HOOKUPS!

AUGUST 15 1925

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MY FAVORITE AF AMPLIFIER

By Capt. P. V. O'Rourke

RADIO WORLD

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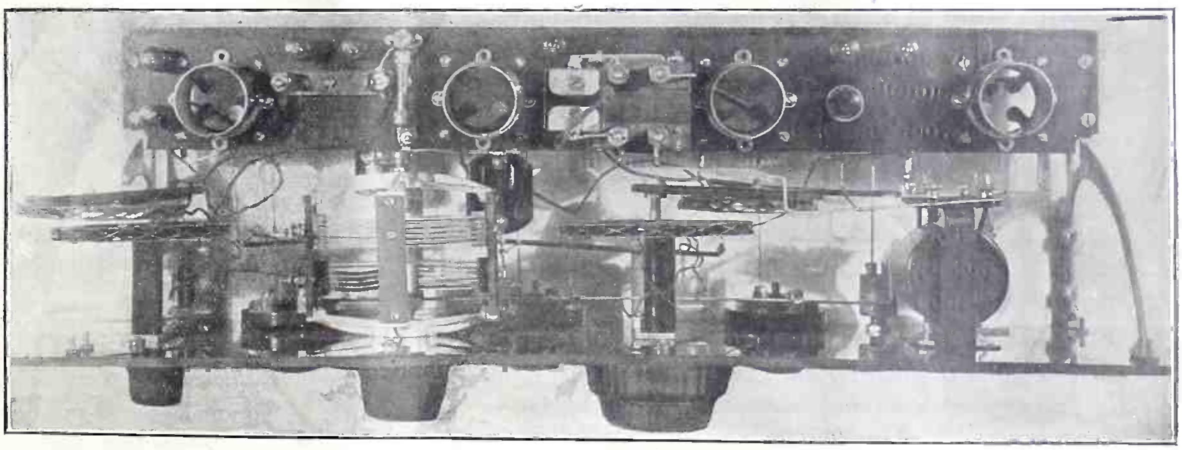
WINNER OF POPULARITY TEST REVEALED

See Page 21

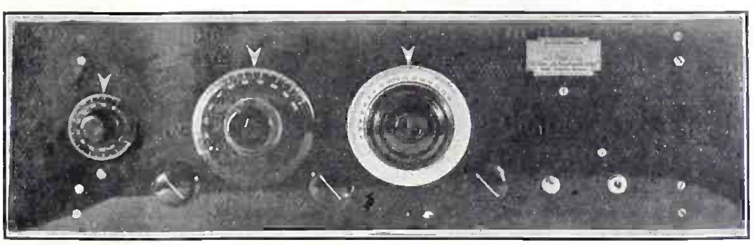
THE DIAMOND

With Variable Antenna Coupling

(SEE PAGE 8)



TOP VIEW OF DIAMOND IS SHOWN ABOVE



AT LEFT IS PANEL VIEW OF THE SET

A 2-TUBE SPEAKER REFLEX!

By DR. DELLINGER: Too Many Stations on the Air; Pay Problem Already Solved

RADIO WORLD

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A 2-Tube Speaker Reflex

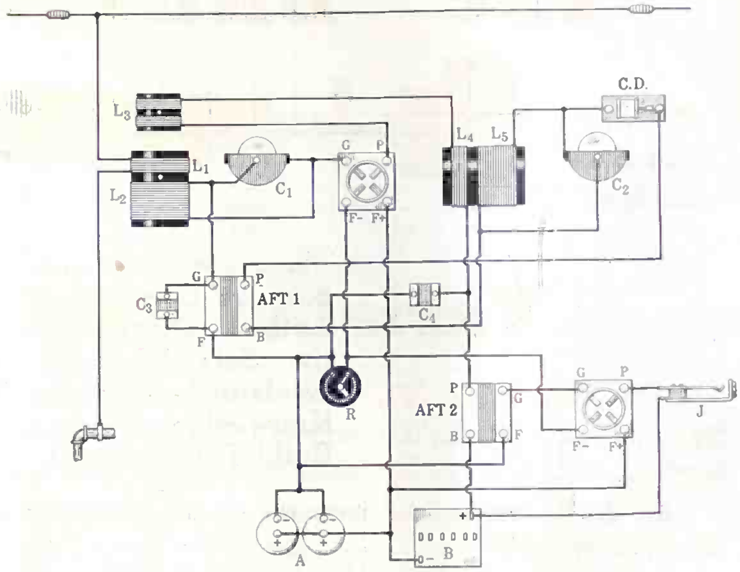


FIG. 1, the picture diagram of the 2-tube reflex, the most inexpensive set that can be built to give comfortable volume on a speaker.

The Most Inexpensive Set That Gives Good Speaker Results—Signals Are Pure and Clear, While Volume Is Not Much Less Than if a Tube Detector Were Used.

By Brewster Lee

A REFLEX that requires only two tubes and which works a speaker quite well is shown in Fig. 1, which is a picture diagram of the set. Personally I do not care for more than one stage of radio-frequency amplification ahead of a crystal detector. So that distant stations may be received the hookup is made to include regeneration in the RF stage. The natural purity of crystal rectification is retained as well as may be, although there is a slight diminution of quality, as compared with the simple crystal set. This is due to the enhanced selectivity, because the broad tuning of most simple crystal hookups causes all side bands to pass into the receiver, including the side bands of unwanted stations! Therefore the diagram represents a good compromise, the necessary selectivity being assured and the quality being somewhat better than that obtained from tube rectification.

Better Than Double Reflex

The reflex as shown is better from most points of view than that employing two tubes also, but reflexing both of them. In such a case some form of stabilization must be introduced, e. g., potentiometer, neutralizing condensers, resistance in the plate or grid circuit, reversed direction of current flow, etc. In the hookup shown in Figs. 1 and 2 nothing like that is necessary, the oscillations being under control at all times, and by the best method known, that is, one which is variable and yet not a "losser." The term "losser" is applied to any device which, although achieving desired results in a set, does so only by incurring severe losses.

Stabilizing Devices

Indeed, that is what stabilization sometimes amounts to, even where neutralizing capacities are used, for there must be resistance losses and the like even there. I am not arguing against forms of stabilization, however. A set must be made easily controllable. Even if some losses are introduced, they often accomplish more good than harm. Take the case of the so-called "self-stabilized" or "self-neutralized" sets. These would include a host of circuits known as tuned radio-frequency, to distinguish them from the Neutrodyne, which, of course, is none the less tuned RF, but which uses neutralizing capacities. The tuned RF sets will be found to employ resistance to create losses which will overcome the oscillatory vice of the tubes. The necessity for some such control arises in every case where you have two stages of RF, tuned or untuned, unless it be at an intermediate frequency, as in the Super-Heterodyne.

One way of introducing this resistance is to mount the coils on the back of the variable condensers, so that there is a severe interplay of the electrostatic fields of the condensers and the electromagnetic fields of the coils that are hooked up to them. Under such conditions the peculiar condition of oscillation on the high waves, with stability on the low waves, may be noticed. At first this seems very puzzling, because the low waves are the ones notorious for the production of oscillation trouble. Therefore how come?

A moment's reflection will show you that as resistance is introduced for the creation of losses, the over-oscillatory condition is present, if at all, on the high waves because it is there that the resistance is least effective. Also, resistance increases with the frequency, and the lower waves represent the higher frequencies, hence the greater resistance introduced by this method.

If possible it is preferable to omit such forms of stabilization, but if not possible—and this is often the case in other sets—the safe rule is to use the method you like best, realizing that there is a net gain. Under no circumstances should the stabilization be so complete as to rob the tubes of their oscillatory virtue. The vice lies in uncontrollable or so-called free oscillations. So soon as a tube is rendered non-oscillatory it is rendered next to useless and the stage of RF in which it is placed does little good, probably none whatever and had better be omitted. The whole stage is a loss. Therefore the losses must not be so great as to make the RF grids positive, the condition which tends to deprive the tube of any ability to oscillate in an RF hookup. In a normal tube detector stage a different condition exists, due to the characteristics of tubes, and a positive grid return is consonant with desired oscillation.

Even in neutralizing a set there should be some "life" on the low waves. A faint trace of a whistle is to be expected. That denotes a healthy condition of the tube. Absolute silence, except for the broadcast words or music in tuning in a low-wave station, might well cause the experimenter to determine whether his set is getting the results that he should normally expect. In most cases he will find that he is being cheated out of reception of distant stations otherwise not difficult to bring in.

The tickler coil L3 in the present circuit effectuates stabilization, once the setting is properly made for a given station. With some exceptions the tickler position will have to be changed for every wavelength change of the tuning condenser, C1. When a set using regeneration is receiving a program well there can be no radiation and no free oscillation takes place. The heterodyne note or whistle that is heard occasionally is only possible when you are tuning in a station, so far as the creation of the disturbance is confined to the receiver itself. Of course a whistle may be heard due to some neighbor's set radiating, or to the beat note set up by stations, usually on the lower waves, because they don't stick to their assigned frequency, or because, although ad-

Simplicity in a Reflex Set

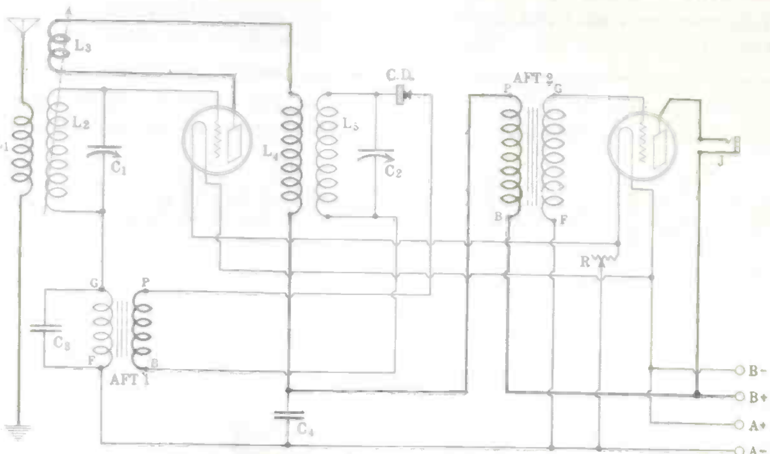


FIG. 2, the schematic diagram of the 2-tube reflex.

List of Parts

One 3-circuit tuning coil, L1, L2, L3.
One radio-frequency transformer, L4, L5.
Two audio-frequency transformers, AFT1, AFT2 (if of different ratios, place higher one in first stage).
Two sockets.
One crystal detector.
Two .0005 mfd. variable condensers, C1, C2 (usually 23 plates).
One .0001 mfd. fixed condenser, C3.
One .001 mfd. condenser, C4.
One 6-ohm rheostat.
Two sockets.
One 7-18" panel.
One 7x16" baseboard.
Three 4" dials, with pointers.
One single-circuit jack, J.
Accessories: two WD11, WD12, C11 or C12 tubes, two 45-volt B batteries, cabinet, speaker, phone plug, aerial wire, ground clamp, lead in wire, lightning arrestor, wire for internal connections, two 1½-volt dry cells for A battery.

hering to it, the 10-kilocycle separation between channels of the air is not enough.

Volume Not Deafening

The volume from this set is not enormous. It never can be when two stages of AF follow a crystal detector, even if there is regenerative RF ahead of the crystal. But it is ample. I sit at night, listening to this set, which I have had in my home for several months, and get plenty of volume from stations up to 100 miles away to make the speaker audible 50 to 60 feet from the set. On stations 100 to 500 miles away the reception is not always loud enough for satisfactory speaker reception, whereas those 1,000 miles off or more can be heard well only on earphones. This is pretty generally true even of sets using tube detection, and the rule is not disproven by the exceptions that one notes from time to time. For instance, 1,000-mile speaker reception is not uncommon with the Diamond of the Air, a 4-tube receiver of great efficiency.

The set as shown in the two accompanying diagrams is the least expensive one that can be built for speaker operation. Two stages of AF, following a simple crystal detector, will never do, for the volume is not a bit uncomfortable for mere earphone reception.

It is very easy to build the present set. Anybody who can read can make a successful job of it. Those familiar with radio may follow the schematic diagram (Fig. 2), as that type of experimenter finds it more convenient to grasp the whole circuit at a glance than by reading picture diagrams. However, the novice, not desiring a bird's-eye view of the hookup, but step by step guidance to sure success, will prefer the picture diagram. It is a fact that experts find picture diagrams harder to read than schematic diagrams.

The Panel

The constructor may use a 7x18" panel. As there are three controls, three holes will be drilled for shafts, usually ¼" diameter. On a central horizontal line, 3½" from top and bottom of the panel the shaft holes may be drilled distant from the left-hand side of the panel as follows: 3½", 3", 14½". Use 4" dials, with pointers or markers. As only one rheostat is used (R), this may be placed between the left-hand and the center dials, 2½" from bottom of the panel, or about 6¼" from left of panel. The jack would be placed an equal distance from the right-hand side of the panel and on the same horizontal line.

