened under the binding posts at the front of the panel. These wires are arranged so that there is a very short space between their ends, as explained in Circular 120. Screw the panel K to the base B and to the support J, meanwhile allowing the coil tube P to lie on the base so that the connecting wires will not be broken.

If the panel has been made especially for this coupler, as described in this pamphlet, it should be mounted according to the following instructions:

Screw the panel to the base and to the support J and insert the binding posts, switch-arms and bolts, and contact bolts in the proper holes. The switch-arms should now be adjusted so that they make firm contact on the heads of the bolts. Now insert 4 small screws E, (Fig. 1) in the front of the panel so that the switch-arms will not drop off the row of contact points where the knobs are turned too far. Insert a wire between the nuts on the end of the lower switch-arm bolt N where it projects through the back of the panel K (Fig. 1). Wind the wire into a spiral of 1 or 2 turns like a clock spring and connect the end to the upper binding post which is marked "Antenna." These connections will be understood by referring to the upper left-hand corner of Fig. 2.

In the same manner connect another wire from the upper switch arm bolt to the lower binding post which is marked "Ground." (See Fig. 2.) The connecting wires should be insulated except where a connection is needed and should not touch each other. Two short pieces of wire are now fastened to the binding posts in the front of the panel, as previously explained.

The coil tube P should now be laid on the base in about the same position as it is shown in Fig. 1. The 16 twisted taps and also the 2 single wires from the

(Continued on page 10.)

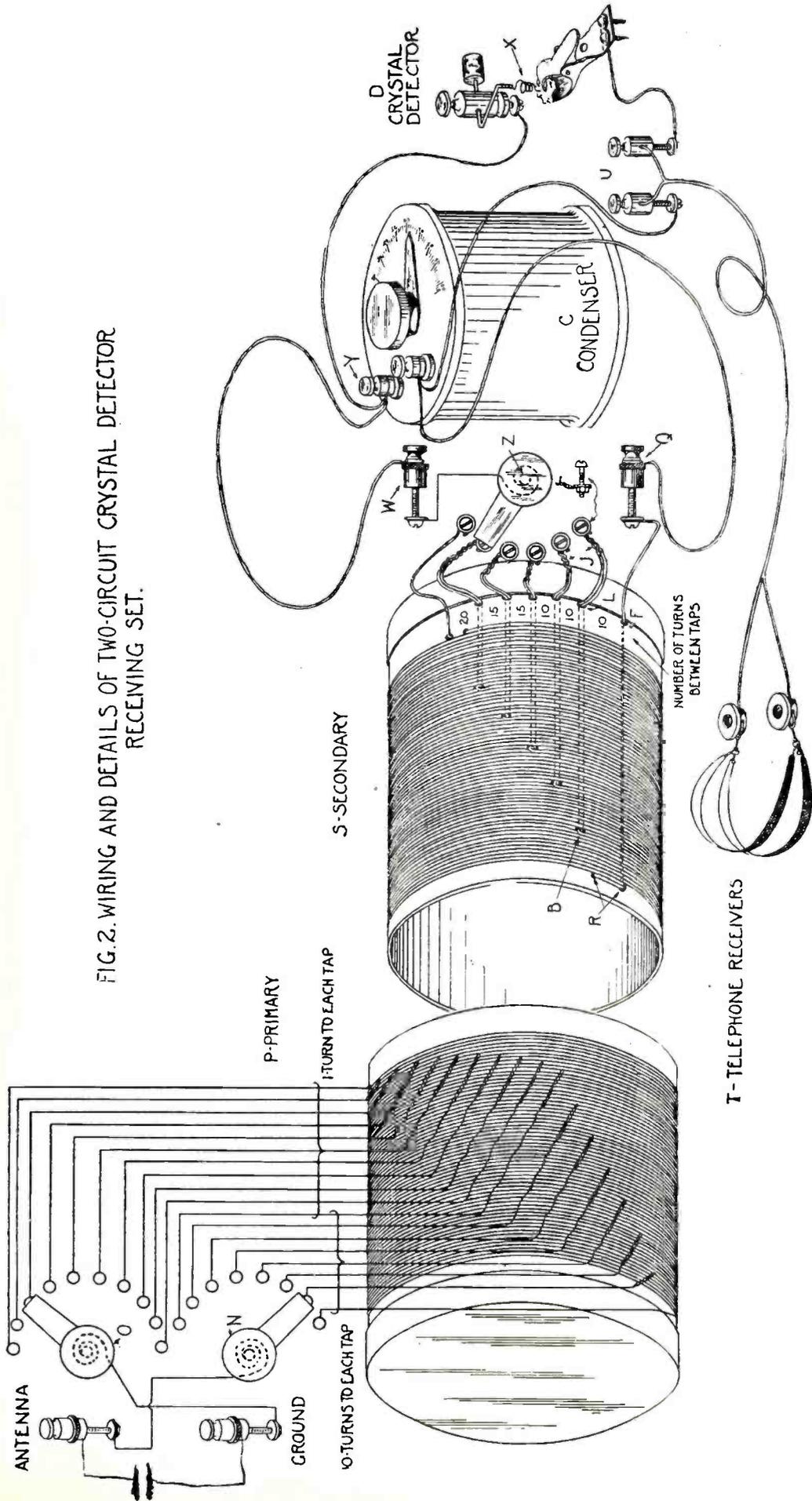


FIG. 2. WIRING AND DETAILS OF TWO-CIRCUIT CRYSTAL DETECTOR RECEIVING SET.

ends of the winding are now to be connected to the back of the 18 contacts on the panel K, following the method given in Circular 120. The order of connecting the taps may be understood by referring to Fig. 2.

Carefully raise the coil tube P against the support J to such a position that when the coil tube S of the movable section of the tuner is pushed in the coil tube P, the space between the two tubes will be equal all around.

Mark this position of the coil tube P on J, and fasten it to J with short wood screws.

Condenser and Crystal Detector, (C and D, Fig. 1).—The mounting of the condenser C and the crystal detector D on the base R is clearly shown in Fig. 1. Crystal detectors have been previously described in this pamphlet and in Circular 120. A wire is run from the binding post Y on the variable condenser C, through a small hole in the base R, and is then connected to the under side of the detector binding post. Another wire is now run from the clip which holds the galena crystal, through a small hole in the base, and is then connected to the under side of the right-hand binding post U. The left-hand binding post U is next connected to the binding post on the variable condenser which has no wire attached to it, by running a wire under the base and up through a small hole. The wiring will be understood by referring to the right-hand portion of Fig. 2. The wires may be the same size as were used for winding the coil tubes and should be insulated. Two pieces of wire should now be connected from the binding posts W and Q (Figs. 1 and 2) to binding posts on the variable condenser. The telephone receivers T are now connected to the binding posts U and the receiving set is complete except for connecting to the antenna and ground.

The connection of the antenna lead and ground wire to the binding posts marked "Antenna" and "Ground" respectively is made as shown in Fig. 2 in Circular 120.

The coil tube P is usually called the "primary" and the coil tube S is usually called the "secondary."

Directions for Operating.

Push the coil tube S (secondary) about half way into the coil tube P (primary) and set the switch 2 on contact point 4. The primary switch N is set on contact point 8. The primary switch O may be left in any position. The crystal detector can be adjusted most easily by the use of the test buzzer, which is described below. If the test buzzer is not used the wire which rests on the crystal must be placed lightly at different points on the crystal until the transmitting station is heard when the set is adjusted as described below.

Having adjusted the crystal detector to a sensitive point, the next thing is to adjust the switches on the coil tube P (primary), the switch on the coil tube S (secondary) and also the variable condenser C so that the apparatus will be in "resonance" with the transmitting station. Set the primary switch N on contact point 1 and while keeping it in

this position move the other primary switch O over all of its contacts stopping a moment at each one. Care should be taken to see that the ends of the switch arms are not allowed to rest so that they will touch more than one contact point at a time. If no signals are heard, set the switch arm N on contact point 2 and again move the switch-arm O over all of its contacts. Proceed in this manner until the transmitting station is heard. This is called "tuning" the primary circuit.

The tuning of the secondary circuit is the next operation. Set the secondary switch Z on contact point 1 and turn the knob of the variable condenser C so that the pointer moves over the entire scale. If no signals are heard, set the switch 2 on contact point 2 and again turn the knob of the variable condenser so that the pointer moves over the entire scale. Proceed in this manner until the signals are loudest, being careful to see that the ends of the switch-arms touch only one contact point at a time. Next slide the coil tube S (secondary) in and out of the coil tube P (primary) until the signals are made as loud as possible. This operation is called changing the "coupling." When the coupling which gives the loudest signal has been secured, it may be necessary to readjust slightly the position of the switch-arm O, the position of the movable coil tube S and the "setting" of the variable condenser C.

The receiving set is now in resonance with the transmitting station. It is possible to change the position of one or more of the switch-arms, the position of the movable coil tube and the setting of the variable condenser in such a manner that the set will still be in resonance with the same transmitting station. In other words, there are different combinations of adjustments which will tune the set so that it will respond to signals from the same transmitting station. The best adjustment is that which reduces the signals from undesired stations to a minimum and still permits the desired transmitting station to be heard. This is accomplished by decreasing the coupling (drawing coil tube S farther out of coil tube P) and again tuning with the switch-arm O and the variable condenser C. This may also weaken the signals from the desired transmitting station but it will weaken the signals from the undesired stations to a greater extent, provided that the transmitting station which it is desired to hear has a wave frequency which is not exactly the same as that of the other stations. This feature is called "selectivity."

The Test Buzzer.—As mentioned above, it is easy to find the more sensitive spots on the crystal by using a test buzzer. This has been described in Circular 120 and is shown at Z, Fig. 3, in that publication. Referring to this figure, the binding post marked "ground" should be connected by a flexible wire to the binding post W, which is shown in Fig. 1 in this pamphlet.

Approximate Cost of Parts.

The following parts are used in the equipment described in Circular 120 and are needed also for the two-circuit set described in this pamphlet.

Antenna:	
Wire—copper, bare or insulated	
No. 14 or 16, 100 to 150 ft., about.....	\$ 0.75
Rope—1-4 or 3-8 inch, 2c per foot	
2 Insulators—porcelain.....	0.20
1 Pulley.....	0.15
Lighting Switch—30-ampere battery switch030
1 Porcelain Tube.....	0.10
Ground Connections:	
Wire (same kind as antenna wire)	
2 Clamps.....	0.30
1 Iron Pipe or Rod.....	0.25
Receiving Set:	
3 Ounces No. 24 double cotton covered copper wire.....	0.40
1 Round Cardboard Box	
2 Switch Knobs and blades, complete.....	1.00
18 Switch Contacts and nuts.....	0.75
3 Binding Posts—set-screw type	0.45
2 Binding Posts—any type	0.30
1 Crystal—tested	0.25
3 Wood Screws—brass, 3-4 inch long	0.03
2 Wood Screws for fastening panel to base	0.02
Wood for panels (from packing box)	
2 Pounds Paraffin.....	0.30
Lamp Cord—2 to 3 cents per foot	
Test Buzzer.....	0.50
Dry Battery.....	0.30
Telephone Receivers..\$ 4.00 to \$ 8.00	
Total.....	\$10.35 to \$14.35

The following additional parts will be required:

3 Ounces No. 24 double cotton covered copper wire.....	\$ 0.40
1 Round Cardboard Box	
1 Switch Knob and blade, complete.....	0.50
6 Switch Contacts and nuts.....	0.25
2 Binding Posts—any type	0.30
1 Battery Clip for crystal.....	0.10
Miscellaneous Screws.....	0.30
1 Variable Condenser—0.0004 to 0.0005 microfarads (400 to 500 micromicrofarads.....	3.00 to 6.00

Total additional cost...\$ 4.85 to \$ 7.85

A One Tube Set

(Continued from page 5.)

tubes may be used, including the W-D-11.

The phone condenser "8" is a .001 fixed mica condenser. Any good phones of 2,000 ohms or more may be used, and a variable "B" battery of 22 1-2 volts will supply the plate current. To tune the set, it should be handled in the same way as any ordinary regenerative set and a little practice is all that is needed to accomplish this. The values of the phone condenser, grid condenser and leak plate and filament voltages have much to do with the efficient working of the instrument.

Local and long distance reception can be obtained with this set if the instructions are carefully followed.

The Super-Radio Survey

By L. J. LESH

THE writer has been actively interested for several years in the subject of radio broadcasting, both by telegraph signals and voice. This interest first resulted in the design, construction and operation of privately owned transatlantic receiving stations located in the offices of The New York Times and The Philadelphia Public Ledger.

These stations successfully copied the radio news broadcasts transmitted from Nauen, Germany, and Bordeaux, France, in addition to regular news items addressed to the papers in question. A considerable saving in time was thus effected over reception and retransmission over land lines from the more distant receiving stations of the company conducting the transmission. This direct service was effective about four months out of the year but during the remainder of the time was seriously interfered with by static.

Following the suggestion of the writer, a centralized receiving station was located in Canada where summer static is somewhat reduced and the messages dispatched over land lines to the newspapers with a minimum of delay and no confusion with the mass of regular commercial radio correspondence which is transmitted at a much higher charge per word and would otherwise claim priority in delivery to destination.

Shortly after the World War it became apparent that radiophone transmitters had reached a state

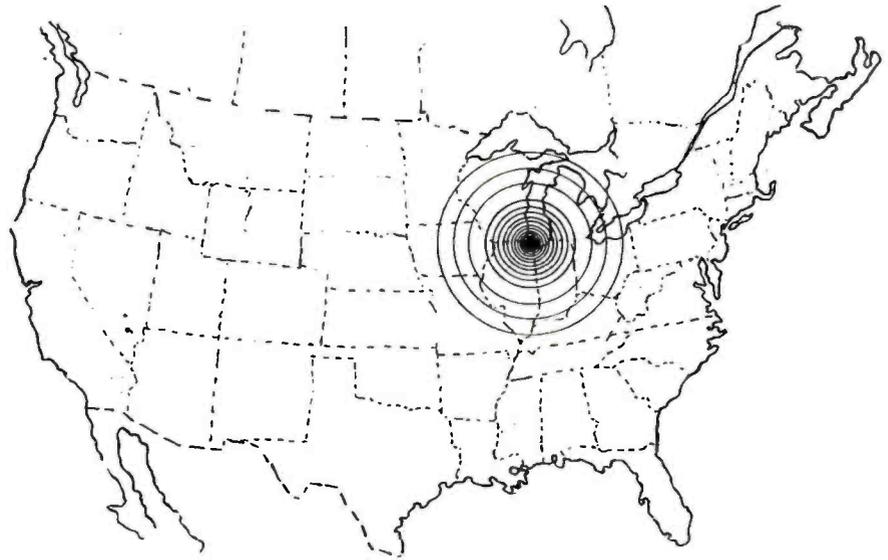
of development where they could be used practically for broadcasting voice and music distances of over five hundred miles. It became evident that the voice on the air might serve the large newspaper syndicates in delivering news to their subscriber publications scattered over the country and the International News was approached on the subject. Through the encouragement of its director, Mr. Marlin Pew, a study was made of this problem and a report submitted in which the various advantages and difficulties were point-

ed out in comparison with the method of distribution in use employing an elaborate network of leased telegraph wires and "looped" or broadcast wire, telephone circuits enabling one announcer at a central office to transmit news items to a number of telephone subscribers simultaneously, these subscribers being the small publications served by the syndicate.

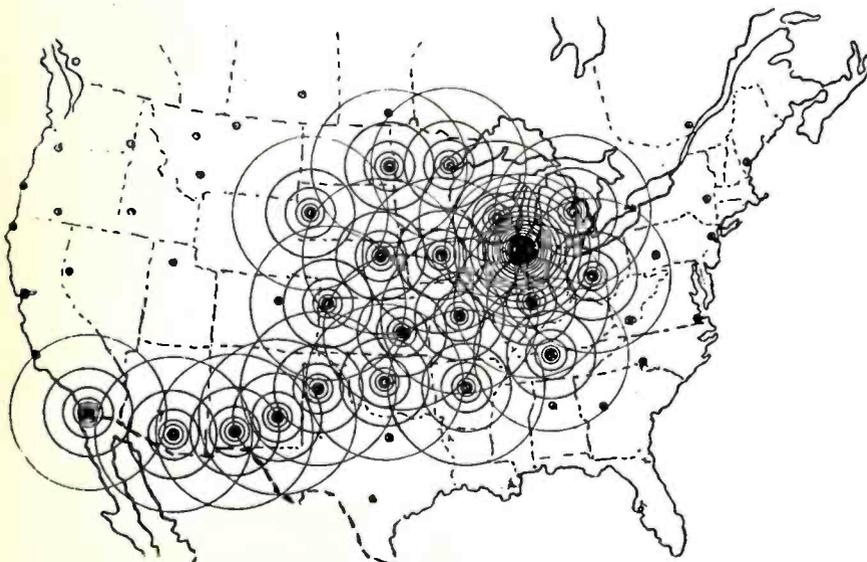
It was concluded that the establishment of a very powerful radio voice distributing station in the centre of the country, which appeared to be the logical solution, was somewhat premature and it seemed best to wait and watch developments. In spite of this decision it might be mentioned that even at that date, about three years ago, the engineers of the large corporation perfecting the radio telephone informally expressed themselves as confident that the plan was feasible and that a central voice broadcasting station radiating sufficient energy to reach the desk of about one-half of the small newspaper editors of the country could be built and economically operated except during the worst periods of summer static interference.

This static bugbear meant that in all probability the syndicates would have to revert to the land lines for a period during the summer and from the leased wire standpoint this was an impossible situation.

Considerable water has flowed under the bridges since that time and it now appears that the static



RELIABLE DAYLIGHT RANGE OF CHICAGO BROADCASTING STATION UNDER PRESENT OPERATION.



SUPERADIO BROADCAST USING PART OF EXISTING STATIONS TO COVER MIDWEST U.S. AND OPEN SOUTHERN ROUTE TO CALIFORNIA. OTHER STRATEGIC STATIONS SHOWN.

difficulty can be overcome. The plan will be described as the Super-radio Survey after its big brother, the Super-Power Survey which links together the power plants and network of electrical distribution wires of the eastern part of the United States, effecting many economies and nicely balancing the demand and supply of electricity for light heat and power in the cities as well as the small towns.