The Coils

The set is not very particular what kind of coils are used. The solenoid, which is the familiar coil on the cylindrical form, will do splendidly. The spider-web, diamond-weave, toroidal (the last-named for L4 L5 only) and others will be all right. The reader may consult his own preference.

Kinks on Wiring a Reflex Set Are Solved by the Author—Theory of How the Sets Works Is Explained — No Radio Knowledge Needed to Build This Reciever.

Assuming that the solenoid type is to be used, get two forms, each 3½" in diameter, both being 4" high, or one 4" high and the other 3" high (exclusive of tickler form).

L1 is wound, beginning near the top of a 4" high form. Two holes are punctured and about 6" excess wire is threaded through an anchorage thus provided. Other winding terminals will be similarly anchored. The excess is to be used later, in connecting the leads to instruments in the set, the wire being cut after the distance is covered in a straight line. Wind 18 turns of No. 24 double silk covered wire for L1. Terminate. This is rather large for an aperiodic primary, but it means more volume and, also, the added resistance is not injurious to excellent results, in fact, tends toward stability in this particular instance without harmful losses. Leave no space, or up to ¼", and wind the secondary, consisting of 43 turns of the same kind of wire, wound in the same direction. The only necessity for leaving any space between these metallically separate windings would be to allow for a hole through which the shaft of the coupler is to be inserted. No harm will be done if circumstances require a larger space than any specified.

The tickler form should be a cylinder about 2" high and 2" diameter, although up to 2½" diameter, 2" high, will be all right. The sole object is not to get a form that will hit against the stator when the tickler is rotated. The tickler, if a 2" diameter, will consist of 28 turns of the same kind of wire, 14 on each side of where the rotor shaft is to enter. This shaft must pass through the panel, through the stator form and enter the rotor, to effectuate rotation. The diametrically opposite side of the rotor form may be secured to the stator by bushing, washer and nut, to allow free rotation, however. This dispenses with the loss-producing method of having a metal rod right through the tickler form, from one side to the other. Still one more mechanical consideration is to provide continuously variable motion (which is difficult and requires pig-tail connection and special contact) or to have end stops. Use the end-stop method, inserting small wooden pegs or other device to stop the rotor after it has gone nearly 180 degrees.

If the diameter is larger than 2", then put on fewer turns. For 2½" diameter about 22 turns should suffice.

The coil just described is L1, L2, L3, where L1 is the aperiodic primary of 18 turns, L2 the secondary, 43 turns, and L3 the tickler. The radio-frequency transformer used as the interstage coupler (L4, L5) is wound exactly the same as the stator of the other coil, except that the primary has 12 turns, instead of 18. If one 3½" diameter is less than 4" high, this will be the one.

The forms may be cardboard, hard rubber, fibre, wood or anything else that's handy. If anything is used that is inclined toward moisture absorption, like cardboard, you may immerse the forms in molten beeswax, which makes them more or less impervious to moisture.

The manner of connecting the coils is shown clearly in the picture diagram. It is well to mount the coils at right angles, to minimize or entirely avoid stray inductive coupling.

Tips on Mounting

As for the mounting problems in general, the 3-circuit tuning coil may be at left, the two shaft holes to the right thereof, on the same line, being for the two variable condensers, both .0005 mfd. Behind the 3-circuit coil place the first socket, on a baseboard, with the G and F minus posts of the socket facing the panel. To the right of the tube would be the first audio transformer, AFT1, with the G and F posts facing the panel. Next place the RF coil on the baseboard, using two brass right angles. This will be far enough back to clear the variable condenser in the center. Between the two variable condensers, nearer the panel, the second audio transformer is put (AFT2) and near the right-hand end of the baseboard place the other socket.

Although a reflex set normally is one that will give more trouble than any other, both in wiring and in getting to work properly, no such difficulty need be experienced with the present receiver, since it is designed with the express purpose of achieving best results consonant with extreme simplicity.

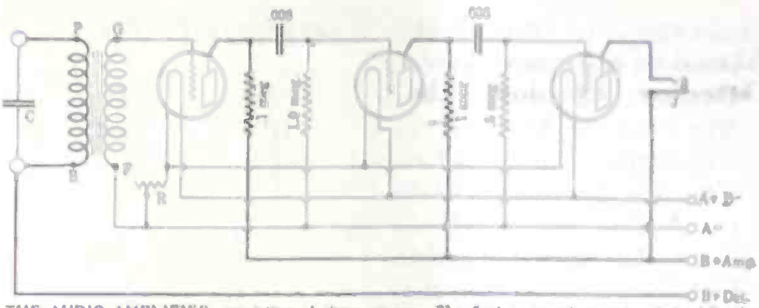
(*Continued on page 30*)

My Favorite Audio Amplifier

By Capt. P. V. O'Rourke

ALMOST every time one builds a set, no matter what kind it may be, he has to consider the problem of the audio amplifier, for these days nearly everybody constructs a set for speaker operation. The usual recommendation is to employ two stages of transformer-coupled audio-frequency amplification. This is based solely on the fact that the transformer method affords more volume per stage than any other. Hence all-sufficient volume is obtained on two tubes by employing this method. No other audio hookup will give sufficient volume on two tubes. Therefore if anything different is used, why so? And will three tubes be enough?

CAPTAIN PETER V. O'ROURKE



THE AUDIO AMPLIFIER, consisting of three stages. The first is transformer-coupled while the second and third are resistance-coupled. The transformer primary posts are at left. The input binding posts are at left on the subpanel, the two output posts at right.

The Captain's Favorite

My favorite audio hookup comprises one stage of transformer coupling and two resistance-coupled stages. My chief reason is that I desire to avoid any possibility of overloading the final audio tube, whereby quality suffers, and I must admit that I am a stickler for quality in radio reception. Sometimes two transformer stages will give very good quality, but it will not be better quality than the hookup shown in Fig. 1, and frequently will not be as good.

From a purely theoretical viewpoint it is impossible to have any audio amplification, indeed any radio reception at all, without distortion, which means the alteration of emphasis from that of the original sound produced before the microphone. But it takes scientific instruments to determine this and the real goal is reception that is not distorted so that the human ear, even that of the trained musician, can detect it. We listen to a receiver with our ears, not with radio instruments. The hookup shown in Fig. 1 achieves the satisfying goal.

Delightful Result

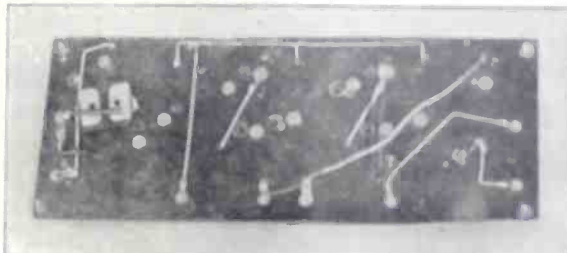
Different forms of audio-amplification produce different results. The transformer, with the accompanying high step-up, works some notes more efficiently than others, and the same is true of the resistance-coupling, but in the opposite respect. Therefore the two sort of balance each other, and the net result is indeed delightful. Every possessor of a radio set who is of an experimental turn of mind should give this hook-up a trial and satisfy himself that it is entirely to his liking. I can assure him of such satisfaction in advance.

The audio amplifier may be constructed on a hard rubber subpanel so that it may be readily included in any set one is building or has constructed.

Wiring Data

The plate of the detector tube is connected to the P post of the audio transformer, which should be a transformer of good make. The Samson was used in the laboratory model shown in the photograph. The B post of this transformer is connected to B plus detector voltage, usually around 22½, although up to 45 will give greater volume in most cases. Two binding posts are affixed to the subpanel, representing the points where the detector tube leads, plate and B plus, are introduced, and these posts are connected by wire to P and B on the transformer, as explained.

HOW the filament and B battery leads are wired up underneath the baseboard. Some leads from the audio-frequency transformer, which cannot be conveniently put above the baseboard are put below. This gives the builder more elbow space while wiring the set.

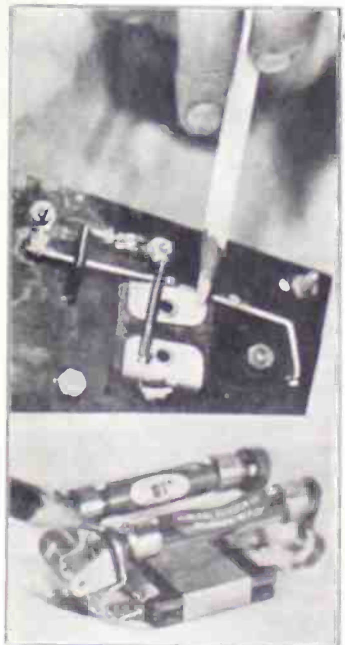


The G post of the transformer is connected to the grid post of the first amplifier tube socket (No. 1 in Fig. 1), while the F post of the transformer goes to A minus. Do not make this connection to filament minus.

The output of the first audio stage is from the plate of tube No. 1, and this is connected (a) to one side of a .1 meg. (100,000-ohm) resistor and (b) to one side of a fixed condenser, the capacity of which should be at least .006, and may be considerably more. There are two unconnected ends now and these are disposed of by joining the free terminal of the resistor to B plus amplifier voltage, which may be from 90 to 135, and connecting the free side of the coupling condenser to two points (a) the grid of tube No. 2 and (b) to one side of a fixed grid leak, 1 meg. (1,000,000 ohms). The open end of this grid leak is connected to A minus (not to filament minus).

This completes the wiring of the first two stages. The last stage is wired just as was the second stage, the plate resistor being .1 meg. here, too, but the grid leak being .5 meg. (500,000 ohms). The plate of the last tube is connected to one side of the single-circuit jack J, the other side of which goes to B plus amplifier voltage.

This comprises all the wiring with two exceptions. One is an optional by-pass condenser, C in Fig. 1, which ordinarily would be .001 or .002 mfd. This condenser might be placed underneath the subpanel, where indeed many of the wired leads are more conveniently carried. One side of this fixed condenser goes to the P post of AFT, the other side to the B post.



THE FIXED BY-PASS CONDENSER, is used across the primary of the transformer, may be mounted on the under side of the subpanel. The lower photograph shows the combination double mount for resistors and the isolating condenser, all as one unit. Two such units are used.

The Filament Wiring

The other uncompleted task is to wire the filaments. One rheostat is used to govern all three tubes. If UV201A, C301A, DV2 and similar storage battery tubes are used, this rheostat may be 10 or 15 ohms. For WD11, WD12, C11 or C12 use 6 ohms. The arm of the rheostat connects to A minus, the other rheostat terminal to the F minus posts on all three sockets. A plus connects direct from battery to the F plus posts of all three sockets.

The rheostat, however, need not be a part of the amplifier construction, indeed preferably should not be so, because the rheostat normally would be in a more convenient position on the panel of the radio set itself. Hence, in introducing the amplifier into a set, connect A minus

(*Concluded on page 21*)

A Set That Taxes Ingenuity

Cabinet for Detector-Amplifier

One Stage of Tuned RF Ahead of a Regenerative Detector Employs the Marconi Method of Feedback and Also Couples Detector Plate to Aerial by Variable Capacity—Set is Hard to Get Working Right, But Once the Problem is Solved, DX and Great Volume Are Assured.

By Lewis Winner

Associate, Institute of Radio Engineers

THOSE desirous of learning the fundamental basis of radio by practice, instead of by theory alone, should pay strict attention to constructional articles and follow directions. More can be learned when making something than when studying it merely from paper. Of course practice is based on theory in most cases, but even so the man who brought out that theory first had to build or do something constructional.

LEWIS WINNER

Very often I have read a book on radio theory and gleaned a fair knowledge of what I read. But I couldn't employ that knowledge in some constructional field. All I could do was to imagine what the thing would look like when completed. Pictures help, but one cannot depend solely upon visualization. If that article, which the man was discussing in the text, were in your hands you would know better what you were reading about and the knowledge would be firmer.

Herewith is a circuit (Fig. 1) which looks difficult, but which is very, very simple. It is a very old circuit and employs only fundamental ideas which when combined give wonderful results. This circuit contains a step of tuned radio-frequency amplification. This means that there is a tube which acts an amplifier at radio-frequencies. This tube does not rectify signals (except trivially) but makes them louder. It is placed there to obtain more volume and sensitivity, so stations which are difficult to obtain with just a tube detector, will be heard well.

Currents which are oscillatory in action and of a radio-frequency character are those vibrations too swift for the human ear to hear. This is usually above a frequency of 10,000 per second. We then have a detector, which rectifies these signals. We use a regenerative detector here. The plate of the detector tube is electromagnetically coupled back to the grid. After the signal is rectified, it is again amplified, this time through two steps of audio-frequency amplification. The AF makes the signals much louder, hence a speaker can be operated.

The above is a simple description of just what happens in the set after the signal is attracted by the antenna and induced from the primary of the oscillation transformer to the secondary of the oscillation transformer. The primary of the oscillation transformer is nothing more than the primary (which always has fewer turns than the secondary) of the radio-frequency transformer. The secondary of the oscillation transformer is the secondary of the first radio-frequency transformer.

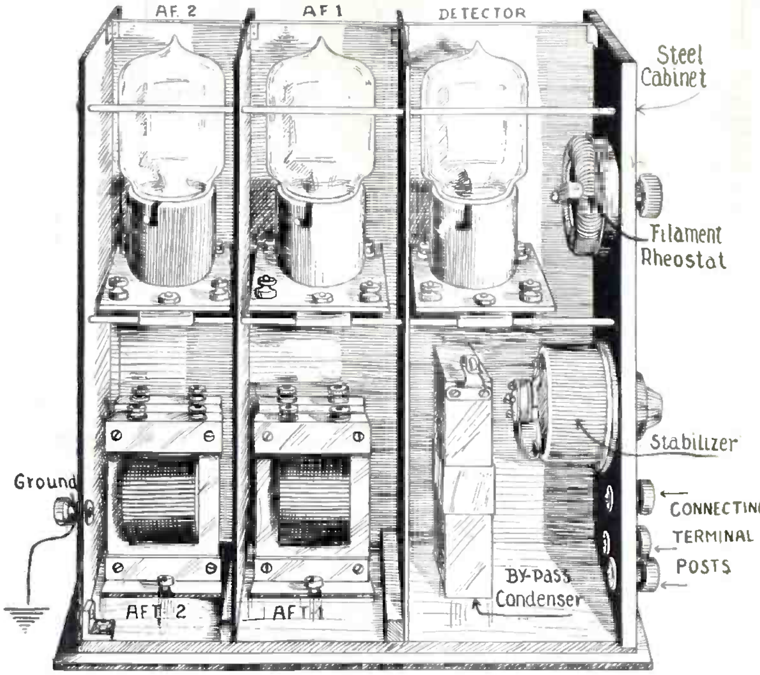


FIG. 2, picture diagram of a steel cabinet which is made to contain the detector tube and the two audio-frequency amplifiers. Note that there are no tuning units. The potentiometer and the filament rheostat for the detector tube are shown. The AF rheostat is on the other side. A unit like this is very practical, as it can be combined with any new hookup within a few minutes. A steel cabinet is used so as to prevent any stray feedback. It is very easily grounded and all strays are thus lost. Of course the panel itself is hard rubber and should not be mistaken for steel. The whole cabinet is 12" high, 8" wide on the sides and 6" wide in the front and back. Six inches are devoted to the top portion and 6" to the bottom portion. The tubes are on the top and the audio-frequency, transformers and the large by-pass condenser are on the bottom. The by-pass condenser has a capacity of 1.0 mfd. and is inserted in series with the plate, variometer, (it being taken for granted the set is regenerative and a 3-tube affair). This by-pass condenser may be taken out and the space utilized for another tube (radio-frequency, for instance). Don't let any of the wiring touch the cabinet. This is best accomplished by using insulated wire, which if it does touch will do no harm. Most of the wiring done here is battery wiring, except that of the audio-frequency transformers. The terminal posts on the lower right-hand corner are four in number, although three are shown. They are, plate of the detector tube, plates of the amplifier tubes (B plus), filaments of the tubes (A plus and A minus-B minus). Potentiometers are not used very much at present and may be left out.

The AFT should be of the low ratio type. Test the primary and the secondary with a pair of phones and a battery. Put the phone tips across the primary and battery. A loud click should be heard. Put them across the secondary. A dull click should be heard. Put one terminal of the phones to the primary and one terminal to the core, also to the secondary terminals. No click should be heard. Repeat with the secondary windings.

There are two filament-control jackets employed. See that all the inner and outer terminals make contact with each other when the plug is put in. See that the plug goes all the way in the jack. Some jacks have a very short head and will not permit the plug to go all the way, therefore causing a lot of trouble.

The Panel

Build the set on a baseboard. Get a long heavy piece of white pine or other wood (24" long and 9" wide).

Whether the set works at first or not, it will work later on. A panel already drilled saves a lot of trouble later on. We use a baseboard so that we can have lots of space and see what we are doing, without any jamming. Six inches from the left-hand side of the panel drill a hole for the rotor of the variable condenser which is to be used across the secondary of the first RFT. The diameter of this hole is about 3/16". Six inches from this hole drill another hole of the same dimensions. This is for the rotor of the variometer. Six inches from this one drill another hole for the rotor of the second variable condenser, this one being shunted across the secondary of the second RFT. These holes are all 3½" from the top and bottom of the panel. Two and one-eighth inches from the bottom of the panel, and 8" from the left-hand side drill a hole for the one of the filament-control jacks diameter ¾". Four inches from this hole, and in the same line, drill another hole for the other filament-control jack. Four inches from this hole drill a hole for one rheostat. Eight inches from this drill hole for other rheostat. That is all there is to the drilling of the panel.

The drilling of the panel automatically locates the tuning elements. The AFT are placed at the left-hand corner of the baseboard, at right angles to each other. There is no necessity for placing the transformers at right angles if they are internally

How to Wire and Work the Set

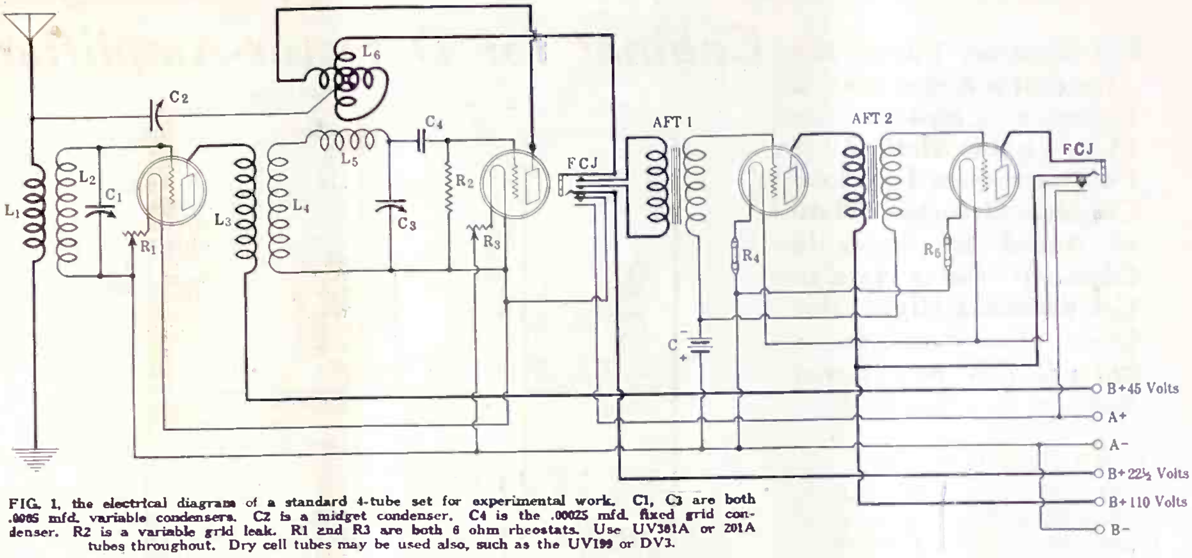


FIG. 1, the electrical diagram of a standard 4-tube set for experimental work. C1, C3 are both .0005 mfd. variable condensers. C2 is a midget condenser. C4 is the .00025 mfd. fixed grid condenser. R2 is a variable grid leak. R1 and R3 are both 6 ohm rheostats. Use UV301A or 201A tubes throughout. Dry cell tubes may be used also, such as the UV199 or DV3.

shielded, as a great many of them are today. The sockets are placed in the following manner: RF tube socket near the first RFT, detector tube socket near the detector-coupler, and the two AF sockets near the two AFT.

How to Wind the Coils

The winding of the coils is a very simple operation. Both coils, L1L2 and L3L4 are wound on a piece of tubing 3½" diameter, 4" high. Use No. 22 double cotton covered wire. About 1 lb. will be needed here. Stand the coil up so that the circumferences are on the top and bottom. One-half inch from the top of one form punch two holes, each hole 3/16" in diameter and separated ½" from each other, left and right. On the opposite end (bottom) and ½" from that edge, punch two more holes, of the same diameter and separation. Insert binding posts here. Right next to the holes on the top of the form wind 11 turns (L1). Bring the end and the beginning of the coils to the two binding posts on the top. Mark the top one Ant. and the other Gnd. Leave no space. Bring the beginning of the wire to the binding post on the bottom. Wind 47 turns (L2). Bring the end of the coil to the other binding post. Label the post holding the beginning (top) of the wire F and the other post G.

Take the other form. Perform the same operation as far as the holes are concerned as you did for L1L2. L3 has 11 turns, no spacing, L4 has 37 turns. Bring the beginning (top) of L3 to a post an mark this P. Bring the other lead to a post and mark this one B plus 45. These are the primary posts. The end of L4 (bottom) goes to one post on the bottom which is to be marked G. The beginning of the winding goes to the other post (next to primary) marked F.

Procure another from 3½" in diameter and 4" high. Punch two holes in the top or the bottom each spaced ½" from each other and ¾" in diameter. Wind 10 turns. Bring the beginning and the end to the two binding posts.

The Wiring

The coils completed, the wiring of the set is the most desirable thing to proceed with. Always start at the beginning, that is never wire up the set from the AF tubes back, as you may get mixed up. The beginning is from the antenna coil on. Bring the post marked antenna to the beginning of L1, which has a post marked Ant. on the form. Bring the end of this winding (marked Gnd. on the form) to the terminal post marked Gnd. The antenna post also goes to one end of a midget variable condenser (the capacity being .00004 mfd.). The other terminal goes, not to the mid-tap on the variometer L6, but to your own tap taken off the middle of the ROTOR Winding. The end of L2 (marked G on the form) goes to the grid post on the socket. This same terminal also goes to the stator plates of the .0005 variable condenser C1. The rotary plates of this condenser go to the beginning of L2 (marked F). This post goes to the pointer or movable arm of the rheostat R1. The resistance wire goes to the F minus post of the socket. The arm of this rheostat goes to the A minus of the terminal strip. The beginning of L3 (marked P on form) goes to the plate post on the socket. The end of this coil goes to the B plus 45 volts on the terminal strip (marked 45 plus on form). Now for the second or detector tube.

LIST OF PARTS

Two .0005 mfd. variable condensers. (C1 and C3).
One variometer (L6).
One .00025 mfd. fixed condenser. (C4).
One Bretwood variable grid leak. (R2).
One lb. of No. 22 DCC wire.
Two 3¼" diameter forms, 4" high.
One form 3½" in diameter, 3" high.
One midget condenser. (C2).
One double-circuit closed filament jack. (FCJ at left).
One single-closed circuit filament jack. (FCJ at right).
Two 6-ohm rheostats. (R1 and R3).
Two Amperites, type determined by tube used. (R4 and R5).
Three 4" dials, with pointers.
Four sockets.
Two low-ratio AF transformers.
Accessories: Two 45-volt B batteries, one 22½-volt B battery, one 4½-volt C battery, one A battery, phones, speaker, etc.

Before doing any wiring place the coil L5 at right angles to L4. The G of L4 goes to the beginning of L5, the end of L5 going to one terminal of C4, which in turn goes to one terminal of R2 and also to the grid post on the socket. Bring the stator plates of C3 to the end of L5. The rotary plates go to F of L4. This lead goes to the end of R2 and also to the F plus on the socket. The resistance wire of R3 goes to the F minus post of the socket. The movable arm of this rheostat goes to the A minus post on the terminal strip. Bring the two F pluses together. Connect one terminal to the fifth post on the filament control jack. The end or last post of the FCJ goes to the A plus of the terminal strip. For those who wish to employ neutralization the following is given: Bring the stator plates of C1 to one terminal of a variable neutralization condenser and the other terminal to the 16th turn from the beginning of L4. See that coil L5 is in inductive relation to the variometer. By inductive relation is meant placing the coils in such a manner that the magnetic fields of both will be at the highest point. The rotor of L6 goes to the plate post on the socket, while the stator goes to the top post of the jack. The next post on the jack goes to the P post on the first AFT. The next terminal goes to the B plus post of the same AFT. The last terminal (last part concerning the opening and closing of the audio-frequency transformer circuit) goes to the B plus post on the terminal strip. This is marked 22½ volts. We now hit the insulation, and then two more terminals. These are for the shutting off of the filaments of the tubes. This was described. This completes the wiring of the radio-frequency amplifier, the detector and the first part of the AFT. The G post on the first AFT goes to the grid post of the third tube socket. The F minus goes to the minus terminal of the C battery terminal. This same terminal (C minus) goes to the F minus post of AFT 2. The plate post of the third socket goes to the P post of AFT 2, the other terminal which is marked B plus going to the B plus terminal (100 volts). The post G on AFT 2 goes to the grid post on the last socket. The plate post of this socket goes to the

(Concluded on page 27)

Varying the Aerial Coupling

The Primary Has Large Inductance and May Be Used for Matching Coils, Especially if a Condenser Is Employed —Author Applies Tests to the Diamond of the Air, Which He Calls "Unbeatable Set."