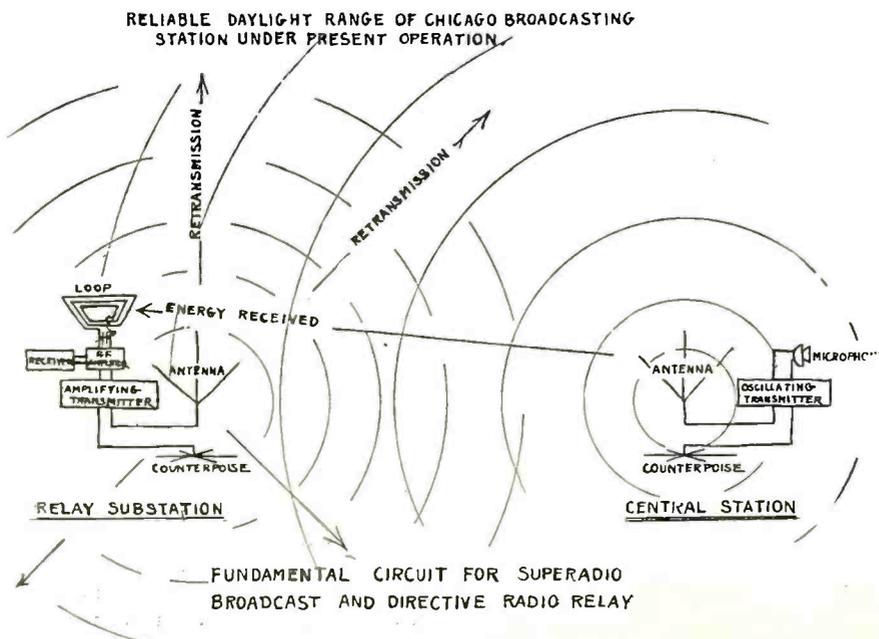
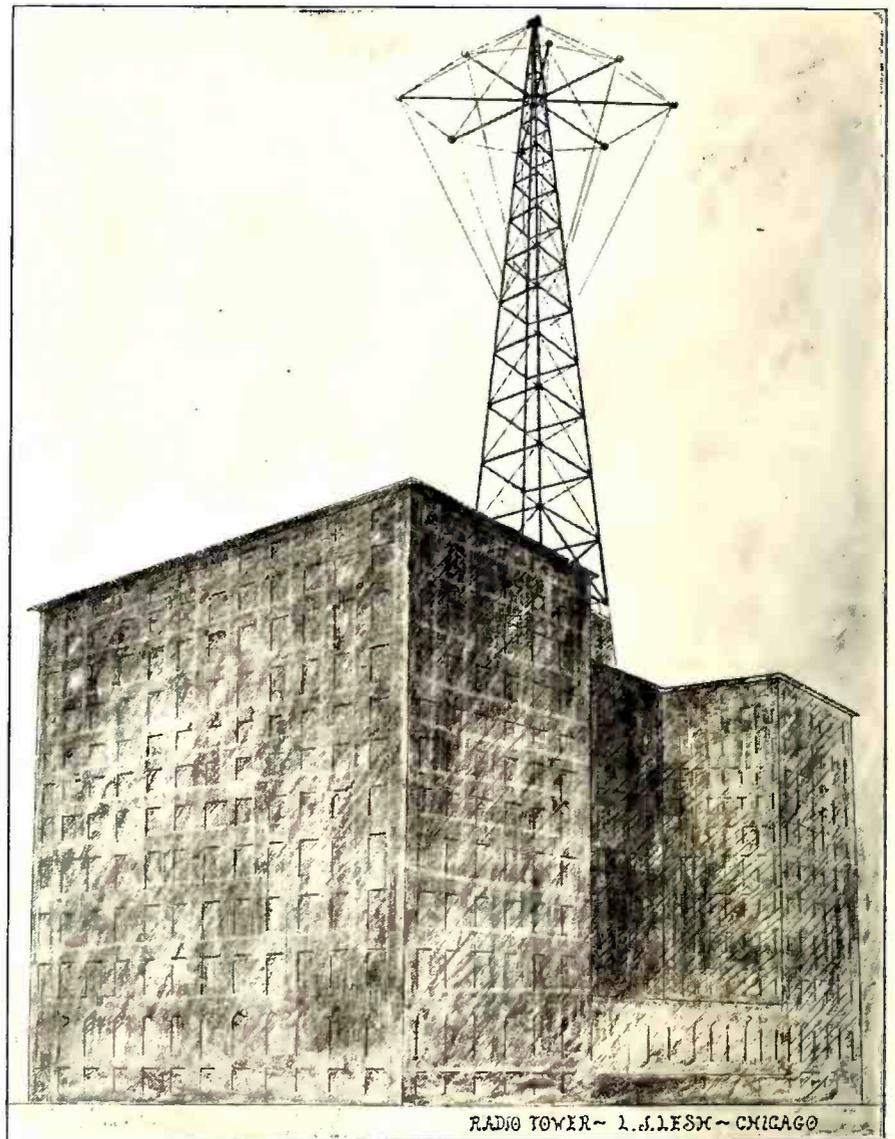
At present the situation in radio broadcasting is highly chaotic and inefficient. It will be even more so during the coming summer when static limits the daylight range of the most powerful broadcasting stations to a few hundred miles during daylight unless something is done to improve matters. So long as the listeners are only tuning in for musical concerts, static and weakened signals will merely spoil their pleasant evenings with the loud speaker, but for that portion of the daily broadcast which endeavors to get market prices of commodities to the large audience of farmers and small town listeners the failure of transmission will result in a serious economic loss all around.

The only way known at present to cope with static or atmospheric interferences in radio is to overpower the static. That is to project such a powerful volume of radio voice that the received intensity exceeds that of the static crashes and noises. The radio receiving set may then be adjusted so that it will only respond to the voice or music wave while the static of lesser intensity is unable to open the door or climb in the window, so to speak.

Within about one hundred miles of a very powerful broadcasting station, the voice is understandable even during the worst parts of the summer using proper receiving

equipment which need not be expensive. Considering this fact in relation to the broadcasting of market quotations from Chicago it becomes obvious that in order to reach out five hundred miles, as is necessary, either the power of the central transmitter at Chicago must be enormously increased or a method of relaying the voice to the outlying districts must be adopted. The transmitter necessary to give an audible voice at five hundred miles would be very expensive and cumbersome with the additional disadvantage that the signal intensity would be unevenly and inefficiently distributed, being unnecessarily loud near the central station and weakest at the limits of reception where, unfortunately the broadcast information is most interesting on account of distance and absence of other sources of news.

Relaying the voice by means of radio substations appears to be the only solution and I will now describe how this is to be done from

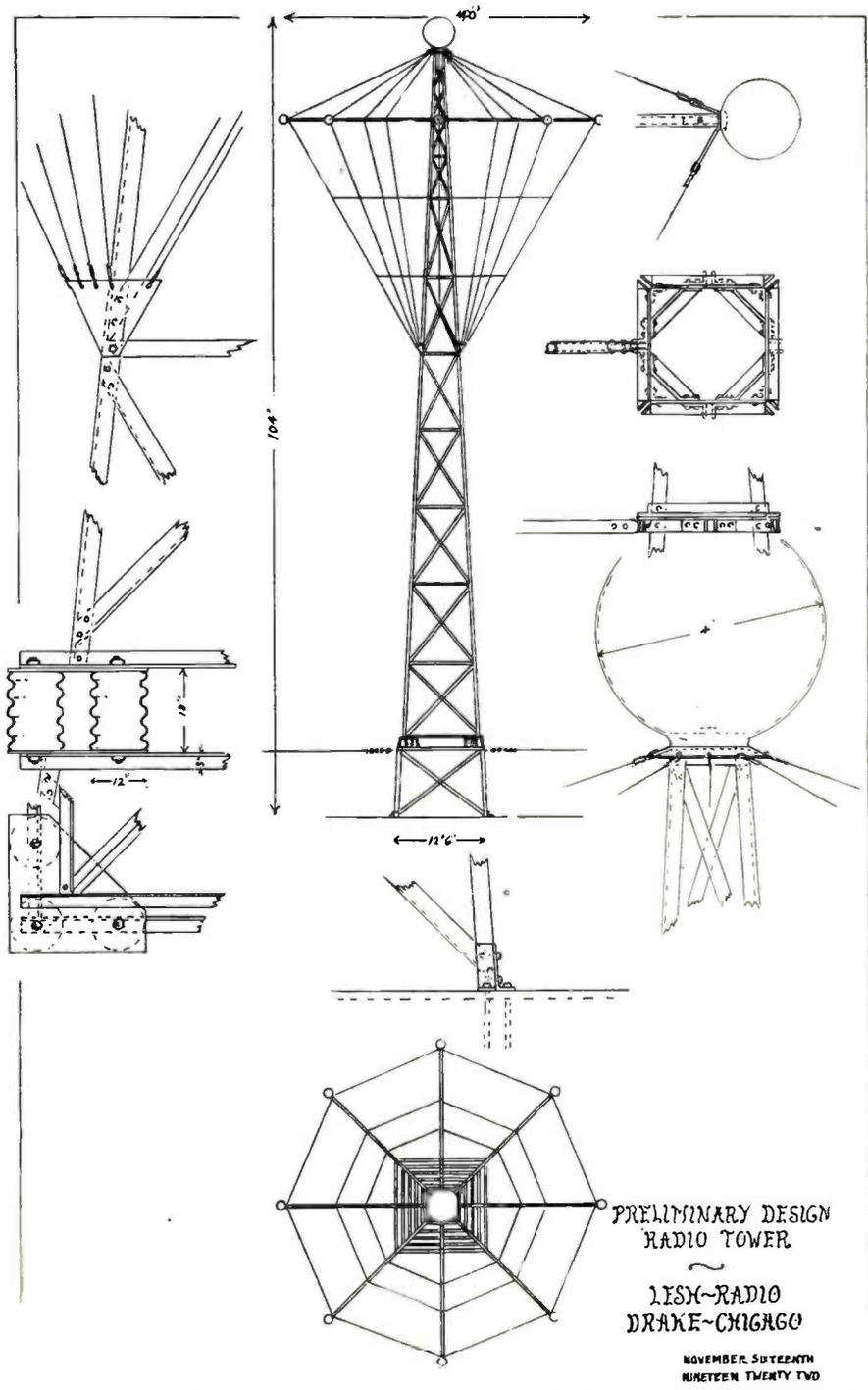


a central station, WDAP located on the Drake Hotel, Chicago, owned by the Chicago Board of Trade and operated by the Midwest Radio Central of which Thorne Donnelly and J. Elliot Jenkins are the principals. For the central radiating structure, the writer has designed a new form of tower, serving the purpose of a transmitting antenna. This tower, which is entirely of metal, is insulated at its base and has been approved by competent authorities from an electrical and mechanical standpoint. It will be energized by a three kilowatt radiophone transmitter tuned very sharply as to wave length. The direct range of this equipment is expected to exceed two hundred miles during the worst periods of daylight reception in the summer.

Within a range of two hundred miles of Chicago there are located several smaller radiophone transmitting stations and where possible, these together with other special stations to be erected will serve as substations or relays "boosting" the voice of the central station onward during the period of transmission of vital information, such as market values, with the result that the entire area within five hundred miles of Chicago will be "blanketed" by the voice of WDAP to an even intensity at all parts of the region. The cooperation of local Boards of Trade and similar institutions in the smaller cities in this matter is quite assured from the fact that they receive their market quotations from Chicago.

The design of the substations or relays offers little difficulty and will add very little to the cost of existing available broadcast transmitters which may be easily adapted to the new function. The method employed will be to pick up the voice of the central station on a receiving loop and amplify the energy at radio frequency by means of the local transmitter maintained, of course, in a non-oscillating condition. The operator of the substation will be able to listen to the signal as it passes through his relay and easily tune his transmitter so that it amplifies only the voice of the central station. The use of a directive loop for reception will further assist him in avoiding the amplification of signals from other broadcasting stations unless they happen to be on exactly the same wave length as the radio central and in the same direction.

A further expansion of the Super-Radio Survey will apply to the general broadcasting of music and



news all over the country with the practical annihilation of static except in isolated cases. To accomplish this result, an arrangement will be worked out whereby radiophone transmitters not engaged in direct broadcasting will operate as tuned amplifiers of energy picked up from active stations, reradiating the distant music or voice over a local area. The proper employment of the relaying principle will also make possible a degree of directive radio telephony at desired periods, broadcasting stations across the country being linked in line so that a message may be transmitted from coast to coast with a minimum

amount of total power, the signal intensity at the terminal station, say three thousand miles away, being the same as the voice heard only two hundred miles from the point of origin.

In conclusion, it might be pointed out that the thought of relaying radio has been suggested many times before and is even now being practiced but in a much different manner than that outlined by station KDKA at Pittsburgh. KDKA picks up the Arlington time signals on long wave, reduces them to audio frequency and then causes the

(Continued on page 30.)

Pick-up Records by Our Readers

I enclose a "hook-up" and also a very good idea which I believe never to have been published in any Radio magazine before.

I am enclosing a list of the stations that I have heard with this hook-up. They are as follows: KDKA, East Pittsburgh; KDZL, Ogden, Utah; KFAF, Denver, Colo.; KWKY, Chicago; WBAY, New York; WDAP, Chicago; WDAJ, College Park, Ga.; WDAI, Syracuse, N. Y.; WDAF, Kansas City; WDA, Nashville; WCX, Detroit; WCM, Austin, Texas; WBT, Charlotte, N. C.; WFAA, Dallas, Texas; WGM, Atlanta, Ga.; WGY, Schenectady, N. Y.; WHA, Madison, Wis.; WHAS, Louisville, Ky.; —, Atlantic City; WHB, Kansas City; WIAF, New Orleans; WNAC, Boston; WMAQ, Chicago; WKY, Oklahoma City;

on an average of fifteen to twenty stations in three hours. The farthest being Salt Lake City, a distance of about 2,000 miles.

I hope that you will publish all information I have sent and also this letter if you wish.

Yours very truly,
LEON P. SAID,

1065 So. Wellington St., Memphis, Tenn.

Radio Fans:

Here is something that might hold your interest awhile. This hook-up is an improvement on one published some time ago in the "Mail" and you can take it from your Uncle Dudley that it is a Lulu. It is the sad truth when I say

condenser. This is proof to me that it pays to experiment.

MYRON P. GREEN,
560 W. 192nd Street, N. Y.

Duke's Demon

The hookup illustrated below is all that the name implies—it is a demon for audibility.

Material required: 1 variometer; 1 43-plate condenser; 3 binding posts; 1 open circuit jack; 1 vernier rheostat; 1 socket; 1 grid condenser with leak; 1 23-plate condenser.

In the illustration C1 is the 23-

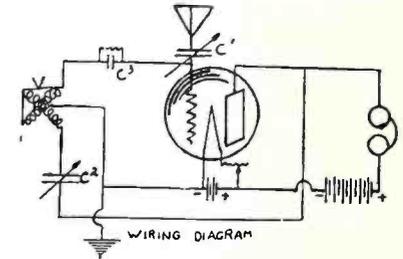


plate condenser and C2 is the 43-plate. In connecting the variometer first be sure that the rotor is in series between the halves of the stator, then shunt the ends of the rotor and take a lead from there to the ground. This connection is the secret of the set and should be made exactly as stated. The 23-plate condenser, C1, is not necessary when only broadcasting is wanted as the natural wave-length of the set is higher than 200 meters. If less than 300 meters is wanted the 23-plate condenser is necessary in the antennae circuit.

This set is very sharp on the variometer and regeneration is controlled with the 43-plate condenser. Audibility is better than any hook up the writer has tried and is equal to that of a single-circuit of the most popular type using one-stage of amplification —From Carl E. Duke, 2625 Yale Boulevard, Springfield, Ill.

John A. Barnes, 5911 MacPherson Avenue, St. Louis, writes:

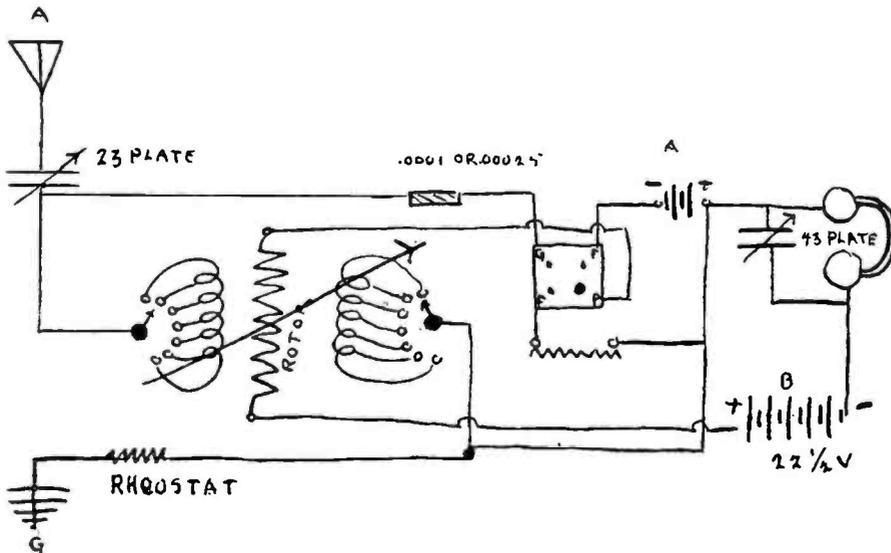
I have been reading your radio column and would like to submit to you the record I obtained on a two slide, one tube set with a one wire antenna, the stations and their air line distance from St. Louis:

- | | |
|-----------------|-----------------|
| WOC, 200 miles | WL2, 400 miles |
| WHB, 200 miles | WBAP, 550 miles |
| WSB, 500 miles | WLAD, 400 miles |
| WGM, 500 miles | WDAJ, 520 miles |
| WDAL, 750 miles | KDKA, 600 miles |
| WMAK, 650 miles | KYW, 250 miles |
| WWJ, 450 miles | |

I believe this to be good for the type of set I am using.

Varsity Radio

Authorities of the University of Pennsylvania have announced that a course in "principles underlying radio communication" will be added to the curriculum.

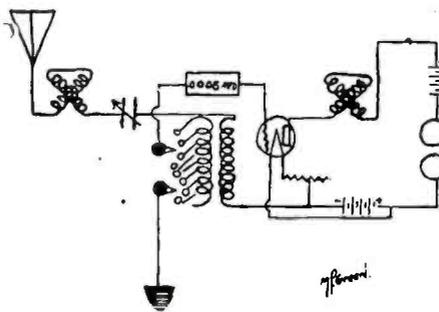


WLW, Cincinnati; WLAG, Minneapolis; WLAP, Louisville, Ky.; WLD, Ludington, Mich.; WSB, Atlanta; WOU, Omaha, Nebr.; WOR, Newark; N. J.; WOS, Jefferson City, Mo.; WOC, Davenport, Iowa; WOAN, Lawrenceburg, Tenn.; WOAI, San Antonio, Texas; WSY, Birmingham, Ala.; KSD, St. Louis; WBAP, Ft. Worth; WDAE, Tampa, Fla.

Last night when I started to tune in all I did was turn the rheostat that controls the filament just about one-fourth inch and I heard someone talking but it was not clear so I turned the rheostat I have in the ground and this is what I heard, "This is the Atlanta Journal."

I have an aerial 125-feet long and a counterpoise the same length. I hear

there are many radio fans who, when relating the merits of their own pet hook-ups, draw somewhat upon their imagination and sometimes strain the credulity of



those listening. But don't, please, put me in that category when I say I have got PWX, Havana, Cuba and CFCA, Toronto, Canada, on one tube and have been able to tune in PWX while WJZ was on. Can get any one of the local stations loud enough to put on my speaker, also on one tube.

Am using a two-wire aerial, 150 feet long, with an 85-foot lead-in.

Live in Washington Heights, New York, on the ground floor of an apartment house. Use 46-plate vernier type

RHEOSTAT IN GROUND TAKES OUT NOISES IN WDM TUBE CIRCUITS



Questions and Answers

P. A. A., Burlington, Wis.

Question: I have just within the past two months "hooked up" with your valuable paper. I have become interested in winding a Reinartz tuner and have been trying to get some information as to the winding of the inductance. I am submitting a few questions which, if you will please answer, will clear up my difficulty. What is the size of the form on which the winding is made, using D. C. C. 22 wire, if this size is suitable? What is the proper position of the three windings on the form, and the proper number of turns to the taps of each winding? According to the diagram I have of the Reinartz hook-up two of the windings are continuous with a tap on the back, or between these windings for a lead to the negative filament. Is this correct? About what wave length will this tuner cover? I would like it to run from 300 to at least 600 meters. Am not particular about size. I will appreciate it very much if you will answer the above questions.

Answer: No. 22 is rather large. Better use No. 24. Form 6 1-2 inches in diameter will do. Would suggest that you get a copy of the September issue, which contains all this information. Wave length is 170 to 570 meters.

G. L. W., Chicago, Ill.

Question: Sometime ago I wrote you in regard to a hook-up diagram of a Reinartz tuner, using one step of radio frequency amplification, but as I did not receive an answer, evidently you did not receive my letter. I have constructed a Reinartz tuner from your article in the November issue of Radio Age. I would now like to put in one step of radio frequency amplification. Will you kindly send me a diagram for this circuit?