By Herbert E. Hayden

Photographs by the Author

THE diamond-weave coil was used perhaps because the name of the circuit in which the inductances were to be utilized—The Diamond of the Air—suggested this. This type of coil lends itself very well to the application of collodion, which in my case proved beneficial. Generally it is not advisable to use even collodion. Never use shellac or varnish. I live in a damp neighborhood and I desired to make the coils impervious to moisture or as nearly so as possible. I knew that honeycomb coils had a tendency to absorb moisture, but I found that even in damp weather the set with the collodionized diamond-weave coils stood up splendidly. I am very fond of the hookup of The Diamond of the Air and I regard it as an unbeatable set. I am using the 2-control model. See the May 23 issue for the diagram.

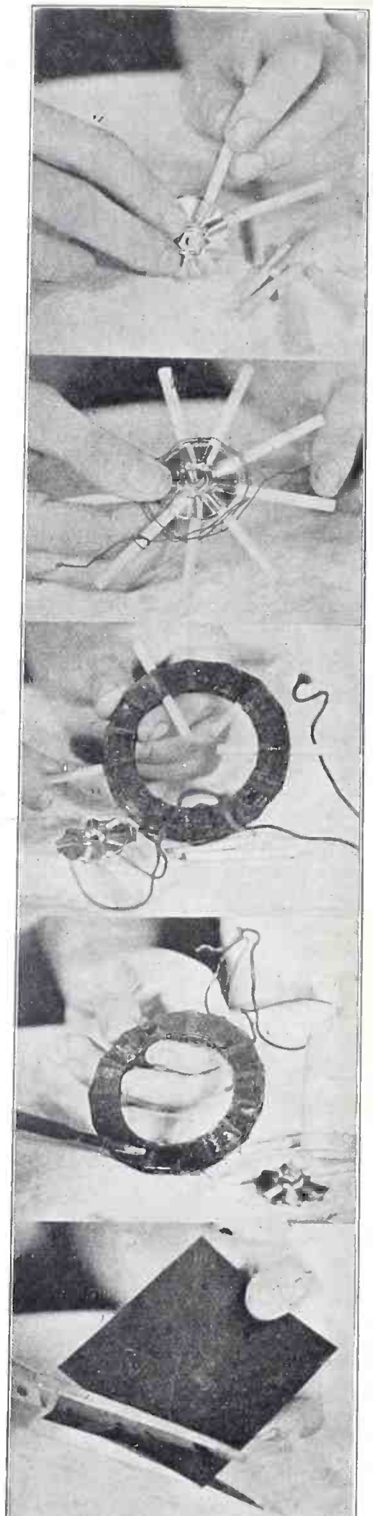
HERBERT E. HAYDEN

The number of spokes used to wind the coils is not important. There should be at least nine, but the number may run up to 17 or even 19. This will depend on the form you will use, providing that you purchase one, as is possible to do in chain stores and in radio stores in general. There is a hub with radiating arms, these arms being circular, usually dowel sticks. A tinker toy, which is the delight of the children, may be used, as shown in Figs. 1 and 2. The hub has no dowel sticks in it, but these may be inserted conveniently. If necessary, cut them down from the ¼" dowel sticks that are purchaseable in a hardware store in 3' lengths, at about 5c a length.

Coil Winding

The coil is wound over one turn and under the next. Starting with an inside diameter of 2¼", 19 turns are put on. The wire used is No. 24 silk over cotton, but if you can't get that readily, use No. 24 double silk covered. This inductance is for the secondaries, where they are to be tuned with .0005 mfd. variable condensers. For .00035 mfd. condensers, put on five more turns. For an aperiodic primary (3-circuit coupler) put on 4 turns extra.

After one coil is wound, the dowel sticks are removed, (Fig. 3) and the collodion is applied with a brush. (Fig. 4). Collodion dries quickly. It certainly holds the windings together very securely, no other form of binder being necessary, certainly no tie-string. The ends of the coil are flush with the winding, and 10" lengths of flexible stranded insulated wire are soldered to these scraped terminals.



TOP to bottom, Figs. 1, 2, 3, 4, 5.

Next cut two strips of fiber, 3½x⅜". These are inserted through the hub into aperatures in the windings formerly occupied by dowel sticks. The fiber strips are placed nearly at right angles to each other and a hole bored through the common center. This hole will take a wood screw or a machine screw and nut, depending on the coil's position. It is not necessary that the two strips be exactly at right angles, indeed the odd-numbered spokes that the form necessarily possessed will tend to defeat the right-angle motion. See Fig. 6 for the method by which these strips may be introduced.

A machine screw accommodation is shown in Fig. 9, where the screw is actually being fastened in the wooden rod. A wood screw is used only for a stator form (to be inserted in the thick wooden rod).

The rack and pinion needed for obtaining the tickler motion are shown in Fig. 7, with the pencil pointing more particularly toward the wheel-like pinion. If anybody finds it difficult to obtain this article in a hardware store, or indeed any other article discussed in this text, I will be glad to tell them where these may be purchased.

As one end of the stout wooden rod is fastened to the cross-arms as explained, so the other end of the rod is fastened to a metal angle, a machine wood screw being used here, too.

It will be difficult, if not impossible, to purchase the metal angle just as it should be, but it is easy to convert it from another form of angle. If the metal is 3½x2¾x¾" dimensions, ⅛" thick or less, then, looking at Fig. 10, the ¾" dimension is the distance between the tip and the bend in the angle, the midpoint being represented by the axle to which a nut is being affixed. The plane at right angles to the smaller one just discussed is 1¾" long, while the larger arm is obvious from the photograph. Hence, if a right angle is obtained, 3½x2¾" (those being the arms of the right angle), then the 2¾" arm may be bent up, about 1" from the end, giving a J-angle 3½x1¾x1", which is correct.

The angle, as completed, is shown in Fig. 8, with pencil pointing to a 1" long, ¼" diameter brass rod. A lock washer being used to hold the pinion in place when a lock nut is fastened over the washer. At bottom of Fig. 8 one sees the axle. Hence two holes must be drilled on corresponding planes (3½" and 1" planes) of the J-angle, so that the axle may be accommodated and the lock nuts put on. So there must be a hole for the dial shaft.

The use for the axle is shown in Fig. 10. A piece of hard rubber or bakelite, 1x3½", is drilled in two places, one so that the nut may be tightened against it as shown, the other so that the machine screw and nut may be tightened to the supporting crossarms of the tickler coil.

Although the making of only one winding was discussed, all windings used were the same, except that 6 turns constituted the primary of the interstage coupler and were wound on the inside at the hub.

Considering the coils in units, there are two: First the RF transformer, which in this case is just like a split variometer, that is, consists of two windings, each the same, but not metallically connected, being only variable inductively; second, the 3-circuit tuning coil, consisting of a 6-turn primary, then the regulation number of turns for the secondary, then a separate DW coil, the tickler, all by itself, but to introduce into the making of the 3-circuit affair by the method just outlined.

The object of introducing the variable primary in the first instance was to match up coils for employment of a double condenser, the secondary or stator (always the coil nearer the panel or shaft) having

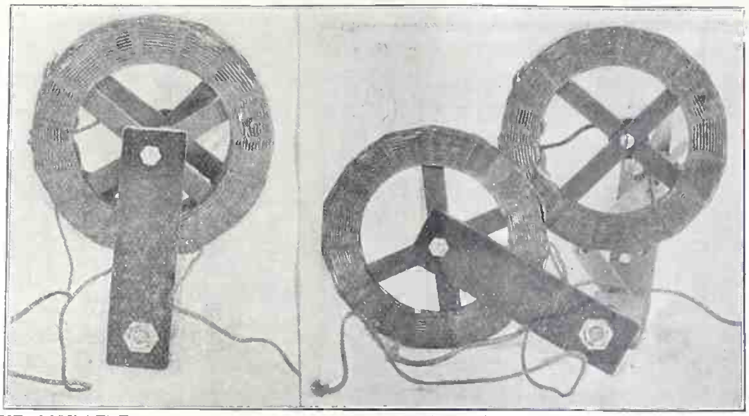
Making Diamond-Weave Coils

Diamond Weave Coils Used and Collodion Applied as Safeguard, Due to Operation of the Receiver in a Damp Neighborhood—Binder Makes Coils Virtually Moisture-Proof.

about the same number of turns on the RF side as in the case of the detector input. As it was difficult to add turns, indeed even to take them off was not convenient, the variable primary in the aerial circuit enabled me to introduce as much of the aerial capacity and resistance as was necessary, by tightening the coupling if there was too little inductance on the RF secondary, or loosening it if the opposite was the case, in comparison with the inductance on the interstage coupler secondary. Once the position was located the question was solved and the adjustable primary did not have to be moved any more. Still, it could be varied slightly on DX work with benefit, hence the dial on panel. See front cover photos.

I also used the same plan in a 3-control Diamond for the express purpose of varying the aerial coupling to get more uniform amplification. The gain is slight. Although some may enjoy the idea of using an adjustable primary, I would not favor it. An aperiodic primary, as called for in the original Diamond, is eminently satisfactory.

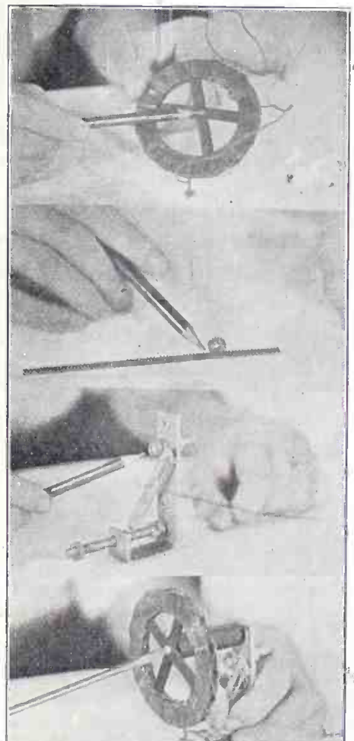
The following should be duplicated, because the listing is for only one unit and two are needed on the Diamond:



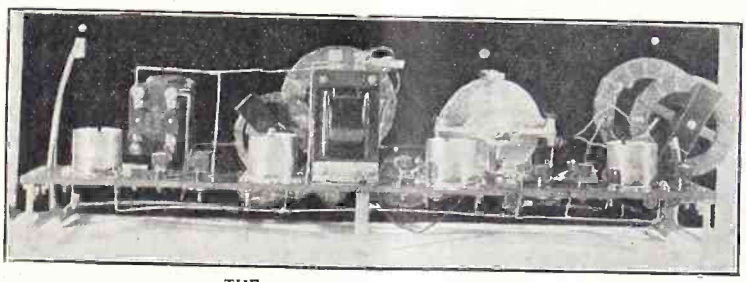
THE COMPLETED DIAMOND-WEAVE Coil, showing how the mutual inductance is varied. (Figs. 11 and 12).

LIST OF PARTS

One lb. of No. 24 silk over cotton wire.
One piece of bakelite, 1x3½x1/16".
One piece of fibre, 4x6".
One 32-pitch pinion.
One 32-pitch, 3½" rack.
One J-bracket, or right angle, 3½x1¾x1".
One ¼" brass axle, 3" long, threaded at both ends, ¼-20 thread.
Three hex nuts for the axle.
One ¼" brass rod, 1" long, with ½" extension, threaded 3/16".
Two ¼" washers.
One 3/16" hex nut.
One 2-56 screw, ⅝" long, washers, hex nut for this.
One wooden rod, 2" long x ⅝" diameter.



FIGS. 6, 7, 8, 9, 10 (top to bottom).



THE rear view of the completed receiver.

Super Power Reduces the Effects of Static

As a test of super-power, WGY, Schenectady, operated with 50,000 watts three nights during a recent week (Sunday, Tuesday and Friday). Officials of the Department of Commerce who listened in on the tests would make no comment regarding them other than that the higher power seemed to overcome whatever static there was. It is believed that data regarding higher power is desired for the consideration of the next national radio conference.

BERLIN ANTENNAS BARRED; CHIMNEY SWEEPS DID IT

The chimney sweeps of Berlin, Germany, have protested vigorously against radio antennas on roofs, claiming they prevent their doing their work properly. As a result a city ordinance has been passed that antenna equipment within the city limits must come down.

200 Apply for Place on Air But Must Wait

There are pending at the Department of Commerce around 200 applications for licenses to operate new broadcasting stations. Just as soon as wavelengths are available they will be given to the new applicants. Until there are wavelengths the present number of stations will not be greatly increased.

THE SPREAD OF WEATHER REPORTS

One hundred and forty-four broadcasting stations located in ninety towns and cities throughout the country are now broadcasting weather forecasts daily. The Weather Bureau believes that weather information will shortly be furnished to fans in every state in the Union by radio.

Forecasts of static are a hope of the future.

The Loop Jack in The Diamond

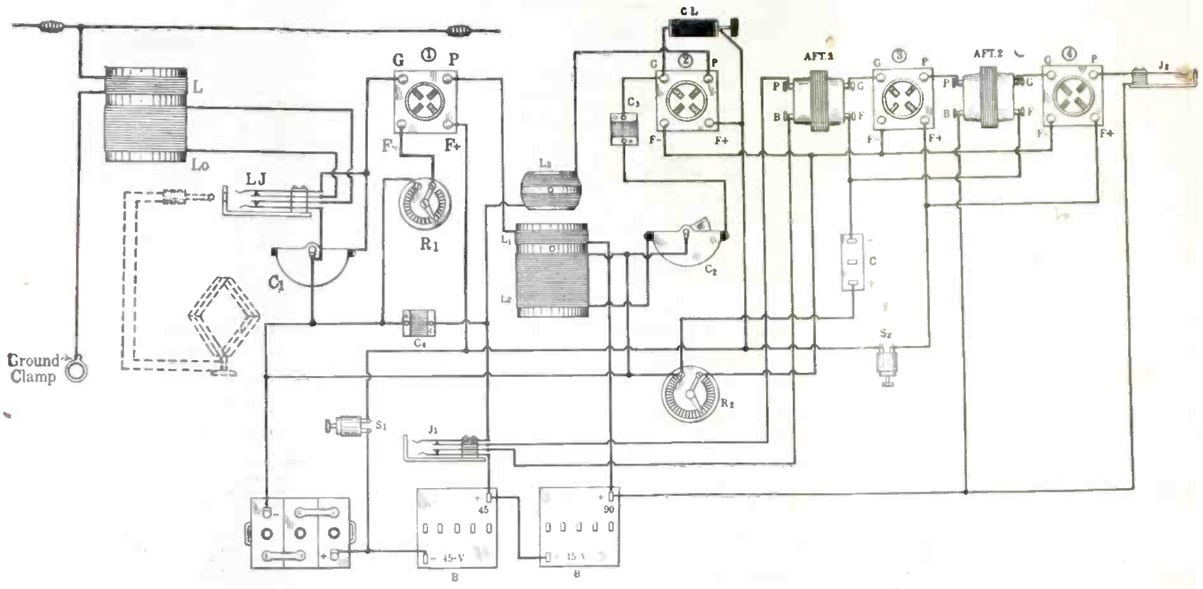


FIG. 2, the electrical wiring of the Diamond of the Air shown in picture form, corresponding to the schematic diagram in Fig. 1. Detailed information on the constants, coil winding and wiring the entire set will be found in the May 23 and July 25 issues of RADIO WORLD.

How to Wire a Jack for Optional Use of Outdoor Aerial or Loop for a Set Sensitive Enough to Afford Satisfaction With a Coil Antenna

By Herman Bernard

Associate, Institute of Radio Engineers

THE method of introducing a loop jack, as employed in The Diamond of the Air, may be followed in any other receiver that is sensitive enough to be worked from a loop. Ordinarily a 1-tube regenerative set will not come up to loop requirements (with or without the audio stages), although some kind of local reception may be obtained. The addition of a radio-frequency amplifying tube, as in The Diamond, makes the set a very good one for loop operation. That in itself would seem sufficient answer to those who may question the advisability of preceding a regenerative detector with RF.

HERMAN BERNARD

The Diamond is shown in schematic form (Fig. 1) and in picture form (Fig. 2). The diagrams are complete in every respect and may be used by any who build the set.

The Loop Jack Wiring

LJ is the loop jack. This is a regular double-circuit jack, the same kind as J1. Notice that the stator of the variable condenser C1 connects direct to grid of the RF tube. The rotor of that condenser connects to minus A. This part of the wiring always is in use, whether outdoor aerial or coil antenna is used.

LIST OF PARTS

Two .0005 mfd. variable condensers, C1, C2.

One radio-frequency transformer, LLo, (Bruno 55).

One 3-circuit tuning coil, L1L2L3 (Bruno 77).

Two double-circuit jacks, LJ, J1.

One single-circuit jack, J2.

One 20-ohm rheostat, R1.

One 6-ohm rheostat, R2.

Two battery switches, S1, S2.

One .00025 mfd. fixed grid condenser, C3.

One .001 fixed condenser, C4.

Two Audio - frequency transformers, AFT1, AFT2.

Four sockets and baseboard with terminal strip; or one 4-gang socket strip with brackets.

One 7x24" panel.

Three 4" dials.

Three dial pointers.

One Bretwood variable grid leak, GL.

Accessories: One loop, one cabinet, one pair of phones, one speaker, 65-foot aerial, lead-in wire, two aerial insulators, one lead-in insulator, ground clamp, lightning arrestor, one 6-volt storage A battery, two 45-volt B batteries, one 4½-volt C battery, busbar or other internal set wire; loop connecting cords; two phone plugs (one for loop, one for speaker).

Therefore these two leads are connected to the outside springs of the jack, for these are always in the circuit, whether loop or outdoor antenna is employed. The terminals of the secondary (Lo) of the aerial circuit radio-frequency transformer are connected to the inside springs of the jack.

Thus when the plug (P in Fig. 1) is not inserted, the inside springs are pressing against the outside ones. The circuit is then said to be closed, in respect to Lo. This accomplishes the direct metallic connection of the Lo terminals to the variable condenser C1.

When the loop jack is inserted the outside springs of the jack are lifted. That is, the contact between outside and inside springs is at an end. The secondary Lo is out of the circuit and both the aerial-ground system and the transformer Lo have no effect, or no substantial effect, on the circuit. Only the jack provides the path for the radio current in the loop flowing to C1 and thence delivered to the tube.

Connection Is Important

It is advisable to pay close attention to the manner of connecting the terminals of Lo. Fig. 2 shows the connections very clearly. The aerial is connected to the beginning (top) of L, the aperiodic primary of the aerial RFT. The ground is connected to the other (bottom) terminal of L. Thus the terminal of the secondary adjoining the ground side of L is properly connected to low potential, minus A. The corresponding part of this circuit that is at high potential is the grid of the RF tube.

The observance of this advice is important, hence attention should be paid to the manner of connecting the jack springs. Generally, if there is a straight right angle on the jack, in which case it comes in contact with the panel on which the jack is mounted, the low potential should be connected to that right angle or the lug on the jack that makes direct and permanent contact therewith. The right angle is shown in Fig. 2. There is a piece of insulation in the jack, but the leaf of the jack right next to the right angle is metallically connected to that right-angle by a wire running through the insulation, hence they are the same lead. Notice, therefore, that the rotor of C1, hence minus A, connects to the right angle, while the hooked spring on top of the jack goes to grid of the RF tube. The lead of Lo which represents low potential, that is the one adjoining the ground end of the primary L, should be joined to the inside spring of the jack that makes contact with minus A when no loop plug is inserted.

Following Polarities

These polarity considerations can not be well followed in any schematic diagram, such as in Fig. 1, so textual ex-

The Stabilizing Phase Angle

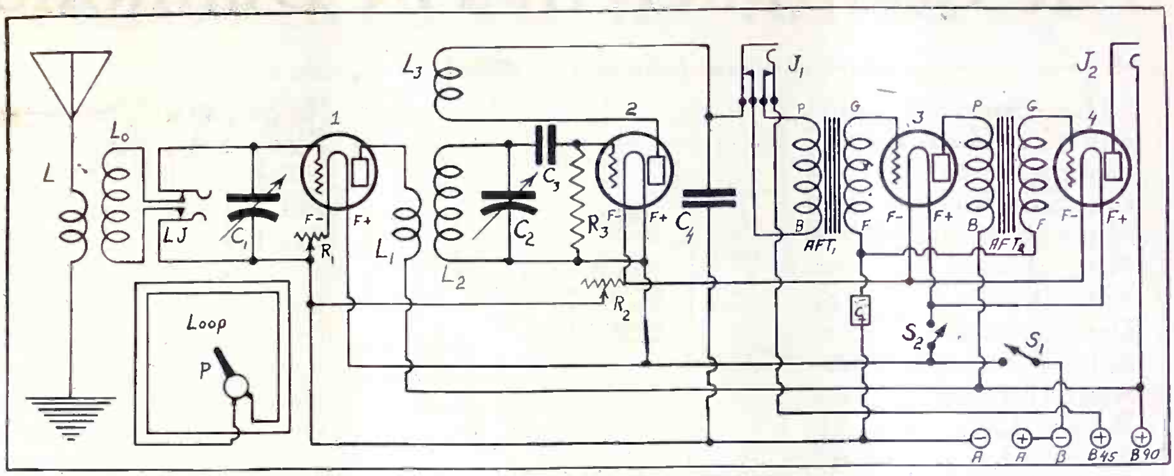


FIG. 1, the schematic diagram of the electrical wiring of The Diamond of the Air, for optional use of outdoor aerial or loop. If only an outdoor aerial is desired, then LJ may be omitted, the terminals of Lo being connected directly to the respective sides of C1. The loop is shown at left, its terminals inserted in plug P. As the optional loop-aerial method of wiring requires only a double-circuit jack, instead of no jack where no loop is to be used, and a single-circuit jack where only loop is to be used, it is advisable to enjoy the convenience of the optional method.

Polarities Should Be Correctly Observed in Connecting the Coils, to Avoid the Danger of Uncontrollable Oscillations—How to Accomplish This

planation and the picture diagram should be taken as the guide.

As there is only one remaining connection for LLo, that necessarily must go to the remaining jack spring, which will make adjustable contact with the leaf permanently connected to grid.

The Interstage Polarities

Now when we consider the interstage coupler (3-circuit tuner) we find that the same method of connection is followed, that is, low potentials are kept together. The plate of the RF tube (high potential) is connected to the beginning of L1, the end of L1 to B battery plus 90 volts (low potential). The radio-frequency voltages are the ones considered, not the direct current B battery voltage, which is approximately the same at battery terminal and at plate post of the socket.

Again grid is high potential, A minus low potential. Hence the terminal of L1 which went to B plus adjoins the terminal of L2 that must go to A minus. If one considers the coils in the position shown in Fig. 2, then the bottom terminal of L1 goes to B plus and the top terminal of L2 goes to A minus.

In this case we are dealing with the detector stage and as we are employing the leak-condenser method of rectification, the high potential will not be metallically connected to grid, but will go to one side of the grid condenser C3. That would be known as the coil side of the grid condenser. The other side of C3 is connected to grid post of the socket, and that would be known as the socket side of the grid condenser.

Mark the Coil Posts

The grid terminal of L2, therefore, is the bottom one in Fig. 2, while the A minus lead is the top terminal of L2. These respective leads are very obvious in many types of coils, where terminal posts are in full view as well as the leads thereto from the coil terminals. But if one is using coils where the leads are not obvious at a glance it is well worth the little time required to trace the leads. This may be done when the coils are held in hand. The posts may be marked "H" and "L", representing high and low, with the two terminals of primary and secondary that are "L" being next to each other on the actual wiring, no matter where the posts may be located on the coil form.

This method of connection creates stability of operation by utilizing to best advantage the phase difference angle established by the tube action. If the output of the RF tube is 180 degrees out of phase so much the better, and the nearer it comes to this point the greater will be the stability, if the wiring method is followed as outlined. The bad effects of stray inductive coupling may be thus overcome or reduced to a minimum. As an enhancement the coils should be mounted at right angles. This is not shown as a fact in Fig. 2. Either may be mounted with axis horizontal, that is, parallel to the baseboard or gang socket, and the other coil with axis at right angles to that plane.

The Alternative L2 Return

The grid return in the detector stage is slightly positive, as it should be for detector action. But in some cases an improvement may be noted if the low potential end of L2 is connected to A plus instead of to A minus. In that case the positive potential is increased. This plan should be resorted to only if the receiver, when made according to the diagram, does not produce desired results. Lack of volume and difficult regeneration control would be guiding points in determining inferior results.

Constructional Data

The details regarding the wiring of the entire receiver, and the constants therefor, were published in the July 25 issue of Radio World and full data on the winding of the coils was contained in the May 23 issue. Any one desiring to construct the receiver should consult those issues.