Answer: Great Scott, G. L. W., if you knew the number of inquiries this department is getting these days, you would not wonder why you did not get your circuit, but I am making good right now and mailing it to you. Hope you have good luck with it.

L. A. H., Ellis, Kansas.

Question: About a week ago I sent you a list of my troubles with the Reinartz coil which I made. I am not sure that I sent a stamped envelope for reply. I enclose one in this letter. I also forgot to state that I used rubber and braid covered wire for the set wiring. My aerial is No. 14 solid copper, 75 feet long and 35 feet high. I rewired the set last night, using No. 16 bare copper, which made a decided improvement in the set. Was necessary to shield the tuner with tin foil. With it, in a few minutes I had Davenport, Iowa, Minneapolis, Atlanta, Ga., Dallas, Texas, and Los Angeles, Calif. Used Cunningham amplifier tube C-301 as a detector and one stage of amplification. My detector tube, C-300, cannot get anything through it. Lights up O. K. Have tested the grid and plate terminals, with tube out of circuit and

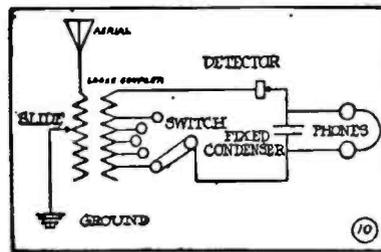
the phone receivers show a circuit through to the filament when it is lighted, but when in the set I get nothing. Referring to the tuner coil, I am using rubber tubing on the taps leading to the switch contacts. Would this have any effect on it?

Answer: The rubber and braid covered wire did not cause your trouble. You probably repaired some poor connection when you rewired it. Once in a while you will find a tube which for some reason will not oscillate. This is probably your answer. Keep the amplifier tube, it is a dandy. The rubber tubing is all right and is just as good as the other insulations.

J. W. R., Milwaukee, Wis.

Question: Wish to ask you if you would kindly draw a diagram for me, showing just how and where the different connections should be on a loose coupler crystal radio set? On the other side of this sheet I have given full description of my set as far as I got with it, but am puzzled about the connections. Your information will be much appreciated.

Answer: Drawing of the circuit follows.



J. F. S., Peoria, Ill.

Question: Enclosed find diagram of set. Is this a good one, and how far can I hear with it? Please send me a diagram of how to make a good tube set out of this one.

Answer: The set is a good one if you reverse the position of the two condensers shown to the right of the variometer. It will not function well as shown.

Hook-up Ideas Are Worth \$1

EACH radio fan who experiments finds something about design or operation that will help his fellow fan. Send in your new hook-ups and other original devices, accompanied by clearly drawn diagrams. Radio Age will pay \$1 for all such original articles and drawings used. Text should be limited to about two hundred words.

Am mailing a circuit showing how to make the change to a tube set.

F. H., Chicago, Ill.

Question: I have two transformers from a Western Electric set. Each has five taps, marked as shown in the enclosed sketch, and numbered as shown. I would like to hook up this transformer on a Reinartz tuner having one step of radio and one step of audio frequency, described in the November issue of the Radio Age. Will you please send me a sketch showing how to hook these transformers up to this set?

Answer: This transformer can only be used for the audio frequency amplification, and you will not need a sketch for it. Use the contacts 1 and 2 for the primary connections as shown in the November issue, and use contacts 3 and 5 for the secondary connections.

F. F. F., St. Louis, Mo.

Question: I am constructing a Reinartz set according to the plans in your magazine. I note an article in the question and answer department which says this set is limited to receive on 130 to 370 meters. Now the broadcasting in this locality is on 400 to 485 meters. Can you instruct me how to build this set to receive up to 500 meters? I would also like to have instructions for tuning.

Answer: This statement was a mistake, as the tuner as described will tune to something over 400 meters, and is capable of receiving waves of 485 meters without any change. If, however, it does not come in as clear as desired, the coil can be rewound, and a few more turns put on to the aerial coil. The same result can be obtained by putting a little inductance in the aerial circuit. The tuning of this set is a matter of practice and no set rules can be given which will apply in every case.

Phonograph Attachment

The Gilbert H. Downey Co., 7 South Seventeenth Street, Philadelphia, Pa., have completed and have ready for distribution their new "E-C" (Easy Change) phonograph attachment for the Victor and Columbia phonographs.

This attachment is complete with special loud speaking unit (with cord) and aluminum case, which fastens on to the tone arm of the phonograph after the reproducer is removed. There are no set-screws to injure the unit.

A phonograph with the "E-C" attachment makes a loud-speaker for the home at a very low cost.

FREE! WITH HOOK-UPS!

REINARTZ RADIO, most popular booklet of year, sent postpaid with one year's subscription to Radio Age for only \$2.00. This is Special Offer for April. Get one while they last. Send currency, check or money order to Radio Age, 64 West Randolph Street, Chicago, Ill.

The Monthly Service Bulletin of the
NATIONAL BROADCASTERS' LEAGUE

Solely by, of and for Radio Broadcasting Station Owners

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Executive Offices, Garrick Building, Chicago, Ill.

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RADIO CONFERENCE.

Just before going to press with this issue, Radio Age received from the Department of Commerce the following announcement, dated March 6:

"The Department of Commerce has sent out invitations for a reassembly of the radio conference held a year ago, together with some additional members.

"The conference held last year was for the purpose of considering legislation necessary in order to reduce the amount of interference in radio broadcasting. The legislation having failed to pass Congress it is felt desirable to investigate what administrative measures may properly be taken temporarily to lessen the amount of interference in broadcasting.

"Since the last conference the number of broadcasting stations has increased from 60 to 581, and it is estimated that somewhere between 1,500,000 to 2,500,000 receiving stations are now in use. The amount of interference has increased greatly and threatens to 'destroy the growth of the art.

"The conference will start on Tuesday morning, March 20, at 11 o'clock at the Department of Commerce."

Arrangements were at once made to insure the presence of representatives of the National Broadcasters' League at this conference. Details will be published in the May issue.

"PIKER CODE-SENDERS."

Radio Age:

I am a constant reader of Radio Age and appreciate your paper and pointed editorials. Can't you do something with those "piker code-senders," who are always spoiling the concerts with their foolish prattle?

Silent night in Chicago is a joke when they permit these heroes to butt in and "destroy the air." If they must play the hog let them put mufflers on their clap-

traps. Concerts coming in from the South and West tonight, Monday, March 5, were really spoiled by these pikers.

Please do something for the cause and thousands will thank you.

Sincerely,

A READER AND BOOSTER.

We also had some trouble tuning out several industrious code-senders on the night mentioned. But we must all admit that the fellows who used to have the air all to themselves have shown a commendable spirit in trying to play the

OWNERS of broadcasting stations who have not yet joined the National Broadcasters' League, may do so by sending their check for the annual membership fee of \$10 to Frederick Smith, Secretary, Garrick Building, Chicago.

Membership will entitle broadcasters to periodical information as to developments in connection with broadcasting, intelligence as to steps taken to eliminate the present almost disastrous interference and news of events in any part of the country affecting broadcasting and broadcasting interests. Also members will receive the official organ of the league for one year.

This nominal fee is required for the cost of issuing circulars and handling the large volume of correspondence. You will find it useful to be associated directly with this clearing house for broadcasting information, which is also a protective institution, offensive and defensive.

game and the Relay League itself is doing what it can. In radio pursuits patience must be something more than a virtue. It must be a habit. Still we admit that had it not been for our pious nature we should have done a little swearing on the night of the 5th.—
[The Editor.]

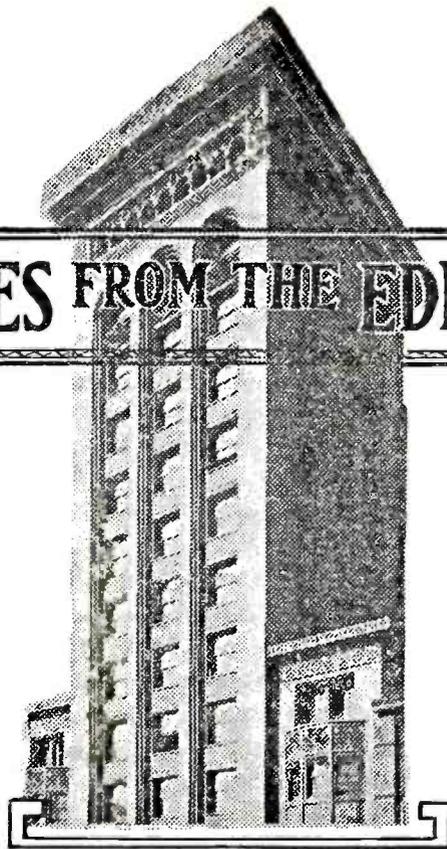
The Department of Commerce has advised broadcasters through the medium of the Radio Service Bulletin that they must comply with regulations and confine their radio activities to broadcasting. A broadcasting license does not permit special tests of radio telephone or telegraph apparatus, communication with specific stations, either ashore or at sea, or any transmission except entertainment, market and weather reports and news on 360 or 400 meters, as the license may specify.

Some stations have stopped acknowledging letters, telegrams and telephone calls, but they talk to one another, conduct contests, which approximate advertising, and some carry on experiments of various kinds. This practice has become so general the Departmental Officials state some new regulations may have to be provided. Special licenses and waves are necessary for code work, station to station transmission and experimental work. There are too many stations licensed for such operation now, it is explained, and when the broadcasters enter this field the interference increases.

All station owners are advised to give their licenses the "once over" and familiarize themselves with exactly what they are permitted to do.

Send \$1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is \$2.50 a year.

THOUGHT WAVES FROM THE EDITORIAL TOWER



IN the January issue of the "World Wide Wireless," a house organ published by the Radio Corporation of America, there appears the following quotation from Daniel Webster:

"Constantly Clamoring.

"There are persons who constantly clamor. They complain of oppression, speculation and the pernicious influence of accumulated wealth. They cry out loudly against all banks and corporations and all means by which small capitals become united in order to produce important and beneficial results. They carry on mad hostility against all established institutions. In a country of unbounded liberty they clamor against oppression. In a country of perfect equality they would move heaven and earth against privilege and monopoly. In a country where the wages of labor are high beyond parallel they would teach the laborer that he is but an oppressed slave."—[Daniel Webster.

In view of the fact that the Radio Corporation was accused in the latest session of Congress of attempting to monopolize the radio industry to the detriment of the fans this quotation is significant.

It is all the more interesting when we pause to consider that the Radio Corporation has undertaken a series of patent suits which would prevent competitors from making equipment necessary to the radio art. The corporation has sued Grebe and it has sued De Forest and both defendants contend that if the corporation wins the victory will tend to give the Woolworth Building people a monopoly.

Does the corporation, in quoting Daniel Webster, mean to imply that in opposing monopoly of radio manufacture and sale radio fans are aligning themselves with labor agitators and chronic kickers? If so there are some other pertinent quotations from sources just as credible as the great Webster from whom we have received counsel about monopolies.

In 1641 the Massachusetts General Court established the "Body of Liberties," which was the first code of laws authorized in New England. This code in section 9 provided:

"No monopolies shall be granted or allowed amongst us, but of such new inventions that are profitable to the country, and that for a short time."

Perhaps the corporation has not read what Francis Bacon, the premier essayist, wrote about monopolies in 1625. Then again, probably the corporation did read Bacon's essays and, to put it in the vernacular, got a hunch from them. In essay XXXIV Bacon wrote:

"Monopolies, and coemption of wares for re-sale, where they are not restrained, are great means to enrich; especially if the party have intelligence what things are to come into request, and so store himself beforehand."

Then there is Adam Smith. Back in 1776, Smith wrote "Wealth of Nations" the best all-around statement of the science of economics ever published. This peerless scholar and thinker believed that free competition would permit industrial problems to solve themselves and the practical maximum of efficiency would be reached.

Adam Smith was a clamorer, too, it seems. He wrote:

"A monopoly granted either to an

individual or to a trading company has the same effect as a secret in trade or manufactures. Monopolists, by keeping the market constantly understocked, by never fully supplying the effectual demand sell their commodities much above the natural price and raise their emoluments, whether they consist in wages or profits greatly above the natural rate.

"The price of monopoly is upon every occasion the highest that can be got. The natural price, or the price of free competition, on the contrary, is the lowest that can be taken, not upon every occasion, indeed, but for any considerable time together. The one is upon every occasion the highest that can be squeezed out of the buyers, or which it is supposed, they will consent to give: The other is the lowest which the sellers can commonly afford to take, and at the same time continue their business."

Yes, radio fans, in "constantly clamoring" are only following illustrious examples reaching back for centuries. If the fans ever stop clamoring against monopoly in tubes let them expect, as Adam Smith says, to pay the highest prices "that can be squeezed out of the buyers."

Any individual, publication, corporation or company that favors a monopoly in radio manufacture or sales is an enemy of popularized radio.

THE WHITE Radio Bill died in committee along with a number of other important legislative documents when the 67th Congress adjourned on March 4. The House and Senate do not convene until December 4, when a new bill will probably be introduced—but that is nine months away.

Whether Secretary Hoover can manage to keep the ether from getting more jammed with broadcasts and other radio communications without legislation, remains to

(Continued on page 30.)

Corrected List of U. S. Stations Alphabetically by Call Signals

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers. Broadcasters: Send in your program schedules.