The Diamond Proclaimed From Maine to California

GETS 1,000 MILES; HOPES TO DO BETTER

Diamond Editor:

I have built The Diamond of the Air and it sure is a wonder. I have received stations up to 1,000 miles on the loud speaker. I hope to do better this winter. —SAMUEL KENNELL, Mt. Pleasant, Pa.

* * *

"BEATS THEM ALL," SAYS THE VOICE OF CALIFORNIA

Diamond Editor:

I have built several receiving sets using different types of circuits described in Radio World but The Diamond of the Air beats them all.

Los Angeles is considered a tough place to get DX from, so the enclosed log is interesting to say the least for there are no silent nights here. I hear other carrier waves whistle but have not taken time to clear them up.

The tone, selectivity, DX, and volume of The Diamond compare with those of several well-advertised Super Hets. I am using only twenty-five feet of aerial and am not troubled very much by static.

I have made a 1-tube low-wave band tuner which when hooked to the audio stages of The Diamond through the detector socket brings in KDKA and KFKX on the speaker.—JACK MILLS, 334 West 91st Place, Los Angeles, Cal.

* * *

"THE CIRCUITS ARE O. K.," SAYS VOICE OF MAINE WOODS

Results Editor:

I recently came across the "sin and shame" note, famous by this time. It made me laugh. Say, I have been reading Radio World for a very long time and find it the best of radio papers. A friend tried that circuit which Mr. E. S. Hancock condemned and he had wonderful results with it. I think that the fan who doesn't have good luck with some

(*Concluded on page* 28)

By Dr. J. H. DELLINGER

Chief of Radio Laboratory, Bureau of Standards

"The Principal Difficulty in Which Broadcasting Finds Itself Is the Existence of Too Many Stations,"—"We Now Have Not So Much the Invention of Devices as the Perfection of Them"—"Substantial Progress Has Been Going on All Along the Line of Radio Engineering."

"Who Shall Pay for Broadcasting Has Solved Itself"—"Of the 500 Stations One-half Are Owned and Operated by Commercial Interests Profiting from the Sale of Radio Apparatus and the Broadcasting by the Other Half Is for Some Form or Aspect of Advertising."

THE extraordinary growth of radio in the two years following the first successful broadcasting on a commercial scale in 1921 has been followed by a period of continuing and substantial progress. Probably one-third to one-half of the people in the United States now have access to the radio programs through receiving apparatus. The type of progress which is now making this possible is not merely empirical but is more largely characterized by actual engineering development. We now have not so much invention of devices as the perfection of them. This statement is very general. There have, of course, been triumphs of engineering in the past history of radio, and on the other hand the process of "cut and try" will continue to be used in the future. Nevertheless, broadly speaking, radio engineering has now taken definite form and is the tool by which progress in radio is being wrought.

Much Progress Made

Substantial progress has been going on all along the line of radio engineering. Thus, in the development of new and improved radio communication methods or systems, we have great extension of the available frequency range, marked improvements in directive radio transmission, advances in the perfection of selective radio systems, and engineering development of line-radio or carrier-current communication. Among radio devices and applications of radio there is outstanding progress on radio beacons, on the uses of radio for aircraft navigation, on direction finders, and on radio picture transmission and vision. In the field of research and study of the problems of radio we have important progress going on in radio measurements, in standardization of apparatus, in the study and mitigation of the vagaries of wave propagation and atmospheric disturbances, and in the wide reaches of the interference problem.

The Laws Applicable

Nowhere has the interference problem been more acute than in radio broadcasting. When broadcasting began it was all carried on on a single frequency or wavelength. The resulting interference soon made this impossible and the service has evolved until at present broadcasting has exclusive use of the frequency band from 550 to 1,500 kilocycles (545 to 200 meters).

This service has developed in the last four years without any new legislation.

As everyone knows, radio is regulated in the United States under two laws of 1912, one of them being the Ship Radio Act requiring radio transmitting apparatus on every ship carrying fifty or more persons, and the other being the Act to Regulate Radio Communication. The latter law provides for the licensing of radio stations and operators, specifies the frequencies to be used by ship stations, provides for the secrecy of private messages, and prohibits fraudulent signals and wilful interference. The law is administered, regulations are formulated and stations are inspected by the Department of Commerce. Contrary to conditions in other countries, this law contains little that is restrictive and permits an almost unhampered growth of radio broadcasting. This growth has taken place almost entirely through private initiative. It has been largely directed through the National Radio Conference called by Secretary of Commerce Herbert Hoover in the years of 1922, 1923 and 1924.

Freedom in Broadcasting

The radio broadcasting system of the United States can be characterized as one of extreme freedom. Anyone is free to erect a broadcasting station and no license or regulation other than patent rights is imposed upon the sale, purchase and use of receiving apparatus. This accounts in large measure for the remarkable growth of radio broadcasting. It is also responsible for the principal difficulty in which broadcasting finds itself at present, the existence of too many broadcasting stations. The Third National Radio Conference, held in October, 1924, made a series of recommendations with a view to reducing interference and otherwise improving broadcasting, and these recommendations have been adopted as the guiding policy of the Department of Commerce in regulating radio communication.

The Frequency Rules

The broadcasting band of frequencies has been divided into two parts, the range from 550 to 1,070 kilocycles being assigned to what are known as Class B stations, and the range from 1,090 to 1,500 kilocyles being assigned to Class A stations. The Class B stations are those which use one-half kilowatt or over, and the Class A stations in general use less than one-half kilowatt, although a few have been licensed to use as high as two kilowatts. There are approximately 100 of the Class B and 400 Class A stations. The frequencies of broadcasting stations are spaced 10 kilocycles apart. It has been found in practice that this is the minimum separation which permits satisfactory reception without interference. Rules for still greater frequency separations at certain distances are also observed. Allowing 100 kilocycles per station it will be seen that there are 53 frequencies available in the frequency range used for Class B stations. Since there are approximately 100 such stations, it follows that each station can not have an exclusive frequency, but must share its frequency with another station. No way has yet been found to avoid this undesirable duplicate assignment of frequencies, and this is why the stations alternate in the use of the frequencies, as for instance by transmitting on alternate nights.

Whistling Interference Reduced

The small separation between station frequencies requires that the frequencies be maintained with very great constancy. This requirement has been kept in view by the Government and by the transmitting stations themselves, and as a result of considerable effort devoted to this end the stations maintain their frequencies with quite satisfactory constancy. Whistling interference produced by the heterodyne action between two station frequencies, while common two years ago, is now comparatively rare. Coincident with this advance there has been improvement in receiving apparatus. Many listeners are still as greatly interested in receiving from distant stations as from nearby ones, and this has given rise to a demand for very selective receiving sets.

The pre-emption of the frequency band mentioned by broadcasting has made it necessary that ship radio communication relinquish the use of certain frequencies formerly used in this band. As a result ship traffic is now carried on at frequencies between 120 and 190 and between 250 and 500 kilocycles. There has been a general reassignment of frequency bands to different services. Government services use the bands 95 to 120 and 190 to 230 kilocycles. Point-to-point land and transoceanic commercial radio communication is carried on below 95 kilocycles.

No Censorship

There has been considerable discussion over the question of regulating the character of programs sent out by broadcasting stations. The Government has consistently opposed censorship, and the result is that the stations are entirely free in their choice of material. The station managements are, in point of fact, very responsive to the public reaction to their programs. This makes for steady improvement in the character of material and in the type of stations doing the broadcasting. Unquestionably the Class B stations with their higher power, greater investment of capital and the maintenance of higher standards of equipment and program are the most popular.

Interconnection A Big Advance

The interconnection of stations so as to provide for simultaneous broadcasting of the same program by several stations has been one of the most important developments of the past two years. It has made possible a wide extension in the knowledge of national events; it makes the talent of the great cities available to everyone. The interconnection of a chain of stations is a matter of regular daily procedure. In a few cases there has been nationwide simul-

(*Concluded on page* 31)

A Quest For Better Quality

RF Stage Connected to Two Tubes in Parallel —First Audio Stage Reflexed in One Case, Last Audio in the Other, to See Which Reduces Distortion More Effectively —Does an RF or an AF Overload Cause the Greater Distortion?

By Sidney E. Finkelstein

Associate, Institute of Radio Engineers

FOR the fan who has made many sets some variations on the accepted themes are very inviting, hence two circuits are presented that offer encouragement to those who like to work out solutions from suggested data.

SIDNEY E. FINKELSTEIN

The first circuit (Fig. 1) consists of a stage of tuned radio-frequency amplification, with its two tubes connected in parallel, a regenerative detector, the first stage of audio reflexed in the parallel-connected tubes, the second stage of audio being "solo."

The other circuit (Fig. 2), using the same principle, makes the last audio stage the reflexed one. The parallel connection of the tubes in the reflexed stage is retained.

Only one reason for connecting tubes in parallel may be advanced—to make them share equally the load of the stage in which they are connected. With RF amplification so popular often there is too much of it, so that distortion arises from RF causes, no less than from an overburden of audio current.

As the test is one for reducing the overload, if any, two audio stages must be employed. Some may find that the hook-ups as suggested will improve the quality of reception. At least experimenters may establish to their own satisfaction which of the two methods, if either, gives them better results in quality, and possibly even greater volume than obtained heretofore, when the four tubes were hooked up simply in straight fashion.

Constructors who have test boards will find the circuits very interesting subjects of experiment. The change involved in making one into the other is slight.

The set, in point of distance-getting, will not accomplish any more than the regulation hook-up. But if a fan is troubled with distorted reception, instead of introducing resistances across audio transformers, or condensers that cut down the volume, he may try either or both of the methods outlined, and see if he can not get very clear reception without any reduction in volume.

L1L2 is a radio-frequency transformer and C1 is a variable condenser of correct capacity to tune the secondary L2 throughout the band of broadcasting. L3L4L5 is a 3-circuit tuning coil in which L5 is the tickler. C2 tunes L4. C3 is a by-pass condenser, about .001 mfd. So is C5. R4 is a grid leak, about 2 megohms.

The tubes are numbered 1, 2, 3 and 4. In effect tubes 1 and 2 represent only one stage in either diagram. The input is to the two grids and the output is from the two plates. These two tubes should be of the same type.

The RF load on the tube is partly determined by the number of turns on the primary L3. Generally speaking, the lesser the inductance and coupling, the lesser the tendency to overload. But unless one has a ratio of at 4-to-1 there may be losses, i. e., insufficiency transfer of energy. Assuming, therefore, one has the type of windings most commonly used, where that ratio is used, or something near it, there may be still quite a tendency to ask too much RF work of the first tube. Hence we will use two tubes in parallel for accomplishing only the same quantitative results. Now, not to require the use of any more tubes than would the standard hook-up, we must resort to reflexing. That often causes difficulties and if the reflexing isn't a careful wiring job, with proper regard for position and length of leads, all attempts to attain improved results are almost certain to fail. Hence be careful of your reflex work.

Now, the last audio tube handles the heavier audio load. Maybe that is the one that should be reflexed, since the signals are to be delivered into the parallel-connected stage, which it is assumed are able to handle them best. But the experimenter may find that the audio load is not the troublesome one. The radio load having been shared satisfactorily between the two tubes (1 and 2), the reflex idea may be embodied solely for the object of avoiding the extra tube, and not for remedying any condition due to an audio overload. Therefore, in such a case, the first audio stage would be properly reflexed. Also the leads would be shorter that way.

Fans who do not care much about the cost entailed may omit the reflexing entirely and use either parallel-connected tubes in the radio stage or in the last audio stage or in both places, as an experiment.

The two sets shown in the diagrams work well, as do the two others suggested. The problem is for the experimenter to decide whether the parallel idea is worth while and if so, whether for radio or audio reasons, or for a combination of both.

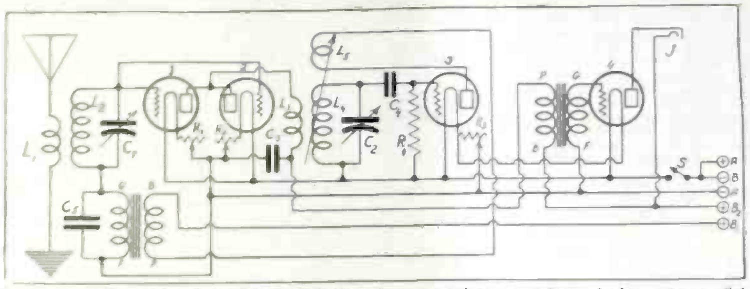


FIG. 1, a 4-tube receiver in which the RF stage is connected to two tubes, which are in parallel, the detector is regenerative and the first audio stage is reflexed in the parallel stage. The object of making this exprimemt is to determine whether overloading of tubes, which results in distortion, may be remedied in this manner without requiring an additional tube, despite the parallel connection. Hence reflex is introduced.

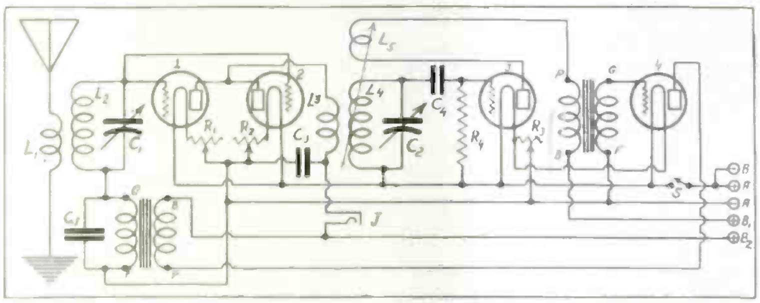
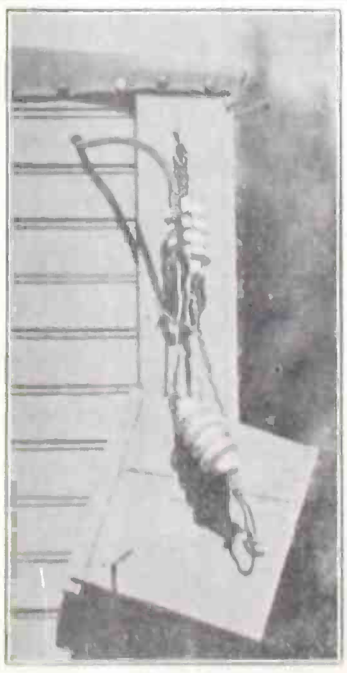


FIG. 2, the same circuit as that shown in Fig. 1, except that the second audio stage is the reflexed one, instead of the first. By trying out the both methods and comparing results one may determine whether overloading at radio or at audio frequencies is the more serious defect in a distorting receiver. Of course bad audio transformers would render the tests of little value.



NOVEL antenna used by Edward A. Keltzer on his auto trips. Wound on a reel, the aerial is cut out of the way, while traveling. When wanted, it need only be pulled out and attached to any convenient tree. (Underwood & Underwood)

THE KEY TO THE AIR

KEY

Abbreviations: EST, Eastern Standard Time; CST, Central Standard Time; MST, Mountain Standard Time; PST, Pacific Standard Time; DS, Daylight Saving Time.

How to tune in a desired distant station at just the right time—Choose your station from the list published herewith. See what time division the station is under (EST, CST, etc.); then consult the table below. Add to or subtract, as directed from the time as given on the PROGRAM. The result will be the same BY YOUR CLOCK that you should tune in, unless daylight saving time intervenes, as explained below.—The table:

If you are in	*And want a station in*	*Subtract*	*Add*
EST	CST	..	1 hr.
EST	MST	..	2 hrs.
EST	PST	..	3 hrs.
CST	EST	1 hr.	..
CST	MST	..	1 hr.
CST	PST	..	2 hrs.
MST	EST	2 hrs.	..
MST	CST	1 hr.	..
MST	PST	..	1 hr.
PST	EST	3 hrs.	..
PST	CST	2 hrs.	..
PST	DST	1 hr.	..

If you are under DST and the station you want is under that time, too, or if both are under ST, the above table will hold.

If you are under DST, and the station operates under ST, add one hour to the table result.

If the station uses DST, and you are under ST, subtract one hour from the table result.

FRIDAY, AUGUST 14

WAAM, Newark, N. J., 263 (ESTDS)—11 AM to 12.
WAHG, Richmond Hill, N. Y., 316 (ESTDS)—12 to 1:05 PM; 8 to 12 PM.
WAMD, Minneapolis, Minn., 243.8 (SCT)—12 to 1 PM; 10 to 12.
WBBM, Chicago, Ill., 226 (CST)—8 to 10 PM.
WBBR, New York City, 272.6 (ESTDS)—8 PM to 10.
WBOQ, Richmond Hill, N. Y., 236 (ESTDS)—7:30 PM to 11:30.
WBZ, Springfield, Mass., 333.1 (ESTDS)—6 PM to 11.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (CST)—9:30 AM to 12 M; 1:30 to 4; 5:30 to 10.
WCAE, Pittsburgh, Pa., 461.3 (ESTDS)—12:30 to 1:30 PM; 4:30 to 5:30; 6:30 to 11.
WDAF, Kansas City, Kansas, 365.6 (CST)—3:30 to 7 M; 8 to 10; 11:45 to 1 AM.
WEAF, New York City, 492 (ESTDS)—6:45 AM to 7:45; 11 to 12; 4 PM to 5; 6 to 12.
WEAR, Cleveland, O., 390 (EST)—11:30 AM to 12:10 PM; 3:30 to 4:10; 8 to 11.
WEAO, Ohio State University, 293.9 (EST)—8 PM to 10.
WEEI, Boston, Mass., 476 (ESTDS)—6:45 AM to 7:45; 2 PM to 3:15; 5:30 to 10.
WEMC, Berrien Springs, Mich., 286 (CST)—9 PM to 11.
WFAA, Dallas, Texas, 475.9 (CST)—10:30 AM to 11:30; 12:30 PM to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30.
WFBH, New York City, 272.6 (ESTDS)—2 PM to 6.
WGBS, New York City, 316 (ESTDS)—10 AM to 11; 1:30 PM to 4; 6 to 11.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:15; 8 to 11.
WGES, Chicago, Ill., 250 (CSTDS)—5 PM to 7; 10:30 to 1 AM.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 3:30 PM; 5:30 to 11:30.
WGR, Buffalo, N. Y., 319 (ESTDS)—12 M to 12:45 PM; 7:30 to 11.
WGY, Schenectady, N. Y., 379.5 (EST)—1 PM to 2; 5:30 to 10:30.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:15 PM; 4 to 5; 6 to 7:30; 8:30 to 10.
WHAS, Louisville, Ky., 399.8 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 360 (ESTDS)—12:30 PM to 1; 2:15 to 5; 7 to 11; 12 to 12:30 AM.
WHO, Des Moines, Iowa, 526 (CST)—7 PM to 9; 11 to 12; 12:30 to 1:30; 4:30 to 5:30; 6:30 to 9:30.
WHT, Chicago, Ill., 400 (CSTDS)—11 AM to 2 PM; 7 to 8:30; 8:45 to 10:05; 10:30 to 1 AM.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—7 AM to 8; 1 PM to 2; 3 to 4:50; 6 to 7.
WJY, New York City, 405 (ESTDS)—7:30 PM to 11:30.
WJZ, New York City, 455 (ESTDS)—10 AM to 11; 1 PM to 2; 4 to 6; 7 to 10:30.
WLIT, Philadelphia, Pa., 395 (EST)—12:02 PM to 12:30; 2 to 3; 4:30 to 6; 7:30 to 1 AM.
WLW, Cincinnati, O., 422.3 (EST)—10:45 AM to 12:15; 1:30 PM to 2:30.
WMCA, New York City, 341 (ESTDS)—11 AM to 12M; 6:30 PM to 12.
WNYC, New York City, 526 (ESTDS)—3:45 PM to 4:45; 6:20 to 11.
WOAW, Omaha, Neb., 526 (CST)—12:30 PM to 1; 5:45 to 7:10; 9 to 11.
WOC, Davenport, Iowa, 484 (CST)—12:57 PM to 2; 3 to 3:30; 5:45 to 12.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 PM to 4; 6:15 to 7.
WPAK, Fargo, N. D., 283 (CST)—7:30 PM to 9.
WPG, Atlantic City, N. J., 299.8 (ESTDS)—7 PM to 8:30; 10 to 12.
WQJ, Chicago, Ill., 448 (CST)—11 AM to 12 M; 3 PM to 4; 7 to 8; 10 to 2 AM.
WRC, Washington, D. C., 469 (EST)—4:30 PM to 5; 6:45 to 12.
WREO, Lansing, Michigan, 285.5 (EST)—10 PM to 11.
WRNY, New York City, 258.5 (ESTDS)—11:59 to 2 PM; 7:59 to 9:45.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 2:30 to 3:30; 5 to 6; 8 to 9; 10:45 to 12.
WSBF, St. Louis, Mo., 273 (CST)—12 M to 1 PM; 3 to 4; 7:30 to 10; 12 PM to 1 AM.
WWJ, Detroit, Mich., 352.7 (EST)—8 AM to 8:30; 9:30 to 10:30; 11:55 to 1:30; 3 to 4; 6 to 7; 8 to 10.
KDKA, Pittsburgh, Pa., 309 (EST)—6 AM to 7; 9:45 to 12:20 PM; 1:30 to 3:20; 3:30 to 11.
KFAE, State College of Wash., 348.6 (PST)—7:30 PM to 9.
KFDY, Brookings, S. D., 273 (MST)—8 PM to 9.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 10.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 9:30 to 12.
KFNF, Shenandoah, Iowa, 266 (CST)—12:15 PM to 1:15; 3 to 4; 6:30 to 10.
KFOA, Seattle, Wash., 455 (PST)—12:30 PM to 1:30; 4 to 5:15; 6 to 11.
KGO, Oakland, Cal., 361.2 (PST)—11:10 AM to 1 PM; 1:30 to 3; 4 to 7.
KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30 PM; 5 to 11.
KHJ, Los Angeles, Cal., 405.2 (PST)—7 AM to 7:15; 12 M to 3:30 PM; 5:30 to 11:30.
KJR, Seattle, Wash., 484.4 (PST)—10:30 AM to 11:30 AM; 1 PM to 6:30; 8:30 to 11.
KNX, Hollywood, Cal., 337 (PST)—11:30 AM to 12:30 PM; 1 to 2; 4 to 5; 6:30 to 12.
KOB, State College of New Mexico, 348.6 (MST)—11:55 AM to 12:30 PM; 7:30 to 8:30; 9:55 to 10:10.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 8:45; 11 to 12 M.
KPO, San Francisco, Cal., 429 (PST)—7:30 AM to 8; 10:30 to 12 M; 1 PM to 2; 4:30 to 11.
KSD, St. Louis, Mo., 545.1 (CST)—4 PM to 5.
KTHS, Hot Springs, Ark., 374.8 (CST)—12:30 PM to 1; 8:20 to 10.
KYW, Chicago, Ill., 536 (CSTDS)—6:30 AM to 7:30; 10:55 to 1 PM; 2:25 to 3:30; 6:02 to 7:20; 9 to 1:30 AM.
CNRA, Moncton, Canada, 313 (EST)—8:30 PM to 10:30.
CNRE, Edmonton, Canada, 516.9 (MST)—8:30 PM to 10:30.
CNRS, Saskatoon, Canada, 400 (MST)—2:30 PM to 3.
CNRT, Toronto, Canada, 357 (EST)—6:30 PM to 11.