- IXAD, Pawtucket, R. I. 300 and 600 meters; 1000 miles; Special license experimental; Standard Radio & Electric Co.
 KDKA, E. Pittsburgh, Pa.; Class B station, up to 485 meters; Westinghouse Elec. & Mfg. Co.
 KDN, San Francisco, Calif.; Leo J. Meyberg Co.
 KDDW, Steamship America, New York.
 KDFM, Cleveland, Ohio; Westinghouse Elec. & Mfg. Co.
 KDPT, San Diego, Calif.; Southern Elec. Co.
 KDYL, Salt Lake City, Utah; news music, entertainment, Telegram Publishing Co.
 KDYM, San Diego, Calif.; Savoy Theatre.
 KDYG, Portland, Ore.; Oregon Inst. Technology.
 KDYS, Great Falls, Mont.; Class B, 485 meters, Great Falls Tribune.
 KDYV, Salt Lake City, Utah; Cope & Cornwell Co.
 KDYW, Phoenix, Arizona; Smith Hughes & Co.
 KDYX, Honolulu, T. H.; 860 wave length; 12:15 to 1:15 p. m., stock reports and weather; 6:30 to 7:30 p. m., music, lectures; Sundays, 11 a. m. to 12:30 p. m., sermon; Honolulu Star-Bulletin, Ltd.
 KDZA, Tucson, Ariz.; Arizona Daily Star.
 KDZE, Bakersfield, Calif.; Frank E. Seifert.
 KDZF, Seattle, Wash.; Rhoads Co.
 KDZF, Los Angeles, Calif.; Automobile Club of Southern California.
 KDZG, San Francisco, Calif.; Cyrus Pierce & Co.
 KDZH, Fresno, Calif.; Fresno Evening Herald, Class B, 845.
 KDZI, Wenatchee, Wash.; Electric Supply Co.
 KDZK, Reno, Nev. Wednesday 8 to 9 p. m., Friday 8 to 9 p. m. Musical and news features; Nevada State Journal, Nevada Machinery & Electric Co.
 KDZL, Ogden, Utah; Rocky Mountain Rad. Corp.
 KDZM, Centralia, Wash.; E. A. Hollingworth.
 KDZQ, Denver, Colo.; Motor Generator Co.
 KDZX, San Francisco, Calif.; Glad Tidings Tabernacle.
 KDZZ, Everett, Washington; Kinney Bros. & Sidprell.
 KFAD, Phoenix, Ariz.; Class B, 485, McArthur Bros. Mercantile Co.
 KFAE, E. Pullman, Wash.; State College of Washington.
 KFAF, Denver, Colorado; George S. Walker, Western Radio Corporation; musical programs, news items, etc., daily except Tuesday and Sunday, 8 to 9 p. m.; mountain standard time.
 KFAJ, Boulder, Colo.; University of Colorado.
 KFAN, Moscow, Idaho; Electric Pub. Co.
 KFAP, Butte, Mont.; Standard Sub. Co.
 KFAS, San Jose, Calif.; City of San Jose.
 KFAR, Hollywood, Calif.; Studio Lighting Service Co.
 KFAS, Reno, Nev.; Reno Motor Supply Co.
 KFAT, Eugene, Ore. Monday, Wednesday and Saturday 8 to 9 p. m. Music; Sunday 8:30 to 9:15 Church Services; Pacific Radio Co.
 KFAU, Boise, Idaho; Class B, 485, Boise High School.
 KFAV, Venice, Calif.; Abbott Kinney Co.
 KFAW, Santa Anna, Calif.; Class B, 485, Radio Den.
 KFAZ, Central Point, Ore.; W. J. Virgin Milling Co.
 KFAZ, Reddley, Calif.; C. H. Weatherill.
 KFBB, Havre, Mont.; F. A. Buttrey & Co.
 KFBC, San Diego, Calif.; W. K. Azbill.
 KFBD, Hanford, Calif.; California Radio Lab.
 KFBE, San Louis Obispo, Calif.; R. H. Horn.
 KFBF, Tacoma, Wash.; First Presbyterian Church.
 KFBN, Marshfield, Ore.; Thomas Musical Co.
 KFBB, Sacramento, Calif., 2,000 miles; daily, 3 to 4 p. m. and 6 to 6:30 p. m.; Sunday and Thursday 8 to 9 p. m.; Kimball-Upson Co. and Sacramento Union.
 KFBL, Everett, Wash.; Lesse Bros.
 KFBU, Laramie, Wyo.; N. S. Thomas.
 KFV, Colorado Springs, Colo.; Clarence O. Ford.
 KFCC, Phoenix, Ariz.; Nielson Radio Supply Co.
 KFCC, Wallace, Ida.; Auto Supply Co.
 KFCD, Salem, Ore.; F. S. Barton.
 KFCE, Walla Walla, Wash.; Frank A. Moore.
 KFCH, Billings, Mont.; Elec. Service Station.
 KFCK, Colorado Springs, Colo.; Clarence Springs Radio Co.
 KFCL, Richmond, Calif.; Richmond Radio Shop.
 KFCE, Ogden, Utah, Ralph W. Flykare.
 KFCE, Houston, Tex.; Fred Mahaffey, Jr.
 KFCE, Le Mars, Ia.; Western Union College.
 KFCE, Omaha, Neb.; Omaha Central High School.
 KFDA, Baker, Ore.; Adler's Music Store.
 KFDB, San Francisco, Calif.; Mercantile Trust Co., also 400.
 KFDE, Boise, Idaho; St. Michael's Cathedral.
 KFDD, Bozeman, Mont.; Everett H. Cuttins.
 KFDP, Des Moines, Ia.; Hawkeye Radio & Supply Co.
 KFDS, San Francisco, Calif.; John D. McKee.
 KFDD, Lincoln, Nebr.; Nebraska Radio Electric Co.
 KFDDV, Fayetteville, Ark.; Gilbrech & Stinson.
 KFDE, Taft, Calif.; City of Taft.
 KFDE, Oak, Nebraska; J. L. Scroggin.
 KFDE, Casper, Wyo.; Motor Service Station.
 KFDE, Denver, Colo.; Knight Campbell Music Co.
 KFDE, Corvallis, Ore.; Oregon Agr. College.
 KFDE, Spokane, Wash.; Radio Supply Co.
 KFDE, Casper, Wyo.; Wyoming Radio Corp.
 KFDE, York, Nebraska; Bullock's Hardware & Sporting Goods.
 KFDE, Portland, Ore.; Meier & Frank Co.
 KFEL, Denver, Colo.; Winner Radio Corp.
 KFEP, Denver, Colo.; Radio Equipment Co.
 KFEE, Oak, Nebraska; J. L. Scroggin.
 KFEP, Fort Dodge, Ia.; Auto Electric Service Co. Inc.
 KFEP, Douglas, Wyo.; Entertainment and weather; Radio Electric Shop.
 KFEP, San Diego, Calif.; Dr. R. C. Shelton.
 KFEE, Los Angeles, Calif.; Los Angeles Union Stock Yards.
 KFEE, Tacoma, Wash.; Guy Greason.
 KFEE, Pendleton, Ore.; Eastern Oregon Radio Co.
 KFEE, Colorado Springs, Colo.; Marksheffel Motor Co.
 KFEE, Mt. Vernon, Wash.; Buchanan, Stevens & Co.
 KFEG, Astoria, Ore.; Astoria Budget.
 KFEG, Stanford Univ., Calif.
 KFEG, Santa Barbara, Calif.; Fallon Co.
 KFEG, Pueblo, Co.; Lowenthal Bro.
 KFEL, Los Angeles, Calif.; Earl C. Anthony, Inc.
 KFEL, Gridley, Calif.; The Preleson Shop.
 KFEL, Yakima, Wash.; Foster-Bradbury Radio Store.
 KFEL, Spokane, Wash.; Doerr-Mitchell Elec. Co.
 KFEG, Tacoma, Washington; Tacoma Daily Ledger; H. F. Higzina.
 KFEG, Portland, Ore.; Hallock & Watson Radio Service.
 KGN, Portland, Ore.; Northwestern Radio Mfg. Co.
 KGO, Altadena, Cal. 2500 miles; every Saturday 8 to 9:30 p. m. Musical program;
 Paul Franklin Johnson, Altadena Radio Lab.
 KGU, Honolulu, Hawaii, Walkiki Beach, Marlon A. Mulroney; Honolulu Advertiser.
 KGW, Portland, Ore.; Oregonian Pub. Co., also 400.
 KGV, Lacey, Wash.; St. Martin's College, (Rev. S. Ruth).
 KHD, Colorado Springs, Colo.; Class B, 485, C. F. Aldrich; Marble & Granite Co.
 KHJ, Los Angeles, Calif.; 400 meters, daily, 12:30 to 1:15 p. m.; from 7 to 7:30 p. m. and 8 to 9:30 p. m.; Los Angeles Times Mirror Co.
 KHQ, Seattle, Wash.; Louis Wasmer.
 KJJ, Sunnyvale, Calif.; The Radio Shop.
 KJG, Stockton, Calif.; C. O. Gould.
 KJS, Los Angeles, Calif.; Bibb Inst. of Los Angeles.
 KLB, Pasadena, Calif.; J. J. Dunn & Co.
 KLM, Del Monte, Calif.; Norgle Elec. Works.
 KLP, Los Altos, Calif.; Colin B. Kennedy Co.
 KFDH, Tucson, Ariz.; Univ. of Arizona.
 KLS, Oakland, Calif.; Warner Bros.
 KLA, Oakland, Calif.; Tribune Pub. Co.
 KLAZ, Denver, Colo.; Class B, 485, Reynolds Radio Co.
 KMAZ, Macon, Ga.; Mercer University.
 KMC, Reedley, Calif.; Lindsay-Wetherill Co.
 KMJ, Fresno, Calif. Max. 2576 Miles; Musical program, San Joaquin Light & Power Corp.
 KMO, Tacoma, Wash., Love Electric Co.; Tacoma Times.
 KNI, Eureka, Calif.; T. W. Smith.
 KNP, Roswell, New Mexico, 350, 485, 1000 miles; Every evening at 8; news, weather reports, stock market, concerts and sermons; Roswell Public Service Co.
 KNN, Los Angeles, Calif.; Bullocks.
 KNT, Aberdeen, Wash.; North Coast Products Co.
 KNV, Los Angeles, Calif.; Radio Supply Co.
 KNX, Los Angeles, Calif.; Elec. Lighting Supply Co.
 KOA, Denver, Colo.; J. M. C.
 KOB, State College, N. Mex. 485 also; time signals and weather reports 12 noon and 10:00 p. m. mountain time; music and lectures Monday, Wednesday and Friday, 7:30 to 8:30 p. m.; New Mexico College of Agriculture and Mechanical Arts.
 KOE, Spokane, Wash.; Spokane Chronicle.
 KOG, Los Angeles, Calif.; Western Radio Electric Co.
 KON, Los Angeles, Calif.; Holzwasser, Inc.
 KOP, Detroit, Mich.; Detroit Police Dept.
 KOQ, Modesto, Calif.; Modesto Evening News.
 KPO, San Francisco, Calif.; Hale Bros.
 KQI, Berkeley, Calif.; Univ. of California.
 KQP, Hood River, Ore.; Blue Diamond Elec. Co.; Hood River News.
 KQV, Pittsburgh, Pa.; Doubleday-Hill Elec. Co.
 KQW, San Jose, Calif.; Chas. Herrick.
 KQX, Los Angeles, Calif.; 1000 miles; Monday, Tuesday, Saturday, 9 to 10 p. m.; Wednesday, Thursday, Friday, 6 to 7 p. m.; Stubbs Electric Co.
 KRE, Berkeley, Calif.; Maxwell Electric Co.
 DSC, San Jose, Calif., O. A. Hale & Co.
 KSD, St. Louis, Mo.; 1700 miles; 485 meters; grain, livestock, cotton, New York stocks, poultry and butter market, metal market, official weather and news at 9:40, 10:40, 11:40, 12:40, 1:40, 2:40 and 4 p. m.; 8 p. m. 400 meters, musical and other features; Pulitzer Publishing Co., St. Louis Post Dispatch.
 KSL, San Francisco, Calif.; The Emporium.
 KSS, Long Beach, Calif.; Prest & Dean Radio Research Lab.
 KSU, Wenatchee, Wash., 360 and 485.
 KTW, Seattle, Wash., First Presbyterian Church.
 KUD, San Francisco, Calif.; Examiner Printing Co., San Fran. Examiner.
 KUS, Los Angeles, Cal. 500 miles; setting up exercises daily, 7 to 7:30 a. m. and 12:00 noon to 12:30 p. m.; concert, 85 voices, 6 to 6:45 p. m., Wednesdays and Fridays; City Dye Works.
 KUY, Del Monte Calif., Coast Radio Co.
 KWG, Stockton, Cal. Daily Market reports, music and news 4 to 5 p. m.; Music, 1 to 3 p. m., Sunday; Tuesdays and Fridays, music, 8 to 9 p. m. Portable Wireless Telephone Co.
 KWH, Los Angeles, Calif., 485 also Los Angeles Examiner.
 KXD, Modesto, Calif., Herald Publishing Co.
 KXS, Los Angeles, Calif., Braun Corp.
 KYI, Bakersfield, Calif., Alfred Harrell.
 KYJ, Los Angeles, Calif., Leo J. Meyberg Co.
 KYQ, Honolulu, T. H., The Electric Shop.
 KYW, Chicago, Ill., Westinghouse Elec. & Mfg. Co.
 KZC, Seattle, Wash., Public Market & Dept. Store Co.
 KZM, Oakland, Calif., Western Radio Inst.; Preston D. Allen.
 KZN, Salt Lake City, Utah, The Desert News.
 KZV, Wenatchee, Wash., Wenatchee Battery & Motor Co.
 NDF, Anacostia, D. C., 412 only, U. S. Navy Dept.
 PWX, Havana, Cuba, Cuban Telephone Co.
 WAI, Dayton, Ohio, McCook Field, U. S. Army.
 WAAB, New Orleans, La., Valdemar Jensen.
 WAAC, New Orleans, La., Tulane Univ.
 WAAD, Cincinnati, Ohio, Ohio Mechanics Inst.
 WAAF, Chicago, Ill., Chicago Daily Drivers Journal.
 WAAG, St. Louis, Mo., St. Louis Chamber of Commerce.
 WAAH, St. Paul, Minn., Commonwealth Electric Co.
 WAAL, Boston, Mass., Eastern Radio Inst.
 WAAC, Milwaukee, Wis., Gimbel Bros.
 WAAL, Minneapolis, Minn., Minnesota Tribune Co. & Anderson-Beamish Co.
 WAAM, Newark, N. J., 200 miles; musical and code, every week day 11 to 11:30 a. m., 3 to 4 p. m., Wednesday evenings 8 to 9; I. B. Nelson Company.
 WAAN, Columbia, Mo., Univ. of Missouri.
 WAAP, Wichita, Kans., United Elec. Co.; Otto W. Taylor.
 WAAG, Greenwich, Conn., New England Motor Sales Co.
 WAAS, Decatur, Ga., Georgia Radio Co.
 WAAT, Jersey City, N. J., Jersey Review.
 WAAW, Omaha, Neb., Omaha Grain Exchange.
 WAAV, Youngstown, Ohio, Youngling Rayner Music Co.
 WAAZ, Emporia, Kans., Daylike 100 miles; nite 500-1000 miles; each Tuesday and Thursday from 7 to 8 p. m. Acknowledge all communications at 7:15 p. m. The Hollister Miller Motor Co.
 WAH, El Dorado, Kans., Midland Refining Co.
 WAJT, Marshall, Mo., Kelly-Vawter Jewelry Co.
 WAJU, Yankton, S. D., Yankton College.
 WAJW, W. La Fayette, Ind., Purdue University.
 WBAB, Syracuse, N. Y., Andrew J. Potter.
 WBAD, Minneapolis, Minn., Sterling Elec. Co. & Journal Printing Co.
 WBAE, Peoria, Ill., Bradley Polytechnic Inst.
 WBAF, Moorestown, N. J., Fred M. Middleton.
 WBAG, Bridgeport, Pa., Diamond State Fibre Co.
 WBAN, Minneapolis, Minn., The Dayton Co.
 WBAM, New Orleans, La., L. E. Benneyson.

(Continued on next page.)

Corrected List of U. S. Stations Alphabetically by Call Signals

WBAN, Paterson, N. J., Wireless Phone Corp.
 WBAF, Decatur, Ill., 100 m.; occasional music; sermons; James Millikin Univ.
 WBAP, Fort Worth Tex. 400-485; 4000 miles; Markets and News; Feature concert Monday to Friday inclusive; 9:30 p m to 10:45 p m, Central Time; Quiet nights Saturday and Sunday. The Star-Telegram.
 WBAQ, South Bend, Ind., Myron L. Harmon.
 WBAU, Hamilton, Ohio, Republican Publishing Co.
 WBAV, Columbus, Ohio, 485, also Erner & Hopkins Co.
 WBAW, Marietta, Ohio, Marietta College.
 WBAK, Wilkes-Barre, Pa., John H. Stenger, Jr.
 WBL, Anthony, Kans., T. & H. Radio Co.
 WBS, Newark, N. J., D. W. May, Inc.
 WBT, Charlotte, N. C. 1200 miles; 11: a m weather report 485; 4:30 p m mechanical music; 8: p m Market Report; 8:30 Tuesday and Friday regular concert; 7:30 p m Sunday, Church Southern Radio Corp.
 WBU, Chicago, Ill., City of Chicago.
 WBU, Springfield, Mass., Westinghouse Elec. & Mfg. Co.
 WCAB, Newburgh, N. Y., Newburgh Daily News; Newburgh News Printing & Pub. Co.
 WCAC, Fort Smith, Ark., John Fink Jewelry Co.
 WCAD, Canton, N. Y., St. Lawrence University.
 WCAE, Pittsburgh, Pa., 400 also; Kaufmann & Baer Co.
 WCAE, Pittsburgh, Pa. 400 meter; 12:30 news and reports; 3:30 weather reports; 4:15 Closing Market reports; 7:30 Late news and lecture; 8:30 musical programs; Kaufmann & Baer Co.
 WCAG, New Orleans, La., Daily States Pub. Co.
 WCAH, Columbus, O., Daily program 11:30 to 12:30; Every Tuesday evening at 7, musical program; C. A. Entekin Electric Co.
 WCAI, San Antonio, Texas, Southern Equipment Co.
 WCAJ, Univ. Place, Neb., Nebraska Wesleyan University.
 WCAK, Houston, Texas, Alfred P. Darl.
 WCAN, Northfield, Minn., St. Olaf College.
 WCAM, Villanova, Pa., Villanova College.
 WCAO, Baltimore, Md., Sanders & Stayman Co.
 WCAP, Kalamazoo, Mich., Kalamazoo College.
 WCAR, San Antonio, Texas, Alamo Radio Elec. Co.
 WCAS, Minneapolis, Minn., Wm. H. Dunwoody Industrial Inst.
 WCAT, Rapid City, S. Dak. 485 also South Dakota School of Mines.
 WCAU, Philadelphia, Pa. 485 also; 1000 miles; Daily 10:30 a m; 2:30 p m; 6:30 p m; regular concert 10 to 12 noon; Tuesdays, Fridays, Saturdays; Durham & Co., Inc.
 WCAV, Little Rock, Ark., J. C. Dice Elec. Co.
 WCAW, Omaha, Neb., Woodmen of the World.
 WCAZ, Burlington, Vermont, University of Vermont.
 WCAX, Milwaukee, Wis., Kesselman O'Driscoll Co.
 WCE, Minneapolis, Minn., Findley Elec. Co.
 WCK, St. Louis, Mo., Stix Baer & Fuller.
 WCM, Austin, Texas, Univ. of Texas.
 WCN, Worcester, Mass., 485 also Clark University.
 WCX, Detroit, Mich., Detroit Free Press.
 WDAC, Springfield, Ill., Ill. Watch Co.
 WDAD, Lindsburg, Kas., Central Kansas Radio Supply.
 WDAE, Tampa, Fla., 485 also Tampa Daily News.
 WDAF, Kansas City, Mo., 400 and 485, also Kansas City Star.
 WDAG, Amarillo, Texas, K. Laurence Martin.
 WDAH, El Paso, Texas, Mine & Smelter Supply Co.
 WDAI, Syracuse, N. Y., 485 also Hughes Electrical Corp.
 WDAJ, College Park, Ga., Atlanta & West Point R. R. Co.
 WDAK, Hartford, Conn., Hartford Courant.
 WDAL, Jacksonville, Fla., 485 also Florida Times Union.
 WDAO, Dallas, Texas, Automotive Elec. Co.
 WDAP, Chicago, Ill., markets, 485; concerts 360; Daily on all business days: 9:30 a. m. receipts and shipments; estimated car lots; local weather report; opening futures market in wheat, corn, oats, rye, barley, pork, lard and ribs. 10 a. m. Future quotations, live stock receipts and prices; 10:30 a. m. futures quotations; 11 and 11:30 a. m. same; 12 noon, futures and cash grain prices; 12:30 and 1 p. m. futures quotations; 1:20 p. m. closing futures quotations and high and low for day. Cash grain prices. Gross bids for cash grain to arrive. 8 p. m. closing quotations; news items. On Saturdays closing prices at 12:05 p. m. instead of 1:20 p. m. Visible supply changes sent when posted. Regular concert schedule 10 p. m. Tuesdays, Thursdays and Saturdays. Sunday evenings 9 p. m. and 10 p. m. Chicago Board of Trade official station.
 WDAG, Brownsville, Pa., Hartman-Riker Elec. & Mach. Co.
 WDAS, Worcester, Mass., Samuel A. Walte.
 WDAU, New Bedford, Mass., Slocum & Kilburn.
 WDAX, Centerville, Iowa, First Nat'l Bank.
 WDAY, Fargo, N. D., Kenneth M. Hance.
 WDM, Washington, D. C., Church of the Covenant.
 WDT, New York, N. Y., Ship Owners Radio Service.
 WDU, Tuscola, Ill., James L. Bush.
 WEAA, Flint, Mich., Fallah & Lathrop.
 WEAB, Fort Dodge, Iowa, Standard Radio Equip. Co.
 WEAC, Terre Haute, Ind., Baines Elec. Service Co.
 WEAD, Atwood, Kans., Northwest Kansas Radio Supply Co.
 WEAF, Blackburg, Va., Virginia Polytechnic Inst.
 WEAF, New York City, N. Y., Western Electric Co.
 WEAG, Edgewood, R. I., Nichols-Hinsline-Bassett Lab.
 WEAH, Wichita, Kans., Wichita Board of Trade and Lander Radio Co.
 WEAI, Ithaca, N. Y., Cornell University.
 WEAJ, Vermillion, S. D.; University of South Dakota.
 WEAK, Vermillion, S. Dak., University of South Dakota.
 WEAL, St. Joseph, Mo., Julius B. Asheromble.
 WEAM, North Plainfield, N. J., Borough of N. Plainfield.
 WEAN, Providence, R. I., The Shepard Co.
 WEAO, Columbus, Ohio, Ohio State University.
 WEAP, Mobile, Ala., 485 also Mobile Radio Co.
 WEAQ, Berlin, N. H., Y. M. C. A.
 WEAR, Baltimore, Md., Balt. American & News Pub. Co.
 WEAS, Washington, D. C., The Hecht Co.
 WEAT, Tampa, Fla., John J. Fogarty.
 WEAU, Sioux City, Iowa, Davidson Bros. Co.
 WEAV, Rushville, Neb., Sheridan Elec. Service Co.
 WEAW, Anderson, Ind., Arrow Radio Lab.
 WEAX, Little Rock, Ark., T. J. M. Daly.
 WEAY, Houston, Texas, Will Horwitz, Jr.
 WEAZ, Waterloo, Iowa, Hulsebus Electric Service Co.
 WEB, St. Louis, Mo., The Benwood Co., Inc.
 WEH, Tulsa, Okla., Midland Refining Co.
 WEV, Houston, Texas, 485 also Hurlburt-Stull Elec. Co.
 WEW, St. Louis, Mo., 485 also St. Louis Univ.
 WEW, St. Louis, Mo., 860 and 485; Market and weather reports at 9: a m, 10: a m, 2: p m; no other regular program; St. Louis University.
 WEY, Wichita, Kans., 485 also Coatsworth.
 WFAA, Dallas, Texas, 400 and 485 also A. H. Belo & Co.
 WFAW, Miami, Fla., 1500 miles; 7:30 to 9 p. m. concerts including Arthur Pryor's Band evenings and W. J. Bryan Sunday School, Sunday a m; Miami Daily Metropolis & Electrical Equipment Co.
 WEAB, Syracuse, N. Y., C. F. Woese.
 WFAC, Superior, Wis., Superior Radio Co.
 WFAD, Salmag, Kans., Watson Weldon Motor Supply Co.
 WFAP, Poughkeepsie, N. Y., H. F. Spratley Radio Co.
 WFAS, Waterford, N. Y., Radio Engineering Lab.
 WFAM, Port Arthur, Texas, Elec. Supply Co.
 WFAJ, Ashville, N. C., Hi-Grade Wireless Instrument Co.
 WFAK, Brentwood, Mo., Donostie Electric Co.
 WFAW, St. Cloud, Minn., 485 also Granite City Elec. Co. and Times Pub. Co.
 WFB, Hutchinson, Minn., 485 also Hutchinson Electric Service Co.
 WFBQ, Cameron, Mo., Radio Co. and Mo. Wesleyan College.
 WFB, Fort Wayne, Ind., United Radio Corp.
 WFBT, Sioux Falls, S. Dak. 485; also Argus-Leader.
 WFAU, Boston, Mass., Edwin C. Lewis.
 WFAV, Lincoln, Neb., 485 also Univ. of Neb. Dept. of Elec. Engineering.
 WFAZ, Independence, Kans., Daniels Radio Supply Co.
 WFAZ, Charleston, S. Carolina, S. O. Radio Shop.

WFI, Philadelphia, Penn., 400 and 485, also Strawbridge & Clothier.
 WGAB, Houston, Texas, QRV Radio Co.
 WGAC, Brooklyn, N. Y., Orpheum Radio Stores Co.
 WGAD, Ensenada, Porto Rico, Spanish-American School of Radio-telegraphy.
 WGF, Des Moines, Iowa 300 miles; Musical and entertainment Tuesday and Friday 7:30 p m; Church Services Sunday at 5 p m or 7:45 p m as announced; Special programs as announced Register and Tribune.
 WGAH, New Haven, Conn., New Haven Elec. Co.
 WGAI, Sheuandosh, Iowa, W. H. Gass.
 WGAK, Macon, Ga., Macon Elec. Co.
 WGAL, Lancaster, Pa., Lancaster Elec. Supply & Construction Co.
 WGAM, Orangeburg, S. C., Orangeburg Radio Equip. Co.
 WGAN, Pensacola, Fla., Cecil E. Lloyd.
 WGAP, Shreveport, La., Glenwood Radio Corp.
 WGAR, Fort Smith, Ark., Southwest American.
 WGAT, Lincoln, Neb., Am. Leftwing, Dept. of Nebr.
 WGAU, Wooster, Ohio, Marcus G. Limb.
 WGAV, Savannah, Ga., B-H Radio Co.
 WGAW, Altoona, Pa., Ernest C. Albright.
 WGX, Washington Court House, Ohio, Ohio Radio Elec. Co.
 WGY, New Orleans, La., Interstate Elec. Co. 485 also.
 WGAZ, South Bend, Ind., South Bend Tribune.
 WGI, Medford Hillside, Mass., 485, also Am. Radio & Research Corp.
 WGL, Philadelphia, Pa., Thos. F. J. Howlett.
 WGM, Atlanta, Ga., 400 only, Atlanta Constitution.
 WGR, Buffalo, N. Y., 485 also Federal Tel. & Teleg. Co.
 WGV, New Orleans, La., Interstate Elec. Co. 485 also.
 WGAQ, Schenectady, N. Y., 400 and 485 also General Elec. Co.
 WHAA, Madison, Wis., 485 also Univ. of Wis.
 WHAA, Iowa City, Ia.; 500 miles; 8:30 p m, Monday, instruction; Tuesday, concert; Wednesday, popular lecture; Friday, University News; public lectures and concerts irregularly; State University of Iowa.
 WHAB, Galveston, Texas, 300, 485, 600 also Clark W. Thompson (Fellman's Dry Goods Co.)
 WHAC, Waterloo, Iowa, Cole Bros. Elec. Co.
 WHAD, Milwaukee, Wis., 485 also; Marquette Univ.
 WHAE, Sioux City, Iowa, Automotive Elec. Service Co.
 WHAG, Cincinnati, Ohio, Univ. of Cincinnati.
 WHAH, Joplin, Mo. 300 miles; Tuesday and Thursday nights 8 to 10; Hafer Supply Co.
 WHAI, Davenport, Iowa, Radio Equip. & Mfg. Co.
 WHAJ, Bluefield, W. Va., Bluefield Daily Telegraph and E. K. Kitts.
 WHAK, Clarkburg, W. Va., Roberts Hdwe. Co.
 WHAL, Lansing, Mich., Lansing Capitol News.
 WHAM, Rochester, N. Y., 485 also; Daily—Weather report 2:40 p m; Organ 2:45, 5:00, 6:45; Orchestra 3:00, 7:00; Bed-time stories, Sport results, Business reports and market reports, the latter on 485 meters, 7:15 p m; Sunday—Radio Chapel Service, 3:15 p m; University of Rochester.
 WHAD, Savannah, Ga., Frederick A. Hill; every evening 8 to 9; Saturday nights, 12:30 to 1:30 a. m.
 WHAP, Decatur, Ill., Dewey L. Otta.
 WHAQ, Washington, D. C., Semmes Motor Co.
 WHAR, Atlantic City, N. J., Paramount Radio & Elec. Co.
 WHAS, Louisville, Ky., Courier Journal and Louisville Times Co.
 WHAW, Wilmington, Del., Wilmington Elec. Spec. Co.
 WHAW, Tampa, Fla., 100 miles; 12 to 1, 4 to 5 p m, music; Pierce Electric Co.
 WHX, Des Moines, Iowa; 300 miles; 5:45 p m to 6:15 p m Daily; 8:00 p m to 10 p m Wednesday evenings; Central Standard Time; Iowa Radio Corp.
 WHAY, Huntington, Ind., Huntington Press.
 WHAZ, Troy, N. Y., 400 only, Rensselaer Polytechnic Inst.
 WHB, Kansas City, Mo., 400 and 485 also Sweeney Auto & Tractor School
 WHB, Morgantown, W. Va., W. Va. University.
 WHK, Cleveland, Ohio, Warren R. Coy.
 WHN, Ridgewood, N. Y., Times Printing & Pub. Co.
 WHU, Toledo, Ohio, Wm. B. Duck Co.
 WIAB, Rockford, Ill., Joslyn Automobile Co.
 WIAC, Galveston, Texas, 485 also Galveston Tribune.
 WIAD, Ocean City, N. J., Ocean City Yacht Club.
 WIAE, Vinton, Iowa, Mrs. Robt. E. Zimmerman.
 WIAF, New Orleans, La., Gustav A. De Corin.
 WIAG, Norfolk, Neb.; 485 also; 200 miles News and Markets 12:15, 3:30 and 5:30 p m. The Huse Publishing Co. The Norfolk Daily News.
 WIAH, Newton, Iowa, Continental Radio & Mfg. Co.
 WIAI, Springfield, Mo., Heer Stores Co.
 WIAJ, Neenah, Wis., Fox River Valley Radio Supply Co.
 WIAK, Omaha, Neb.; 485, 745 a m Livestock receipts; 9:10 a m Livestock receipts and opening on hogs; 10:15 a m rainfall and temperature report and weather forecast for Nebraska and Iowa. Livestock market; 12 m cattle, hog and sheep market; 1:50 p m rainfall and temperature report and weather forecast for Nebraska and Iowa; market detail; 3:50 p m complete market reports and estimated receipts for next day; Daily Journal-Stockman.
 WIAO, Milwaukee, Wis., School of Engineering.
 WIAQ, Springfield, Mass., Radio Development Corp.
 WIAQ, Marion, Ind., American Radio Co.
 WIAR, Paducah, Ky., Musical 3:30 to 4 p. m. and 7 to 8 p. m. except Sundays. Paducah Evening Sun: Albert Bennett, operator.
 WIAS, Burlington, Iowa, Hawk-Eye Home Elec. Co.
 WIAT, Tarkio, Mo., Leon T. Noel.
 WIAU, Le Mars, Iowa, Am. Trust & Savings Bank.
 WIAV, Binghamton, N. Y., N. Y. Radio Lab.
 WIAW, Saginaw, Mich., Saginaw Radio Elec. Co.
 WIAY, Washington, D. C., Woodward & Lothrop.
 WIAZ, Miami, Fla., Elec. Supply Sales Co.
 WIK, McKeenport, Pa., K. & L. Elec. Shop.
 WIL, Washington, D. C., Continental Elec. Supply Co.
 WIP, Philadelphia, Pa., Gimbel Bros.
 WIZ, Cincinnati, Ohio, 485 also Cino Radio Mfg. Co.
 WIAB, Lincoln, Neb., American Radio Co.
 WIAD, Waco, Texas, 485 also Jackson's Radio Engrng. Lab.
 WIJF, Muncie, Ind.; 1800 miles; 7:30 to 8 Monday, Wednesday, Friday evening, music; 6:30 to 7 p m Saturday, music; 3:30 to 4 every afternoon, News; 10:30 to 12 M Sundays, Church service. Smith Electric-Muncie Press.
 WJA, Dayton, Ohio 200 miles; Sunday 8:40, 9:15 Religious; Wednesday 9:15, 9:45 Entertainment; Friday 9:15 to 9:45 Entertainment. Y. M. C. A.
 WIJK, Stockdale, Ohio, 485 also WJRC Radio Lab.
 WIAM, Cedar Rapids, Iowa, Evening Gazette.
 WIAN, Peoria, Ill. Daily except Sunday; 9:15 a. m. official weather (485); 11:30 a. m. weather and markets (860) 1:30 p. m. market close (360). Tuesday, Thursday and Saturdays; concerts at 9:15 p. m. Peoria Star.
 WIAP, Duluth, Minn. 1500 miles; Sunday 11 a. m. 12:30 p m Church Service and organ recital; First Methodist Church, Rev. Chas. N. Pace, Pastor, Monday 8 p m to 9 p m, musical; Thursday 8 p m to 9 p m, musical; Kelley Duluth Co.
 WIJQ, Topeka, Kans., Cadper Publications.
 WIAR, Providence, R. I., The Outlet Co. J. Samuels & Bros.
 WIAS, Pittsburgh, Pa., Pittsburgh Radio Supply House.
 WIAT, Marshall, Mo., Kelley-Vawter Jewelry Co.
 WIJX, Cleveland, Ohio, 485 also Union Trust Co.
 WIJZ, Chicago, Ill., Chicago Radio Lab.
 WID, Grand Rapids, Mich., music by Denison Conservatory, educational lectures and discussions; Denison University.
 WIH, Washington, D. C., White & Boyer Co.
 WIJ, New York, N. Y., Do Forest Radio Telephone & Teleg. Co.
 WIJ, Newark, N. J., 485 also Westinghouse Elec. & Mfg. Co.
 WKAA, Cedar Rapids, Iowa, 485 also H. F. Paar.
 WKAC, Lincoln, Neb., Star Pub. Co.
 WKAD, Wichita, Pa., Tex. W. S. Radio Supply Co.
 WKAN, West Palm Beach, Fla., Planet Radio Co.
 WKAK, Okemah, Okla., Okfuskee County News.
 WKAL, Orange, Texas, Gray & Gray.
 WKAN, Montgomery, Ala., Alabama Radio Mfg. Co.
 WKAP, Cranston, R. I., Duce W. Flint.

(Continued on next page.)

Corrected List of U.S. Stations Alphabetically by Call Signals

- WKAQ, San Juan, Porto Rico, Radio Corp. of Porto Rico.
 WKAR, East Lansing, Mich., Mich. Agril. College.
 WKBS, Springfield, Mo., L. E. Lind College.
 WKAV, Lenoira, N. H., Lenoira Radio Club.
 WKAW, Beloit, Wisc., Turner Cycle Co.
 WKAX, Bridgeport, Conn., Wm. A. MacFarlane.
 WKAY, Gainesville, Ga., Brenau College.
 WKC, Baltimore, Md., Jos. M. Zamolski Co.
 WKN, Memphis, Tenn., Richman-Crosby Co.
 WKY, Oklahoma City, Okla., 485 also Oklahoma Radio Shop.
 WLZ, Fairfield, Ohio, U. S. Army.
 WLAC, Raleigh, N. C., N. C. State College.
 WLAG, Minneapolis, Minn., Cutting & Walsh Radio Corp.
 WLAH, Syracuse, N. Y., Samuel Woodworth.
 WLAJ, Waco, Texas, 485 also Waco Elec. Supply Co.
 WLAK, Bellows Falls, Vt., Vermont Farm Machine Co.
 WLAL, Tulsa, Okla., Tulsa Radio Co.
 WLAM, Springfield, Ohio, Morrow Radio Co.
 WLAN, Houlton, Me., Putnam Hdw. Co.
 WLAP, Louisville, Ky., W. Y. Jordan.
 WLAQ, Kalamazoo, Mich., A. E. Schilling.
 WLAS, Hutchinson, Kans., Hutchinson Grain Radio Co.
 WLAT, Burlington, Iowa, Radio Specialty Co.
 WLAV, Pensacola, Fla., daily musical program, 8 to 9 p m; The Electric Shop.
 WLW, New York, N. Y., New York Police Dept.
 WLX, Greencastle, Ind., Greencastle Community Broadcasting Station.
 WLAY, Fairbanks, Alaska, Northern Commercial Co.
 WLAZ, Warren, Ohio, Hutton & Jones Elec. Co.
 WLB, Minneapolis, Minn., Univ. of Minn.
 WLK, Indianapolis, Ind., 485 also Hamilton Mfg. Co.
 WLW, Cincinnati, Ohio, 485 also Crosley Mfg. Co.
 WMA, Anderson, Ind., Radio Lab.
 WMAB, Oklahoma City, Okla., Radio Supply Co.
 WMAC, Cozenovia, N. Y., 750 miles; music 11: p m; Cleve B. Meredith.
 WMAD, Rockport, Mo., Atchinson County Mail.
 WMAE, Dartmouth, Mass., Round Hills Radio Corp.
 WMAG, Liberal, Kans., Tucker Elec. Co.
 WMAH, Lincoln, Neb., General Supply Co.
 WMAI, Kansas City, Mo., 485 also Croviers Telegram.
 WMAK, Lockport, N. Y., Norton Laha.
 WMAL, Trenton, N. J., 100 miles; 7:30 to 9 p m, Mondays and Thursdays, musical programs, lectures etc; Trenton Hardware Co.
 WMAM, Beaumont, Texas, Beaumont Radio Equip. Co.
 WMAN, Columbus, Ohio, First Baptist Church.
 WMAP, Easton, Pa., Utility Battery Service.
 WMAQ, Fair Store Building, Chicago, 4:35 to 5 p m, daily; 7 to 7:30 p m, Monday, Wednesday, Friday and Saturday; 7 to 8 p m, Tuesday and Thursday; 9:15 to 10 p m, daily; Chicago Daily News and Fair Department Store.
 WMAR, Waterloo, Iowa, Waterloo Elec. Supply Co.
 WMAT, Duluth, Minn., Paramount Radio Corp.
 WMAV, Auburn, Ala., Polytechnic Inst.
 WMAW, Wahpeton, N. D., Wahpeton Elec. Co.
 WMAX, Ann Arbor, Mich., K. & K. Radio Supply Co.
 WMAZ, St. Louis, Mo., 400 miles; Religious services Sunday, 11 a m and 8 p m; Tuesday at 7 p m; Kingshighway Presbyterian Church.
 WMAZ, Macon, Ga., Mercer University.
 WMB, Auburn, Maine, Auburn Elec. Co.
 WMC, Cincinnati, Ohio, 485 also Precision Equipment Co.
 WMU, Washington, D. C., Doubleday-Hill Electric Co.
 WNCB, Bowling Green, Ky., Park City Daily News.
 WNCB, Boston, Mass., Radio 4 to 5 p m, (silent at night) Tuesday 4 to 5 p m, Wednesday 4 to 5 p m, Thursday 4 to 5 p m, Friday 4 to 5 p m, Saturday 4 to 5 p m, Sunday 4 to 5 p m; The Shepard Stores; J. J. Fanning, announcer; Samuel Curtis, operator.
 WNAO, Norman, Okla., Okla. Radio Engineering Co.
 WNAH, Manhattan, Kans., Manhattan Radio Supply Co.
 WNAL, Omaha, Neb., R. J. Kowalek.
 WNaN, Syracuse, N. Y., Syracuse Radio Telephone Co.
 WNAF, Springfield, Ohio, Wittenberg College.
 WNAQ, Charleston, S. C., Charleston Radio Elec. Co.
 WNAS, Austin, Texas, Radio Corp.
 WNAT, Philadelphia, Pa., 1000 miles; Talks, Radio information, music, Chapel Service, Wednesday 7:30 p m; Saturday 7:30 p m; Sunday 2:30 and 4:30; Every day 12:15, 1 p m, Lennik Bros. Co.
 WNAV, Knoxville, Tenn., People's Radio and Tel. Co.
 WNB, Baltimore, Md., Shipowners' Radio Service.
 WNAZ, Yankton, S. D., Dakota Radio Apparatus Co.
 WNAW, Fortress Monroe, Va., Henry Kunzman.
 WNJ, Albany, N. Y., Shotton Radio Mfg. Co., Inc.
 WND, Jersey City, N. J., Wireless Telephone Co. of Hudson Co., N. J.
 WDAQ, Omaha, Neb., 100 miles; Woodmen of the World.
 WDA, Ardmore, Okla., Dr. Walter Hardy.
 WDAE, Lima, Ohio, Maus Radio Co.
 WDAF, Fremont, Neb., Medland College.
 WDAF, Tyler, Texas, Tyler Commercial College.
 WDAH, Charleston, S. C., Palmetto Radio Corp.
 WDAI, San Antonio, Tex., 485 also; daily except Sunday 10:30, 12:15, 3, 6 p m. News, market, weather reports; Wednesday, Concert 7:30 to 8:30 p m; Sunday evening concert 9:30 to 10:30 p m; Southern Equipment Co. and The Evening News and The Express.
 WDAK, Parsons, Kans., Erving's Electrical Co.
 WDAK, Frankfort, Ky., Collins Hardware Co.
 WDAL, Webster Groves, Mo., Wm. E. Woods.
 WDOAN, Lawrenceburg, Tenn., James D. Vaughan.
 WDOAR, Kenosha, Wisc., Henry P. Lundskow.
 WDOAS, Middleton, Conn., Bailey's Radio Shop.
 WDOAT, Wilmington, Del., Boyd Martell Hump.
 WDOAU, Evansville, Ind., Soudner Bolting Piano Co.
 WDOAV, Erie, Pa., Pa. Nat'l Guard.
 WDOAX, Trenton, N. J., Franklin J. Wolff.
 WDOAY, Birmingham, Ala., John W. Wilder.
 WDOAQ, Portsmouth, Va., Portsmouth Radio Ass'n.
 WDOAW, Omaha, Neb., 100 miles, Woodmen of the World.
 WDOAZ, Stanford, Texas, Fenick Hughes Co.
 WDC, Daventry, Ia., 485 meters; time signals, 10:55 a m; weather 11 a m; 3:50 p m, closing stocks and markets; 5:30 p m, educational talk; 5:45 p m, chimes concert; 6:35, sandman's visit; 7:00 musical program; 8 p m, lecture; Sundays, religious and musical and religious features, 9 a m to 10 p m; Palmer's School of Chiropractic.
 WDI, Ames, Ia., 485 also Iowa State College.
 WDK, Pine Bluff, Ark., concert Tuesday and Friday evenings beginning at 9; Sundays, song service and sermons from churches at 11 a. m. and 7:30 p. m., Arkansas Light & Power Co.
 WDO, Philadelphia, Pa., 400 and 485 also, John Wanamaker.
 WQQ, Kansas City, Mo., 485 also Western Radio Co.
 WOR, Newark, N. J., 400 only, L. Bamberg & Co.
 WOS, Jefferson City, Mo., 485 also; first fifteen minutes of every hour from 8: a m to 2: p m; 5 p m, markets and music, 360 meters; Monday, Wednesday, Friday nights, 8 to 9:30 concerts; no Sunday program; Missouri State Marketing Bureau.
 WOV, Omaha, Neb., R. B. Howell.
 WOU, Omaha, Neb., Metropolitan Utilities.
 WQZ, Richmond, Ind., 485 also Palladium Printing Co.
 WPA, Fort Worth, Texas, 485 also Fort Worth Record.
 WPA, Waboo, Neb., Anderson & Webster Elec. Co.
 WPAB, State College, Pa.
 WPAC, Okmulgee, Okla., Donaldson Radio Co.
 WPAD, Chicago, Ill., Wieboidt & Co.
 WPAF, Council Bluffs, Iowa, Peterson's Radio Co.
 WPAG, Independence, Mo., Central Radio Co.
 WPAH, Waupaca, Wis., Wisconsin Dept. of Markets.
 WPAI, New Haven, Conn., Doolittle Radio Corp.
 WPAK, Fargo, N. D., North Dakota Agricultural College.
 WPAL, Columbus, Ohio, Superior Radio & Tel. Equip. Co.
 WPAM, Topeka, Kans., Awerbach & Guettel.
 WPAP, Winchester, Ky., Theo. D. Phillips.
 WPAQ, Frostburg, Md., General Sales & Eng. Co.
 WPAR, Wilmington, Del., Radio Installation Co., Inc.
 WPAE, Beloit, Kans., R. A. Ward.
 WPAS, Amsterdam, N. Y., J. M. Electric Co.
 WPAT, El Paso, Texas, St. Patrick's Cathedral.
 WPAU, Moorhead, Minn., Concordia College.
 WPAV, Laurium, Mich., Paul Tinetti & Sons.
 WPAZ, Thomasville, Ga., S. W. Radio Co., J. R. Shumate, Jr.
 WPAZ, Bangor, Me., Bangor Radio Laboratory.
 WPAZ, Charleston, W. Va., Dr. John R. Koeh.
 WPE, Independence, Mo.
 WPG, New Lebanon, Ohio 1500 miles; Program exclusive for the farmer; 12 to 12:15 p m News Flashes; 6 to 6:30 p m, News, Markets; 8 to 9:45 Monday and Wednesday; music and farm program. Nushawg Poultry Farm.
 WPI, Clearfield, Pa., Elec. Supply Co.
 WPM, Washington, D. C., Thos. J. Williams, Inc.
 WPO, Memphis, Tenn., United Equip. Co.
 WQA, Clemson College, S. C., Clemson Agriculture College.
 WQA, Parkersburg, W. Va., 1500 miles; 10:30 p m every evening, Horace A. Beale, Jr.
 WQAB, Springfield, Mo., Southwest Missouri State Teachers' College.
 WQAC, Amarillo, Texas, E. B. Gish.
 WQAD, Waterbury, Conn., Whitall Electric Co.
 WQAE, Springfield, Vt., Moore Radio News Station.
 WQAF, Sandusky, Ohio, Sandusky Reclater.
 WQAH, Lexington, Ky., Brock-Anderson Elect. Eng. Co.
 WQAI, Ann Arbor, Mich., Ann Arbor Times-News.
 WQAK, Dubuque, Iowa, Apple-Higley Elec. Co.
 WQAL, Mattoon, Ill., Cole County Tel. and Tel. Co.
 WQAM, Miami, Fla., Electrical Equipment Co.
 WQAO, New York, N. Y., Calvary Baptist Church.
 WQAP, Lincoln, Neb., Am. Radio Co.
 WQAQ, Abilene, Texas, West Texas Radio Co.
 WQAR, Muncie, Ind., Press Publishing Co.
 WQAS, Lowell, Mass., Prince-Walker Elec. Co.
 WQAT, Westhampton, Va., Radio Equipment Corp.
 WQAV, Greenville, S. C.; Huntington & Guerry, Inc.
 WQAW, Scranton, Pa., Scranton Times.
 WQAW, Washington, D. C.; Catholic University.
 WQAY, Hastings, Neb., Gaston Music & Furniture Co.
 WQX, Chicago, Ill., Riverfront Park, Walter A. Kuehl.
 WQY, Houston, Tex., Rice Institute.
 WRAB, Savannah, Ga.; Savannah Board of Public Education.
 WRAC, Mayville, N. D., State Normal School.
 WRAD, Marion, Kansas, Taylor Radio Shop.
 WRAJ, Pittsburgh, Penn., M. H. Pickering Co.
 WRAM, Carthage, Ill., Robert E. Compton & Carthage College.
 WRAM, Galesburg, Ill., Lombard College.
 WRAN, Waterloo, Iowa, Black Hawk Elec. Co.
 WRAO, St. Louis, Mo., Radio Service Co.
 WRAU, Amarillo, Texas, Daily News.
 WRAY, Yellow Springs, O., Antioch College.
 WRAY, Scranton, Pa., Radio Sales Corp.
 WRK, Hamilton, Ohio, Doron Bros. Elec. Co.
 WRL, Schenectady, N. Y., Union College.
 WRM, Urbana, Ill., Univ. of Ill.
 WRP, Camden, N. J., Federal Inst. of Radio Telg.
 WRR, Dallas, Texas, 485 also City of Dallas, Police and Fire Signal Dept.
 WRW, Tarrytown, N. Y., Koenig Bros., Tarrytown Radio Research Lab.
 WSA, Marietta, O., B. S. Sprague Electric Co.
 WSAB, Cape Girardeau, Mo., Southeast Mo. State College.
 WSAC, Clemson College, S. C.; Clemson Agricultural College.
 WSAH, Chicago, Ill.; A. G. Leonard, Jr.
 WSAJ, Grove City, Pa., Grove City College.
 WSAL, Brookville, Ind.; Franklin Electric Co.
 WSAS, Lincoln, Neb., State of Neb.
 WSAT, Plainview, Texas, The Plainview Electric Co.
 WSAV, Houston, Texas, C. W. Vick Radio Const'n Co.
 WSB, Atlanta, Ga., 400 and 485 Atlanta Journal.
 WSL, Utica, N. Y., J. & M. Elec. Co.
 WSY, Birmingham, Ala., Alabama Power Co.
 WTAC, Johnston, Pa., Penn. Tram Co.
 WTAS, Elgin, Ill.; George D. Carpenter.
 WTAU, Tecumseh, Neb., Buegy Battery & Elec. Co.
 WTAW, College Station, Texas, Agricultural and Mechanical College of Texas.
 WTG, Manhattan, Texas, Kans. State Agril. College.
 WTP, Bay City, Mich., Ra-Do Corp.
 WVP, New York, N. Y., Signal Corps, U. S. Army.
 WWAC, Waco, Tex.; 3000 miles; Weather forecasts 11 a m daily; musical concerts, daily, 1:30 p m, and on Wednesday and Saturday evenings at 8; Sanger Bros.
 WWAO, Philadelphia, Pa., Wright & Wright, Inc.
 WWAX, Laredo, Texas, Workman Bros.
 WWAY, Chicago, Ill.; Margold Gardens.
 WWB, Canton, Ohio, Daily News Printing Co.
 WWI, Dearborn, Mich., Ford Motor Co.
 WWJ, Detroit, Mich., 400 485, Evening News.
 WWL, New Orleans, La., Loyola Univ.
 WWX, Washington, D. C., Post Office Dept.
 2XA, Newark, N. J., Westinghouse Elec. & Mfg. Co.
 2XI, New York City, A. T. & T. Co.
 2XJ, Deal Beach, N. J., Amer. Tel. & Tel. Co.
 3XW, Parkersburg, Pa., Horace A. Beale, Jr.
 3YU, Washington, D. C., Nat'l Radio Inst.
 9ARU, Louisville, Ky., Darrell A. Downard.



WGY Vesper Services

Every Sunday afternoon a little group of people assembles in the radio studio of WGY in the midst of the towering factory buildings of the General Electric Company at Schenectady and conducts a vesper service including organ selections, hymns, scripture reading and sermon. The group in the studio is small but many thousands in city and country participate in the devotions.

These services not only enter many homes but they are multiplied by means of receiving sets and loud speakers and made to furnish the religious inspiration of other gatherings in distant places. For example the Railroad Y. M. C. A. at Oneonta, N. Y., no longer arranges for a special afternoon service but instead receives WGY and according to letter from the general secretary, A. C. Lange "These services come through very clear and are enjoyed by all who attend."

Charles J. Clark, a merchant at Holland Patent, N. Y., informed WGY that the Baptist Church at that place was closed recently on account of the scarcity of coal. He invited the congregation to meet with him in his home and they listened to the service broadcast by WGY.

Amateurs Increase

There is still great interest in amateur radio telegraphy. This fact is shown by the increase in general and restricted amateur licenses issued by the Department of Commerce since January 1, which number 601. On January 1, there were 17,102 amateur licenses in effect, and on March 1, there were 17,703.

These figures do not include 617 other non-commercial stations, which comprise 134 technical and training school stations, 297 experimental and 186 special amateur stations.

The distribution of special amateur licenses by districts is as follows, showing the Chicago District, including northern peninsula of Michigan, Wisconsin, Illinois, Kentucky, Indiana, Minnesota, Iowa, Missouri, North, and South Dakota, Nebraska, Kansas and Colorado first:

District	Headquarters	Total	Mar. 1
1	Boston	2,490	
2	New York	2,589	
3	Baltimore	1,919	
4	Norfolk	420	
5	New Orleans	825	
6	San Francisco	2,019	
7	Seattle	863	
8	Detroit	2,749	
9	Chicago	3,729	
Total, special amateurs		17,703	

Amateurs Suspended

The Department of Commerce has recently suspended the licenses of a number of amateur operators for violation of the act of August 13, 1912, section 4, regulations 3, 4, and 15. Similar action may be taken against any other operator reported for violation of the

radio law. The above-cited regulations read as follows:

Regulation third. At all stations if the sending apparatus, to be referred to hereinafter as the "transmitter," is of such a character that the energy is radiated in two or more wave lengths, more or less sharply defined, as indicated by a sensitive wave meter, the energy in no one of the lesser waves shall exceed ten per centum of that in the greatest.

Regulation fourth. At all stations the logarithmic decrement per complete oscillation in the wave trains emitted by the transmitter shall not exceed two-tenths, except when sending distress signals or signals and messages relating thereto.

Regulation fifteenth. No private or commercial station not engaged in the transaction of bona fide commercial business by radio communication or in experimentation in connection with the development and manufacture of radio apparatus for commercial purposes shall use a transmitting wave length exceeding two hundred meters, or a transformer input exceeding one kilowatt, except by special authority of the Secretary of Commerce contained in the license of the station: *Provided*, That the owner or operator of a station of the character mentioned in this regulation shall not be liable for a violation of the requirements of the third or fourth regulations to the penalties of one hundred dollars or twenty-five dollars, respectively, provided in this section unless the person maintaining or operating such station shall have been notified in writing that the said transmitter has been found, upon tests conducted by the Government, to be so adjusted as to violate the said third and fourth regulations, and opportunity has been given to said owner or operator to adjust said transmitter in conformity with said regulations.



Free Hand Book of Radio Hookups

We will send you free a useful hand-book containing 25 easily understood diagrams of tested radio hookups. Just enclose 2c stamp for postage.

We will appreciate it as a favor if you will mention the name and address of the radio dealer with whom you prefer to trade, and whether he now carries All-American Audio and Radio Amplifying Transformers.

RAULAND MFG. CO.
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Radio Needs Trained Men

Radio is sweeping the country like wild fire. Thousands of dollars are being spent for expensive outfits. RADIO EXPERTS are needed everywhere to keep this equipment in order and to sell and install new outfits.

Be a Radio Expert

I will train you quickly and easily in your spare time, to become a RADIO EXPERT so you can install, construct, repair and sell Radio equipment. I am a Graduate Electrical Engineer and from actual experience I will give you exactly what you must know to make the really big money in radio.

FREE My Consultation Service to you is FREE. This outside help which I gladly give you is, in itself, worth more than the small cost of the Complete Course.

START NOW

Don't let others beat you to the big money. Start now and within a few weeks' time I will train you at home, at an amazingly low cost, to become a RADIO EXPERT. Write for "Radio Facts" sent free without obligation.

A. G. MOHAUPT, Electrical Engineer
American Electrical Association

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Reinartz Radio Book with Hook-ups—best book on best circuit—written and illustrated by Frank D. Pearne. If you want one free sign the coupon below and get the book and one year's subscription to Radio Age for \$2.00.

RADIO AGE,
64 West Randolph St.,
CHICAGO.

Please send me FREE one of your Reinartz Radio Books and send me Radio Age for one year. I want to take advantage of this Special April Offer. I enclose \$2.00.

Name.....

City.....

Street and Number.....

Honolulu Tells Radio Age of Wireless in Hawaii

HERE is a letter that fairly takes the breath away.

The greatest daily newspaper in Hawaii is the Honolulu Star-Bulletin. The Star-Bulletin operates the broadcasting station KDYX, which is a regular he-man outfit.

If you think you are entitled to a bit of a thrill when you get a Canadian station, or one perhaps two-thirds of the way across the continent, think of the kick the Star-Bulletin must get out of listening to the Kansas City Nighthawk and talking to the South Sea Islands. Not only listens to America but re-broadcasts the programmes for radio fans in strange island communities and on distant shores.

In publishing this letter Radio Age makes grateful acknowledgment and extends best wishes to the brothers out in the Pacific.

Here is the letter:
Editor Radio Age:

"KDYX, the station of the Honolulu Star-Bulletin was recently successful in re-broadcasting portions of the special programs broadcast by KHJ (the Los Angeles Times); KFDB (The Mercantile Trust Co., San Francisco) and KGW (the Portland Oregonian), on Sunday morning, January 21, between the hours of 1 and 3 a. m. Pacific Coast time. Because of the difference in time it was still Saturday night (10:30 p. m.) when their concerts were received here.

"Through the cooperation of the Radio Corporation of America who loaned their special wires or "tone-channels" from their receiving station at Koko Head, about ten miles from Honolulu, and the Mutual Telephone Company, who arranged lines from the downtown office of the Radio Corporation to the broadcasting rooms of the Star-Bulletin, we were able to put over the first (to my knowledge) re-broadcasting of stations over 2,000 miles distant.

"Receiving Engineer Corey at Koko Head station, using a receiving set the circuits of which he has developed himself, and which is privately owned, succeeded in first tuning in KHJ (the Los Angeles Times) and after boosting the signal with two steps audio frequency fed it through a telephone transformer into the tone channels and thence through a roundabout circuit to the Star-Bulletin, where the signal was further amplified and fed into KDX transmitter, operating on 360 meters.

"With the exception of difficulties caused by "static" and interference from ships close to Koko Head, the concert was re-broadcast with perfect clarity and the applause of those in the studio at KHJ following each number was plainly audible in the re-broadcast. KFDB (Telegraph Hill, San Francisco) was next tuned in and the announcer was heard, also part of an address given eastern amateurs; KGW (the Portland



DR. HUDSON MAXIM, the distinguished scientist, recently made an address from Station WSY, Birmingham, Ala., on the question "Shall Man or Bug Inhabit the Earth?" The picture shows, left to right, Mrs. Thomas W. Martin, Mr. Thomas W. Martin, President of the Alabama Power Co.; Dr. Maxim and Mrs. Maxim. The studio of WSY is extremely well appointed and the station is a popular one with the fans.

Oregonian) was tried and from them the best signal for re-broadcast was received. Orchestra numbers from this station were received and re-broadcast with absolute clarity and the conductor could be heard striking the music rack or marking time by some such means at the beginning of their selections.

"Frequent changes were made back to the other stations so that local fans—even those with the most simple crystal detectors—were able to hear representative parts of the program from these excellent stations quite as if they had been within ten miles of the stations themselves instead of over 2,000 miles away.

"It is hoped in the near future to re-broadcast a portion of the program from

the Kansas City Star and the Sweeney Automobile School at Kansas City.

"I hope to soon be able to send you a diagram of Engineer Corey's receiving set which employs three circuits and shunt traps for other interfering waves as well as two tuned antennas.

"Radio Age is a welcome visitor at KDYX and I notice in your January issue several items on long distance receiving by local listeners.

"I might add that British Samoa heard our re-broadcast signal quite clearly making the original concerts heard over an area of four thousand miles of the Pacific.

"Sincerely yours,

"C. B. ROSS,
"Manager, Radio KDYX.

Europe Gets W O R

The Bamberger broadcasting station, WOR, of Newark, N. J., succeeded in transmitting a complete classical concert to Europe in February. The hour selected was midnight of February 23-24, Eastern time, that hour being chosen because the transmission conditions over the Atlantic are best at that time.

Miss Edith Bennett was chosen from a long list of American and European concert stars to sing into the microphone for the reason that Miss Bennett's voice was found to be peculiarly adapted to radio-phone transmission. The result proved that the jury of radio musical experts were competent.

The entire country was watching for reports as to how the test succeeded and there was great gratification when the cables brought the news that Europe had listened in and had been vastly entertained.

One of the most interesting reports on the successful experiment came from Lichterfeld, Germany, whence it was reported that Seehof, an experimental wireless station, had picked up Miss Bennett's songs. By one of those freaks of difference in time the Seehof people apparently heard the singer six hours after she sang, having picked her voice up at six on the morning of Saturday, February 24. Which proved that Seehof is six hours ahead of Newark, by suntime.

Both the vocal and instrumental tones were perfectly audible. The transmission is regarded as remarkable since the broadcasting station operated on a 400-meter wave length, the same as is commonly used for nearby American listeners. Eight high vacuum amplifiers were used in receiving, but only an ordinary antennae eight meters high.

Lichterfeld is a suburb of Berlin. Reports were received in New York that receiving stations in England and France and far inland cities of the United States also heard Miss Bennett singing in Newark.

The program was sung in Italian, French and English. It was made up entirely of selections by eminent French, Italian, English and American composers and most of them were among the auditors of the first inter-continental radio recital, here and abroad.

Several of the big Continental newspapers, including the Paris N. Y. Herald, the Antwerp Neptune, the Geneva Courier and the Stockholm Svenska Dagbladt, made arrangements to receive Miss Bennett's concert for assembled audiences. Practically every radio club over there did likewise and, of course, almost every individual radio fan abroad made a serious attempt to listen-in.

WOR had been heard clearly in France, Italy, Belgium, England, Scotland and Sweden on a dozen previous occasions.

Beware of Thieves!

Fake radio inspectors have been gaining admission to Chicago houses on pretense that they wish to see if the receiving sets are properly connected, etc. They take advantage of the opportunity to steal valuable radio accessories and other property.

Health Broadcasting

On the first anniversary of its broadcasting, the Public Health Service announced that since its inauguration a year ago on NOF, the service has grown until today ten stations in the nine states and one in Canada are carrying its educational talks. It is unique, in that it is the only national health radio service in the world. Its messages are not only heard by thousands, but are being used extensively in the foreign language press in both America and Europe. For the first time, a call is being made for replies from listeners-in to determine exactly how extensive is its scope and how its 102 broadcasts are received.

More Broadcasters

Washington, D. C.—An increase of eleven broadcasting stations was shown on the records of the Department of Commerce during the month of February. On the first of February, there were 570 stations licensed to broadcast entertainment data and news while on March 3, there were 581 broadcasters operating.

During February, twenty-four new licenses were issued to broadcast, but thirteen old stations ceased to function. Of the total stations transmitting entertainment today, twenty-eight are Class B stations operating on 400 meters, the balance being on 360.

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100% Efficient*

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Million Point Mineral

The World's Greatest Radio Crystal

THE discovery of M. P. M. has revolutionized the possibilities of ordinary crystal sets. Concerts have been clearly heard over 1000 miles. M. P. M. is super-sensitive—reproducing from every point on its surface. It increases audibility as well as radius and makes the purchase of an expensive tube set unnecessary.

Send 25c and name of your Radio Dealer for a sample M. P. M. crystal—concert tested and guaranteed.

DEALERS: Write today for our attractive sales proposition.

M. P. M. SALES COMPANY

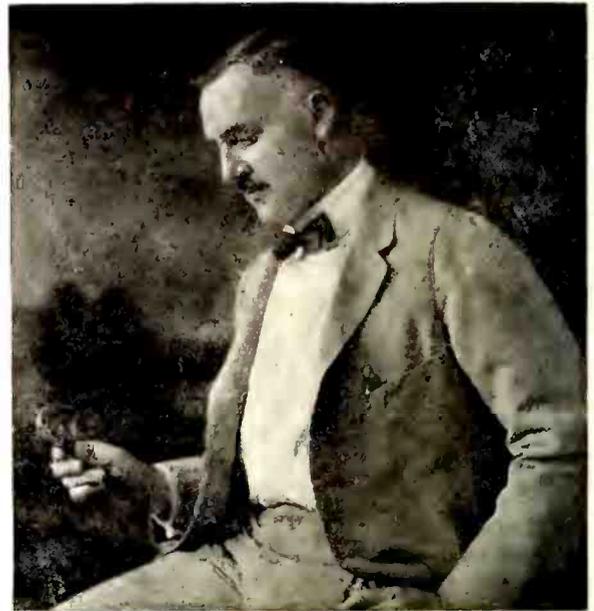
Dept. RA

247 S. Central Ave.

Los Angeles, Calif.

Perfect Broadcasting Now Possible

Westinghouse Engineer Solves Transmitter Problem



At right — Dr. Thomas, the inventor of the Glow discharge microphone.

Below — Close up view of the glow discharge transmitter.

At left — Artist singing into the glow transmitter at KDKA.



MILLIONS of radio fans will be benefited by a new radio transmitter invented by Dr. Phillips Thomas, research engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The new transmitter makes possible the broadcasting of music and other sounds exactly as produced. It has been used at the Westinghouse broadcasting station KDKA within the past few months, which explains the clarity and strength of this station's signals.

The basis of Dr. Thomas's invention is the elimination of the diaphragm now used in all transmitters in practical service. This diaphragm consists of a thin disk of metal or other substance and operates by being vibrated by the sound waves which strike it. But because of its inherent inertia, no material diaphragm is capable of vibrating in perfect sympathy with the entire range of audible sounds. If it can transmit low notes successfully, it will fail on high notes; and vice versa. The ordinary diaphragm is designed with reference to the

middle register, and it therefore does not transmit extremely high and extremely low notes satisfactorily. The piano is a case in point. The radio audience hears the highest notes as a series of clicks and the very bass notes as a roar.

In the Thomas transmitter, a minute electrical discharge takes the place of the mechanical disk. This discharge flows between two points, separated by a very small fraction of an inch. It is affected by sound waves, just like the diaphragm, but being non-material and having no perceptible inertia, it responds equally well to all vibrations. Hence music broadcasted by means of it is transmitted in all its original purity.

Dr. Thomas has recently been experimenting with his transmitter at the Westinghouse Pittsburgh Station, KDKA. Listeners all over the country have noticed from time to time the great improvement in the quality of the voice of this station, but have naturally been unaware of the cause. Within the near future, all Westinghouse sta-

tions will be regularly equipped with this device, and the art of broadcasting will take another step forward.

In appearances, the Thomas transmitter resembles a large watch, with the front and back covered by wire gauze. On looking into it, a point of light can be seen, caused by the flow of the electric energy against one of the terminals. From this fact, it is called the Glow Discharge transmitter.

Send \$1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is \$2.50 a year.

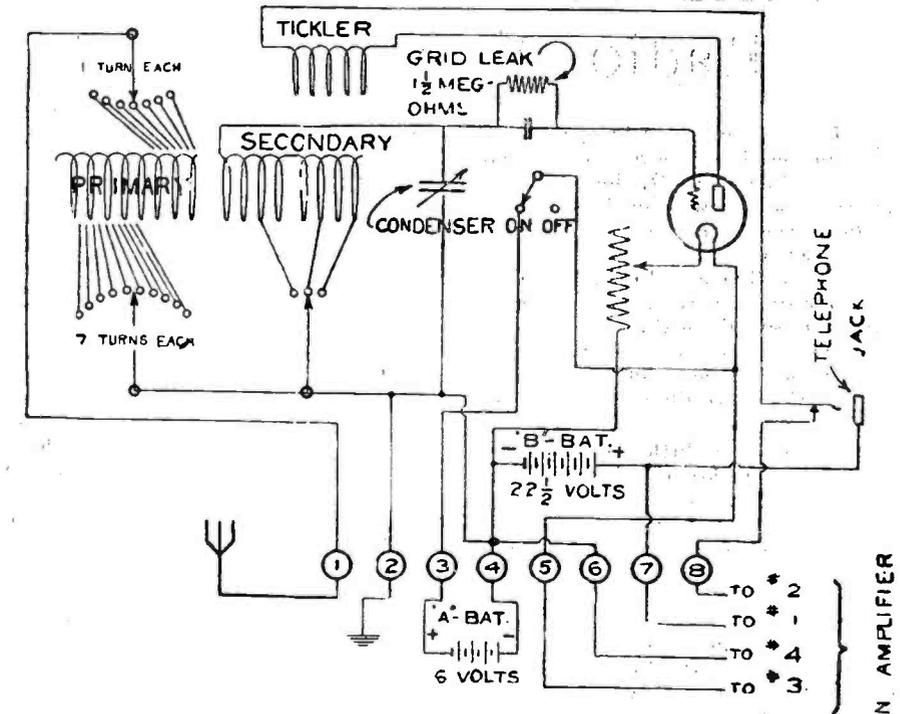
How WDAP Made History

Following is an interesting account of a recent broadcasting achievement sent out by the Drake Hotel Station WDAP, the official broadcasting station of the Chicago Board of Trade.

NOT so long ago, Alexander Graham Bell appeared with his newly discovered telephone, on a stage in Philadelphia. The audience was made up of "doubting Thomases." It was hard to believe the rumors that had swept the country, of the strange and mysterious device that would enable one man to speak over a wire to another. And even after the test, they would not believe that Mr. Bell was heard a few blocks away, through that peculiar looking device he called a "telephone," until affidavits were produced by reputable persons who heard with their own ears.

Then, with the telephone. The other day, with radio. When Thorne Donnelley and Elliot Jenkins, owners of the Drake Hotel broadcasting station, the official broadcasting station of the Chicago Board of Trade, ventured the opinion that messages from the Drake could be heard in mid-ocean, on a prearranged schedule with a liner, their friends looked dubious. They were kind, of course, but— A test was suggested. Mr. Donnelley thought of trying to reach the speeding S. S. Berengaria, which was due to leave New York harbor, and would clear 600 miles of watery waste every day. Well, they set about to give a demonstration, and like Mr. Bell saw to it that good and sufficient evidence of the facts was forthcoming.

On the S. S. Berengaria which sailed January 30th, Miss Florence McDonald had installed a standard Zenith receiving set—a set just like every other that is made by the Chicago Radio Laboratory. From January 30th to February 4th, every day at appointed hours, both early and late in the evening, messages were



Wiring Diagram of Zenith Set Used Aboard the S. S. Berengaria. Furnished Through the Courtesy of Chicago Radio Laboratory.

flashed across the sky by Thorne Donnelley, the actual voice being transmitted, heard, and recognized aboard the Berengaria, which was speeding on its way to France. Each time an erroneous statement regarding the length of the Berengaria would be made (newspaper men picked the number haphazard out of a hat a few moments before the broadcasting), and each time came back the answer from the Berengaria giving the incorrect length as well as the correct length, now 250 miles out, then 725 miles out, again 1286 miles out, and so on until the maximum distance was reached.

This was the first successful attempt to reach a voyaging ship from an inland station, on a predetermined schedule. No special tubes were used by the Drake

Broadcasting Station. No special tubes were used in the Zenith receiving set. Out of a little bantering among friends sprouted an idea, only vague at first but soon developed definitely, finally into a reality that gives the Drake Broadcasting Station WDAP, and the Zenith, the distinction of having made important history in the field of radio.

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 (See coupon on Page 21.)

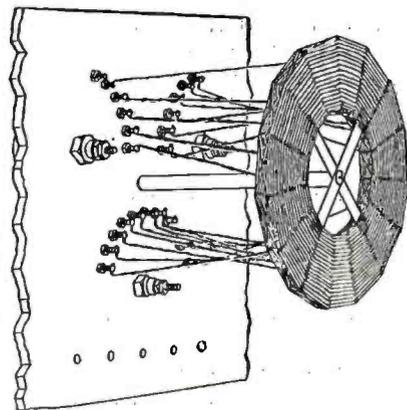
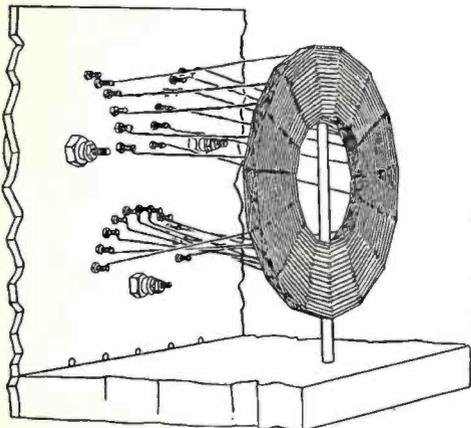
PFANSTIEHL INDUCTANCE

FOR

Reinartz Radio

Twenty-one long taps wound with double green silk. The most efficient and sensitive coil for the wonderfully efficient and sensitive Reinartz Circuit.

Ask also for Pfanstiehl Honeycomb Coils.



PFANSTIEHL RADIO SERVICE COMPANY
 HIGHLAND PARK ILLINOIS

Radio Diverts Big Rotary Meeting

AT a meeting of Chicago Rotary in the Hotel Sherman, Chicago, on February 27, four hundred Rotarians were entertained by a radio demonstration of practical radio. Paul G. Niehoff was master of ceremonies. He engaged Ransome Fiske, a brilliant and youthful amateur, to set up an "operating room" on the rostrum. This was concealed by screens until after luncheon was disposed of and then the lights in the Tiger Room were switched off.

Revealed on the little platform were Mr. Niehoff and Mr. Fiske at work with a "rock crusher" from a ship's equipment. This contraption sputtered and flashed in a startling fashion. It was then announced that the speaking program would be received for that meeting by radio.

Ostensibly a program was sent over the air from WDAF, the Kansas City Star station. In reality the speeches were transmitted by radio as represented but they came no greater distance than from a room in the hotel which had been equipped for the purpose.

An address on Radio was thus transmitted by Frederick Smith, editor of Radio Age. Many of those who were present still believe that the address was radioed all the way from Kansas City.

The speaker said:

"It is indeed a pleasure to be speaking to an invisible audience which is unable to talk back. It must indeed be a pleasure to the invisible audience to be able to go to sleep and even to snore, if it so desires, without fear of offending the speaker.

"Most of the tricks of oratory are lost in speaking over the electro-magnetic waves. Gestures do not help. The flashing eye and the corrugated brow make no impression upon this cornucopia of sound known to the up-to-date as the radio microphone. Therefore the speaker by radio must depend upon facts. Being a newspaper man, you will understand in what a difficult position this places the speaker.

Industrial Romance

"But while radio development in the United States will some day be recognized as one of the most interesting industrial romances of the country's history, it will not require romancing to make the voice of radio seem worth while listening to this afternoon.

"You gentlemen are having but a glimpse here of the marvelous new art upon which a giant industry is being built. What radio can do, is doing and will do for business, social progress and for civilization generally, no man may now say.

Radio Not New

"We speak of radio as a new science, or art, but we must remember that it is no such thing.

"More than a quarter of a century ago Marconi had made successful demonstration of practical wireless communi-

cation. His genius was devoted to obtaining transmission of telegraph signals through the air. He succeeded so well that for years wireless telegraphy has been used in directing ocean traffic and in intercommunication among nations and armies. Wireless is no new thing.

"Edison, Fleming and De Forest developed many phases of it when you gentlemen were still at the age when every goose was a swan and every lass a queen.

Popular Grand Opera

"It was the establishing of broadcasting stations from which music and voice could be heard at distant points with apparatus equipped with common telephone receivers that brought the world to attention.

Broadcasting of grand opera in the season of 1921-1922 literally electrified the radio world. That popular adventure in radio broadcasting sent thousands and tens of thousands of citizens in search of radio outfits. They could not understand the international wireless telegraph code any more than they could read the hieroglyphics on the tomb of jovial old King Tut in Egypt. But they could understand splendid music brought to their own firesides.

Opera listeners who hear the solos, mass singing and orchestrations get the music before it reaches the audience in the upper galleries of the auditorium in which the opera is being presented because the radio receiver gets its music by electro-magnetic waves, which are much faster than the common sound waves.

570 Broadcasting Units

"A year ago on the first of this February there were thirty-six broadcasting stations in the United States. This afternoon there are 570 stations licensed to transmit programs of news, music and speeches and these stations represent an investment of many millions of dollars.

"Monday afternoon the Commonwealth Edison Company broadcast the news of its annual stockholders' meeting by radio.

"Banks all over the country are supplying their country clients with market and stock quotations by means of radio. The Chicago Board of Trade has purchased Station WDAP, one of the most powerful in the United States. Now news of the live stock and grain markets is officially broadcast throughout the country each day from that station.

A Moving Force

"Radio is coming to be recognized as something far beyond a fad, an experiment or a toy.

"It is a moving force in the world of today. Its possibilities are beyond our wildest dreams.

Our Boys

"There is one phase of radio history that must not be overlooked when the world begins to reap its wireless ben-

efits in full. That phase relates to the American boy. It is the boy in knickerbockers who has brought the United States to the front as a radio country.

"It was the boy in knickerbockers who mastered the intricate science of transmitting telegraph code by wireless and who mastered the electrical equipment necessary for such transmission. These boys, who saved their dimes and built their crude laboratories in city basements or country woodsheds, are the pioneers of radio.

"They were the same boys who went to the fore when our country called for skilled men for the signal corps. They went aboard our battleships and worked the radio, thus performing a service whose importance cannot be estimated.

A Relay League

"The American boy worked days and stayed awake nights to toil with his outfit. He organized a relay league, through which messages were sent and are still sent from one end of the country to the other.

"So when the broadcasting stations appeared with their popular programs and the man or woman who understood little of electricity, found that music and speeches, sermons and news could be heard over a simple radio outfit in their living rooms, they exclaimed at the wonderful new discovery, radio. The American boy and his pioneering in code sending were practically forgotten.

Dad Listens to Learn

"It is the boy, however, who is still the radio expert.

"It is his daddy who sits humbly by and tries to learn. It is the American boy who is constantly experimenting, developing.

"If our country gains new prestige through its progress in radio, if the world becomes better, more enlightened, through radio, it is the duty—and I may say it will be the privilege of every man of us—to take off our hats to the American boy and say, 'You did it, youngster.'

Good!

Congressman White introduced in the last Congress a joint resolution in the House directing that the Federal Trade Commission investigate the status of the radio industry, with a view to ascertaining whether anti-trust statutes have been violated. The Commission was directed to investigate the ownership of radio patents used in interstate and foreign commerce and to examine contracts and agreements controlling manufacture and sale of apparatus, and also to learn whether there exists agreements giving exclusive rights or special privileges in the reception and transmission by radio.

Multi-Layer Coils

Multi-layer coils, that is coils having more than one layer of winding, are used in radio and many other classes of electrical work. The simple form of coil, that is, one wound layer on layer, has a very considerable capacity between the windings and is, therefore, unsuitable for radio work in which the capacity of the coils must be kept as low as possible. Various means have been used to reduce this capacity, such as special forms of winding and methods of separating the different windings from each other.

In the design of electrical apparatus and particularly radio apparatus, it is important to be able to calculate the inductance of the various types of multi-layer coils. Formulae for the inductance of simple types of multi-layer coils have been derived by a number of scientists, and it has been found that for the special types of low-capacity windings employed in radio work, the same formulae apply as for a simple circular coil of rectangular cross-section provided that an appropriate correction is made for the space occupied by the insulation.

These formulae, however, are complicated and for any given case the necessary computation is tedious. Furthermore, there are a number of different formulae, each one suited to some particular type of coil, so that the engineer may find it difficult to select the formula best suited to his particular problem. Methods having for their object the avoidance of these difficulties have been in use for some time, but none of them allow an accuracy greater than 1% at the best, and in some instances the use of such approximate formulae give only a very rough degree of accuracy.

Scientific Paper No. 455 of the Bureau of Standards, "Tables for the Calculation of the Inductance of Circular Coils of Rectangular Cross-Section," may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at ten cents a copy, gives tables which have been carefully calculated by means of which the inductance of multi-layer coils may be quickly and accurately computed by the simplest of mathematical operations.

The values in the tables are correct to one part in 10,000. The necessity for long and tedious computations directly from complicated formulae and for selecting the most suitable formula for a given case are thus avoided. The formulae on which the tables are based are collected for reference, and the theoretical problems involved, as well as the limitations of each formula, are discussed. Examples are given to illustrate and explain the use of the tables and the calculation of mutual inductance for certain cases of multi-layer coils is treated.

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A Radio Hero

Harry Sadenwater, one of the heroes of the air service of the United States navy, has been placed in charge of the technical operation of the broadcasting stations of the General Electric Company, including WGY at Schenectady, N. Y., and the projected station at San Francisco, Cal. The selection of Mr. Sadenwater was made by Martin P. Rice, director of broadcasting.

Two years before he entered the ranks of the Radio Engineering Department of the General Electric Company, Mr. Sadenwater was a lieutenant in the United States Navy and was one of the few out of hundreds of volunteers selected for the hazardous flight of the NC flying boats, NC-1, NC-2 and NC-4, across the Atlantic, from Newfoundland to Portugal.

Lieut. Sadenwater was radio officer on the NC-1, commanded by Lieut. Commander P. N. L. Bellinger. The NC-4, it will be recalled, was the only one of the three boats to successfully make the crossing. The NC-1, which carried Lieut. Sadenwater, encountered heavy fog. Navigation was made so difficult that the big flying boat was brought down to float on the sea until the fog lifted. Instead of the calm sea expected the boat ran into rough water and in a very short time the NC-1 was so badly rammied by the waves that it was impossible to ride off the water and every minute added to the damage.

Lieut. Sadenwater sent out S. O. S. calls until the batteries became exhausted. Nothing remained but to wait for a passing boat or the complete destruction of the hydroplane. A Greek freighter, the S. S. Ionia, finally sighted the NC-4 and picked up her crew which was landed safely at Horta Fayal, in the Azores. Lieut. Sadenwater, with other members of the crew, was made a knight of the Military Order of the Tower and Sword by the president of Portugal.

Wallace for Radio

Secretary of Agriculture Wallace, states that as a means of getting market information to the country, radio is growing popular. Although still in an experimental stage, he says radio broadcasting gives promise of great future usefulness.

The first agricultural news bulletins were broadcast from the Bureau of Standards on December 15, 1920.

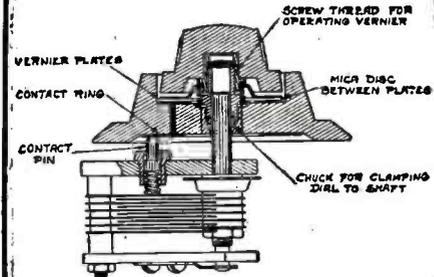
Today, two years after its inception, the Department of Agriculture has practically a nation-wide broadcasting service for weather, crop and market reports by radio telegraph and telephone. Radio is held as an invaluable means of immediately getting news on agricultural affairs to the farmers and others interested in food production and marketing. From sixty-one radio transmitting stations of the Navy, Post Office, State Agricultural colleges and other agencies market information is broadcast daily. Requests for an extension of this service from other localities have had to be denied by the Department, due to lack of funds, Secretary Wallace states.

"NEW UNITED" VERNIER

A Miracle-Worker in Fine, Selective Tuning Operates on a New Principle



Will bring in the elusive stations that have thus far defied you, by giving at least twice as fine a tuning as has ever been possible with the best condensers thus far developed.



Can be attached to any plate condenser by drilling one hole in top plate.

Price, each, postpaid \$2.50.

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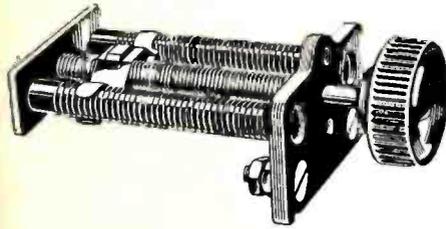
Symbols Used in Radio Diagrams

CROSSED WIRES, NOT JOINED		VOLTMETER	
JOINED WIRES		GALVANOMETER	
RESISTOR		CRYSTAL DETECTOR	
RESISTOR, VARIABLE		ELECTRON TUBE (THREE-ELECTRODE)	
INDUCTOR		TELEPHONE RECEIVER	
INDUCTOR-VARIABLE		TELEPHONE TRANSMITTER (MICROPHONE)	
INDUCTOR ADJUSTABLE		BUZZER	
INDUCTOR, IRON CORE		SPARK GAP, PLAIN	
MUTUAL INDUCTANCE, OR INDUCTIVE COUPLER		ANTENNA, CONDENSER OR OPEN TYPE	
INDUCTIVE COUPLER, WITH VARIABLE COUPLING		COIL ANTENNA	
TRANSFORMER		KEY	
		SINGLE POLE, SINGLE THROW KNIFE SWITCH	
BATTERY		SINGLE POLE, DOUBLE THROW KNIFE SWITCH	
LONG LINE, POSITIVE ELECTRODE		DOUBLE POLE, SINGLE THROW KNIFE SWITCH	
SHORT LINE, NEGATIVE ELECTRODE		DOUBLE POLE, DOUBLE THROW KNIFE SWITCH	
VOLTAGE DIVIDER		TRIPLE POLE, SINGLE THROW KNIFE SWITCH	
GROUND		TRIPLE POLE, DOUBLE THROW KNIFE SWITCH	
CONDENSER AUDIO-FREQUENCY		REVERSING SWITCH	
CONDENSER RADIO-FREQUENCY			
CONDENSER, VARIABLE			
AMMETER			

The Autostat

Representing one of the most radical advancements in Radio Filament Control, the Autostat, developed in the engineering laboratory of the Automatic Electrical Devices Company, Cincinnati, Ohio, also manufacturers of the Hom-charger, has made its appearance this month and is available for general sale.

The Autostat, known as a super radio rheostat, gives the most precise control of filament current, inasmuch as it is not necessary to turn the knob a hair's breadth to get a fine adjustment, since there are forty complete turns of the knob between maximum and minimum resistance, compared to three-quarters to three turns on all others.



Its construction is radically different, too. Two parallel mounted, wire wound, fire-proof resistance tubes are connected in series by a micrometer operated slider—the length of wire in circuit depending upon the location of this slider.

It is claimed that one full turn of the Autostat knob produces finer tuning than a hair's breadth adjustment on any other—that it brings in distant stations loud and clear and tunes in those elusive stations that heretofore have remained unheard.

It gives a uniform change in resistance with each turn of the knob, possessing practically "zero" resistance at full-on position.

The Autostat is compact in size, neatly mounted, requiring less space than any other. Furthermore, it is a most economical rheostat inasmuch as only

one Autostat is necessary to control two amplifying bulbs. It can also be used with six volt or W D-11 Detector tubes, or one 5 Watt Power tube.

The Autostat is popularly priced at \$1.35. For further information, we would suggest that you write the Automatic Electrical Devices Company at 146 West Third Street, requesting their new bulletin No. 646.

Dry Cell Tube

The Westinghouse WD-11 vacuum tube for radio receivers which operates on a single dry cell is the subject of much discussion among the radio amateurs who have been accustomed to using the big six-volt tube. This small tube, which is one of the most important developments in radio during the past year, has become very popular in the radio world, but, perhaps because of this very popularity, there has been much misinformation about its characteristics.

One of the most popular fallacies is that the WD-11 is a soft tube, only suitable for use as a detector, and that it cannot be used as an amplifier because the increased plate voltage would destroy it. In reality, however, the WD-11 is a very hard tube, mercury pumps being used during its manufacture to make sure that the last trace of air is removed from the bulb. During this operation, the filament is heated in the regular way and, in addition, a high frequency coil is lowered around the bulb which induces currents in the plate and grid of sufficient strength to bring them to a red heat. All occluded air or gas is thus eliminated.

The tubes will stand any voltage that may be put on them up to a point where the glass stem, through which come the lead-in wires, breaks down due to electrolysis. It is practically impossible to break down in vacuum. The Westinghouse Electric & Manufacturing Company, manufacturers of the tube, recommend voltages of from 22 1-2 to 45 volts when the tube is used as an amplifier.

New Vacuum Tube

A new and improved vacuum tube for radio use which uses but one-fourth the filament current of the present type radiotrons has been perfected by the General Electric Company. This can be used either as a detector or an amplifier and is interchangeable in all receiving sets now using radiotrons UV-200 or UV-201 tubes.

According to W. C. White, who developed this tube, UV-201-A guarantees quieter operation, with no tube noises, and assures greater amplification due to greater filament and plate area.

Greater electron emission amounting to about five times that of the present type tubes is given off. Much less distortion of received signals and greater volume when used in connection with loud speaker is said to be found.

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Pallophotophone

If you have tuned in to 370 meters recently and have picked up WGY you have probably been surprised at the purer and truer tone quality of music and speech from the General Electric Company broadcasting station, at Schenectady, N. Y. The answer is the Pallophotophone.

A new use has been found for the remarkable device which photographs sound on motion picture film and then reproduces the sound from the film. C. A. Hoxie, the inventor, has now devised a pick-up or microphone using the principle of the Pallophotophone re-producer.

The microphone is the link between the artist or instrument in the studio and the electrical circuit; it converts or transforms the variations of tone into corresponding variations of current. Microphones now in general use are constructed on the principle of the telephone transmitter in which the compression or expansion of granular carbon affect the electric current.

In the Pallophotophone pick-up a very sensitive diaphragm is set vibrating by sound. The movement of the diaphragm is communicated to a mirror three sixty-fourths of an inch square. A strong light strikes the dancing mirror which reflects the light beam at a sensitive light cell. The variation in the beam of light, caused by the vibration of the mirror varies the effect on the light cell and thus produces a corresponding variation in the electric circuit. Amplification is then obtained in the ordinary way by means of pliotrons.

The new pick-up eliminates the hiss which accompanies the use of the ordinary microphone; it is more sensitive and responds more readily and accurately to sound waves, capturing harmonics which would ordinarily be lost. A feature of the new pick-up is the weight of the moving or vibrating part. The diaphragm and mirror combined weigh one-tenth of a grain or half as much as the head of a common pin.

The Pallophotophone pick-up is now a permanent part of the studio equipment of WGY. Many letters complimenting WGY on the improvement of its tone quality were received after the program of January 30, when the play "Bought and Paid For," which was put out through the new pick-up, was presented.

Editorial

(Continued from page 17.)

be seen. Lack of a new law makes it necessary for the Department of Commerce to continue under legislation enacted ten years ago when broadcasting was unknown and there were few commercial and amateur stations.

It is probable that the Secretary will undertake the partial reallocation of wave lengths, within the limits of the existing radio law, in an effort to reduce interference and make for peace in the ether.

How Radio Grows

Number of licensed radio stations on June 30, 1913, and on January 1, 1923.

	1913	1923
Broadcasting class A.....		544
Broadcasting class B.....		25
Amateur.....	1,312	16,898
Special amateur.....	3	201
Experimental.....	10	291
Technical and training schools.....	7	126
Point to point inland.....	14	167
Coast stations communicating with ships.....	64	39
Transoceanic.....	1	12
Ship stations.....	479	2,762
Total.....	1,890	21,065

Number of operators licensed during fiscal years 1913 and 1922.

	1913	1922
Commercial.....	1,832	3,136
Experimental and instruction.....	8	43
Cargo.....	1	14
Amateur, first class.....	1,075	4,530
Amateur, second class.....	766	4,390
Total.....	3,682	12,113

Just what plan the Department has for improving conditions in the present radio pandemonium is not known, but a plan for execution within a few months is being worked out, it is understood.

The decision of the District Court of Appeals requiring the Secretary of Commerce to re-issue a license to the Inter-City Radio Company of New York, although that station had been severely complained of due to interference will be appealed, it was announced recently.

Secretary Hoover and his solicitor have taken the matter up with the Attorney General's office requesting that the case be appealed to the Supreme Court of the United States. It was the action of the Court of Appeals that caused Secretary Hoover to state recently that: "This removes the last shred of the Department's authority over radio."

Super Radio Survey

(Continued from page 13.)

resultant to modulate her short wave transmitter. This method introduces marked losses and distortion and could never be practically applied on a large scale to voice and music unless radical improvements in audio frequency circuits are made.

After all, it is not the novelty, or priority of suggestion of a new method which concerns the general public; it is the actual reduction to practice in engineering form and work is well under way to assure that the above plan for the co-ordination of radio effort towards the elimination of static will be in operation before the coming summer static season settles its usual blight on radio.

Station KYW

Radio fans of the United States will be entertained on the evening of April 17 with another feature attraction from Westinghouse Station KYW. Since the entire production of Shore Leave was broadcast from Powers Theatre several months ago Wilson J. Wetherbee and Walter C. Evans, director and chief engineer respectively of KYW have endeavored to develop the broadcasting of spoken drama to meet the popular demand of the invisible audience for this form of entertainment. Their efforts have culminated in arranging through the cooperation of Jessie Royce Landis, director of the North Shore Players company, a schedule of one-act plays to be produced from time to time in the studio of KYW.

The first of these is entitled Bargain Day and was arranged and directed under the personal supervision of Mrs. Landis. The part of the harassed husband will be played by Sidney M. Spiegel, Jr., who acted the role when the play was given in Chicago. The finale lead will be interpreted by Jessie Royce Landis.

Station KYW is now widely known to be the first broadcasting station in America to have broadcast an entire drama directly from the stage of a theatre and the aim of the management is to give KYW's audience more plays and to make the station a theatre without a stage.

War Secretary on Radio

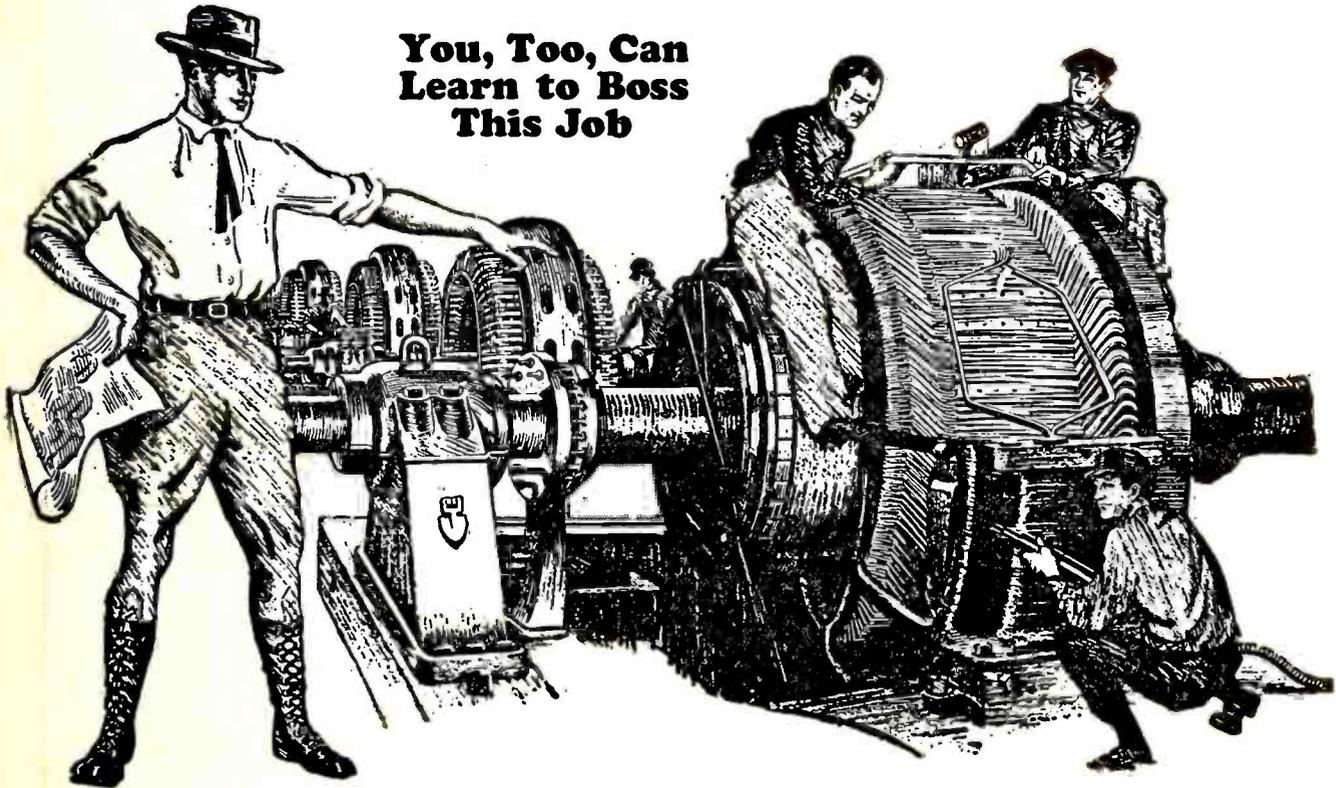
Secretary of War Weeks delivered an address before the American Agricultural Editors' Association at the Hotel Harrington, Washington, D. C., on February 26 in which he said:

"Because of the isolation of the farm, the development of communication facilities is highly important, not only in transmitting weather reports but also in broadcasting data on markets and in dispensing music and recreational programs to the living room of the farmer. The prominent part played by the Signal Corps of the Army in building up our system of wired communication is being carried on fully as effectively in the promotion of radio. The Signal Corps is responsible for the use of the vacuum tube in this country, and also largely for the development of the small radio set now used so generally by the amateur.

"General Squier's recent invention will serve to bring the radio even more generally into the home of the farmer, with the resulting enrichment of agricultural life. In certain sections, such as the early frontiers and present day Alaska, the farmer has had no communication with the outside world other than that afforded by the Army signal system. The radio web of the Army is today a reserve system that would enable our country to continue its general contacts even in the face of a complete breakdown of the civil lines. The modern farmer will appreciate what this means.

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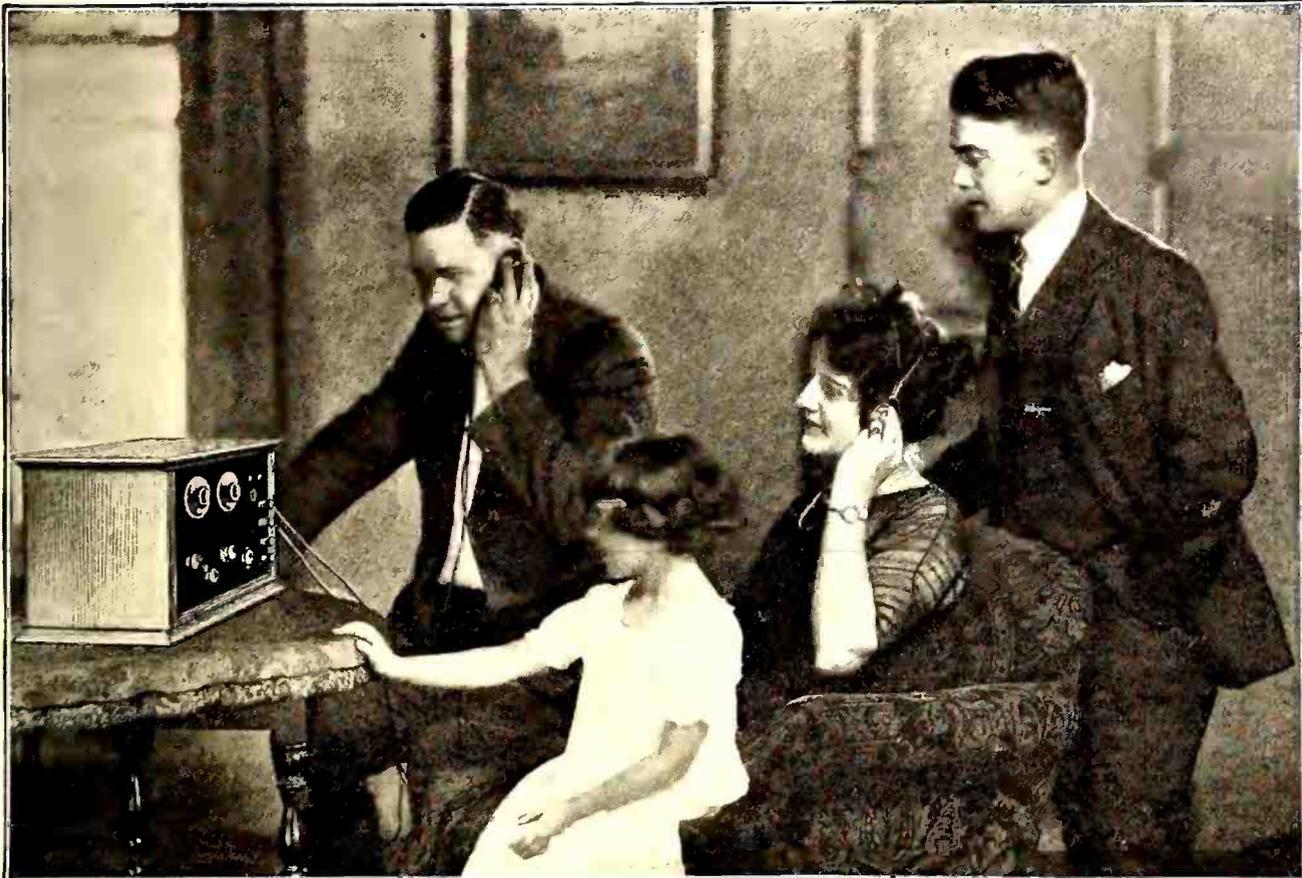
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READ THESE TESTIMONIALS!

Harold R. Wakem Co.
Chicago, Ills.

Seaton, Ills., December 22, 1922.

Dear Sirs:

Following is a report of the different stations I received on the Sensitone Detector, and all came in very clear, on the 21st.
Ft. Worth, Texas
Davenport, Iowa.
Cincinnati, Ohio.
Indianapolis, Ind.
Pittsburg, Pa.
Kansas City, Mo.

Memphis, Tennessee.
Dallas, Texas.
St. Louis, Mo.
Louisville, Ky.
Schenectady, N. Y.
Denver, Colo.

Harold R. Wakem and Co.,
Chicago.

Dear Sirs:

Last night was the first night that I tried my Sensitone, and here are some of the stations that I heard very well: Houston, Texas; Denton, Texas; Fort Worth, Texas; St. Louis; Dallas News; Cincinnati; Atlanta Journal; Detroit News.
I heard ever so many others, that I just tuned in or out as they interested me or not. Now, don't you think that's a good start for a green beginner? According to what I have read I am living in the "home" of static.

and I am sure there was lots of it yesterday, as it was very warm, and we had a lightning storm also.

I listened in to the St. Louis Post-Dispatch for over an hour, as their concert was fine, and everything was clear. Yesterday afternoon at three I heard Houston, Tex., very well.

Detroit is a mighty long distance from here, so I consider your set a marvel.

With all good wishes for the coming season I beg to remain
Yours sincerely,

REV. JOS. J. BOUDREAUX.

Chicago, Ills.
Atlanta, Ga.

Newark, N. Y.
Detroit, Mich.

Minneapolis, Minn.

I did not go to bed until 3 a. m. next morning. Certainly is a fine machine. Hope to add Amplifiers and Loud Speaker in near future. I am getting stations that other radio bugs here in town don't get. 12 radio sets in town at present. 400 population, and lots of bugs here. You can use my name if you choose.

Yours truly,

D. E. HAIST,
Seaton, Ills.

Telegrapher, M. & S. T. L. R. R.

December 13, 1922, 9:49 p. m.

DB 841, 49 Collect N.L., Lubbock Tex 13

Harold R. Wakem & Co., Chicago, Ill.
In answering queries relative distance Performance he explicit without fear quote this telegram first night's program included Detroit News, Drake Hotel, Chicago, Kansas City, Davenport, Atlanta, Paducah, Ky., Los Angeles, San Antonio, Houston, Ft. Worth, Oklahoma City, entire cotton, cattle, hog, sheep markets from Kansas City. Two p. m.: is more than satisfactory with thirty foot aerial. W. H. WARD, Theriot, Louisiana, December 16, 1922.

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