SATURDAY, AUGUST 15

WAAM, Newark, N. J., 263 (EST)—7 PM to 11.
WAHG, Richmond Hill, N. Y., 316 (ESTDS)—12 to 2 AM.
WAMD, Minneapolis, Minn., 243.8 (CST)—12 M to 1 PM; 10 to 12.
WBBM, Chicago, Ill., 226 (CST)—8 PM to 1 AM.
WBBR, New York City, 272.6 (ESTDS)—8 PM to 9.
WBOQ, Richmond Hill, N. Y., 236 (ESTDS)—3:30 PM to 6:30.
WBZ, Springfield, Mass., 333.1 (ESTDS)—11 AM to 12:30 PM; 7 to 9.
WCAE, Pittsburgh, Pa., 461.3 (ESTDS)—10:45 AM to 12M; 3 PM to 4; 6:30 to 7:30.
WCBD, Zion, Ill., 344.6 (CST)—8 PM to 10.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (CST)—9:30 AM to 12:30 PM; 2:30 to 5; 6 to 10.
WEAF, New York City 492 (ESTDS)—6:45 AM to 7:45; 4 PM to 5; 6 to 12.
WEEI, Boston, Mass., 476 (ESTDS)—6:45 AM to 7 AM.
WEAR, Cleveland, O., 390 (EST)—11:30 AM to 12:10 PM; 3:30 to 4:10; 7 to 8.
WEMC, Berrien Springs, Mich., 286 (CST)—11 AM to 12:30 PM; 8:15 to 11.
WFAA, Dallas, Texas, 475.9 (CST)—12:30 PM to 1; 6 to 7; 8:30 to 9:30; 11 to 12:30 AM.
WFBH, New York City, 272.6 (ESTDS)—2 PM to 7:30; 11:30 to 12:30 AM.
WGBS, New York City, 316 (ESTDS)—10 AM to 11; 1:30 PM to 3; 6 to 12.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:15.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 2:30 PM; 3 to 5:57; 6 to 11:30.
WGR, Buffalo, N. Y., 319 (ESTDS)—8:45 to 10:15 PM, U. S. Army Band.
WGY, Schenectady, N. Y., 379.5 (EST)—7:30 PM to 10.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:30 PM; 4 to 5; 6 to 7:30.
WHAS, Louisville, Ky., 399.8 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 360 (ESTDS)—2:15 PM to 5; 7:30 to 10.
WHO, Des Moines, Iowa, 526 (CST)—11 AM to 12:30 PM; 4 to 5:30; 7:30 to 8:30.
WHT, Chicago, Ill., 400 (CSTDS)—11 AM to 2 PM; 7 to 8:30; 10:30 to 1 AM.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—7 AM to 8; 10:20 to 11; 1 PM to 2; 3 to 4; 6 to 11:30.
WJY, New York City, 405 (ESTDS)—2:30 PM to 5; 8 to 10:30.
WJZ, New York City, 455 (ESTDS)—9 AM to 12:30 PM; 2:30 to 4; 7 to 10.
WKRC, Cincinnati, O., 326 (EST)—10 to 12 M.
WLWC, Cincinnati, O., 422.3 (EST)—9:30 AM to 12:30 PM; 7:30 to 10.
WMAK, Lockport, N. Y., 265.5 (EST)—10:25 AM to 12:30 PM.
WMCA, New York City, 341 (ESTDS)—3 to 5 PM; 6:30 to 2.
WNYC, New York City, 526 (ESTDS)—1 to 3 PM; 7 to 11.
WOAW, Omaha, Neb., 526 (CST)—10 AM to 1; 2:15 to 4; 9 to 11.
WOC, Davenport, Iowa, 484 (CST)—12:57 PM to 2; 5:45 to 7:10; 9 to 12.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—11 AM to 1 PM; 4:40 to 5; 10:55 to 11:02.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 PM to 4; 6:15 to 7:30; 8 to 11.
WQJ, Chicago, Ill., 448 (CST)—11 AM to 12 M; 3 PM to 4; 7 to 8; 10 to 3 AM.
WPG, Atlantic City, N. J., 299.8 (CST)—7 PM to 12.
WRC, Washington, D. C., 469 (EST)—4:30 to 5:30 PM; 6:45 to 12.
WREO, Lansing, Michigan, 285.5 (EST)—10 PM to 12.
WRNY, New York City, 258.5 (ESTDS)—11:59 to 2 PM; 7:59 to 9:30; 12 M to 1 AM.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 3 to 4; 5 to 6; 10:45 to 12.
WWJ, Detroit, Mich., 352.7 (EST)—8 AM to 8:30; 9:30 to 10; 11:55 to 1:30 PM; 3 to 4.
KDKA, Pittsburgh, Pa., 309 (EST)—10 AM to 12:30 PM; 1:30 to 6:30; 8:45 to 10.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 11.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 9:30 to 12:30.
KFNF, Shenandoah, Iowa, 268 (CST)—12:15 PM to 1:15; 3 to 4; 6:30 to 10:30.
KFOA, Seattle, Wash., 455 (PST)—Silent.
KGO, Oakland, Cal., 361.2 (PST)—11 AM to 12:30 PM; 3:30 to 5:45; 7:30 to 9.
KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30 PM; 6 to 7; 10 to 11.
KHJ, Los Angeles, Cal., 405.2 (ESTDS)—7 AM to 7:30; 10 to 1:30 PM; 2:30 to 3:30; 5:30 to 2 AM.
KJR, Seattle, Wash., 484.4 (PST)—1 PM to 2:45; 6 to 6:30; 8:30 to 10.
KNX, Hollywood, Cal., 337 (PST)—1 PM to 2; 6:30 to 2 AM.
KOA, Denver, Colo., 322.4 (MST)—11:30 AM to 1 PM; 7 to 10.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 9.
KPO, San Francisco, Cal., 429 (PST)—8 AM to 12M; 2 PM to 3; 6 to 10.
KSD, St. Louis, Mo., 545.1 (CST)—7 PM to 8:30.
KTHS, Hot Springs, Ark., 374.8 (CST)—12:30 PM to 1; 8:30 to 10:30.
KYW, Chicago, Ill., 536 (CSTDS)—11 AM to 12:30 PM; 4 to 5; 7 to 8.
CKAC, Montreal, Canada, 411 (EST)—4:30 PM to 5:30.
CNRO, Ottawa, Ontario, Canada, 435 (EST)—7:30 PM to 10.
PWX, Havana, Cuba, 400 (EST)—8:30 PM to 11:30.

SUNDAY, AUGUST 16

WBBM, Chicago, Ill., 226 (CST)—4 PM to 6; 8 to 10.
WBBR, New York City, 272.6 (ESTDS)—10 AM to 12 M; 9 PM to 11.
WCCO, St. Paul and Minneapolis, Minn., 416 (CST)—11 AM to 12:30 PM; 4:10 to 5:10; 7:20 to 10.
WDAF, Kansas City, Kansas, 365.6 (CST)—4 PM to 5:30.
WEAF, New York City, 492 (ESTDS)—3 PM to 5; 7:20 to 10:15.
WEAR, Cleveland, O., 390 (EST)—3:30 PM to 5; 7 to 8; 9 to 10.
WFBH, New York City, 272.6 (ESTDS)—5 PM to 7.
WGBS, New York City, 316 (ESTDS)—3:30 PM to 4:30; 9:30 to 10:30.
WGCP, New York City, 252 (ESTDS)—8 PM to 11.
WGN, Chicago, Ill., 370 (CST)—11 AM to 12:45 PM; 2:30 to 5; 9 to 10.
WGR, Buffalo, N. Y., 379.5 (EST)—9:30 AM; 7:15 to 8 PM.
WGY, Schenectady, N. Y., 379.5 (EST)—9:30 AM to 12:30 PM; 2:35 to 3:45; 6:30 to 10:30.
WHAD, Milwaukee, Wis., 275 (CST)—3:15 PM to 4:15.
WHN, New York City, 360 (ESTDS)—1 PM to 1:30; 3 to 6; 10 to 12.
WHT, Chicago, Ill., 238 (CSTDS)—9:30 AM to 1:15 PM; 5 to 9.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—10:45 AM to 12:30 PM; 4:15 to 5:30.
WKRC, Cincinnati, O., 326 (EST)—6:45 PM to 11.
WMCA, New York City, 341 (ESTDS)—11 AM to 12:15 PM; 7 to 7:30.
WNYC, New York City, 526 (ESTDS)—9 PM to 11.
WOCL, Jamestown, N. Y., 275.1 (EST)—9 PM to 11.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—10:45 AM to 12:30 PM; 2:30 to 4.
WPG, Atlantic City, N. J., 209.8 (ESTDS)—3:15 PM to 5; 9 to 11.
WQJ, Chicago, Ill., 448 (CST)—10:30 AM to 12:30 PM; 3 PM to 4; 8 to 10.
WREO, Lansing, Michigan, 285.5 (EST)—10 AM to 11.
WRNY, New York City, 258.5 (ESTDS)—3 PM to 5; 7:59 to 10.
WSBF, St. Louis, Mo., 273 (CST)—9 to 11 PM.
WWJ, Detroit, Mich., 352.7 (EST)—11 AM to 12:30 PM; 2 to 4; 6:20 to 9.
KDKA, Pittsburgh, Pa., 309 (EST)—9:45 AM to 10:30; 11:55 to 12 M; 2:30 PM to 5:30; 7 to 11.
KFNF, Shenandoah, Iowa, 266 (CST)—10:45 AM to 12:30 PM; 2:30 to 4:30; 6:30 to 10.
KOA, Denver, Col., 322.4 (MST)—10:55 AM to 1 PM; 4 PM to 5:30; 7:45 to 10.
KOIL, Council Bluffs, Iowa, 278 (CST)—11 AM to 12:30 PM; 7:30 to 9.
KGW, Portland, Oregon, 491.5 (PST)—10:30 AM to 12:30 PM; 6 to 9.
KHJ, Los Angeles, Cal., 405.2 (ESTDS)—10 AM to 12:30 PM; 6 to 9.
KJR, Seattle, Wash., 384.4 (PST)—11 AM to 12:30 PM; 3 to 4:30; 7:15 to 9.
KTHS, Hot Springs, Ark., 374.8 (CST)—11 AM to 12:30 PM; 2:30 to 3:40; 8:40 to 11.

MONDAY, AUGUST 17

WAAM, Newark, N. J., 263 (ESTDS)—11 AM to 12 M; 7 PM to 11.

WAHG, Richmond Hill, N. Y., 316 (ESTDS)—12 M to 1:05 PM; 8 to 2 AM.
WAMB, Minneapolis, Minn., 243.8 (CST)—10 PM to 12.
WBBM, Chicago, Ill., 226 (CST)—6 PM to 7.
WBBR, New York City, 272.6 (ESTDS)—8 PM to 9.
WBZ, Springfield, Mass., 333.1 (ESTDS)—6 PM 11:30.
WCAE, Pittsburgh, Pa., 461.3 (ESTDS)—12:30 PM to 1:30; 4:30 to 5:30; 6:30 to 12.
WCBD, Zion, Ill., 344.6 (CST)—8 PM to 10.
WCCO, St. Paul and Minneapolis, Minn., 416 (CST)—9:30 AM to 12 M; 1:30 PM to 6:15.
WDAF, Kansas City, Kansas, 365.6 (CST)—3:30 PM to 7; 8 to 10; 11:45 to 1 AM.
WEAF, New York City, 492 (ESTDS)—6:45 AM to 7:45; 4 PM to 5; 6 to 11:30.
WEAR, Cleveland, O., 300 (EST)—11:30 AM to 12:10 PM; 3:30 to 4:10; 7 to 8.
WEEI, Boston, Mass., 476 (ESTDS)—6:45 AM to 8; 3 PM to 4; 5:30 to 10.
WEMC, Berrien Springs, Mich., 286 (CST)—8:15 PM to 11.
WFAA, Dallas, Texas, 475.9 (EST)—10:30 AM to 11:30; 12:30 PM to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30.
WFBH, New York City, 272.6 (ESTDS)—2 PM to 6:30.
WGBS, New York City, 316 (ESTDS)—10 AM to 11; 1:30 to 3:10; 6 to 7:30.
WGES, Chicago, Ill., 250 (CSTDS)—5 PM to 8.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:18; 8 to 10:45.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 3:30 PM; 3:30 to 5:57.
WGR, Buffalo, N. Y., 319 (ESTDS)—12 M to 12:30 PM; 2:30 to 4:30; 7:30 to 11.
WGY, Schenectady, N. Y., 379.5 (EST)—1 PM to 2; 5:30 to 8:30.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:15 PM; 4 to 5; 6 to 7:30; 8 to 10.
WHAS, Louisville, Ky., 399.8 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 360 (ESTDS)—2:15 PM to 5; 6:30 to 12.
WHO, Des Moines, Iowa, 526 (CST)—12:15 PM to 1:30; 7:30 to 9; 11:15 to 12.
WHT, Chicago, Ill., 400 (CSTDS)—11 AM to 2 PM; 7 to 8:30, 10:30 to 1 AM.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—7 AM to 8; 1 PM to 2; 3 to 8.
WJZ, New York City, 455 (ESTDS)—10 AM to 11; 1 PM to 2; 4 to 5:30; 6 to 6:30; 7 to 11.
WKRC, Cincinnati, O., 326 (EST)—8 PM to 10.
WLIT, Philadelphia, Pa., 395 (EST)—12:02 PM to 1; 2 to 3; 4:30 to 6; 7:30 to 11:30.
WLW, Cincinnati, O., 422.3 (EST)—10:45 AM to 12:15 PM; 1:30 to 2:30; 3 to 5; 6 to 10.
WMAK, Lockport, N. Y., 265.5 (EST)—8 PM to 12.
WMCA, New York City, 341 (ESTDS)—11 AM to 12 M; 6:30 PM to 12.
WNYC, New York City, 526 (ESTDS)—3:15 PM to 4:15; 6:20 to 11.
WOAW, Omaha, Neb., 526 (CST)—12:30 PM to 1:30; 5:45 to 10:30.
WOC, Davenport, Iowa, 484 (CST)—12:57 PM to 2; 3 to 3:30; 5:45 to 6.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—11 AM to 1 PM; 4:40 to 6; 7:30 to 11.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 to 4; 6:15 to 11:30.
WPAK, Fargo, N. D., 283 (CST)—7:30 PM to 9.
WPG, Atlantic City, N. J., 299.8 (ESTDS)—7 PM to 11.
WOJ, Chicago, Ill., 488 (CST)—11 AM to 12 M; 3 PM to 4.
WRC, Washington, D. C., 469 (EST)—1 PM to 2; 4 to 6.
WREO, Lansing, Michigan, 285.5 (EST)—10 PM to 11.
WRNY, New York City, 258.5 (ESTDS)—11:59 AM to 2 PM; 7:30 to 11.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 2:30 to 3:30; 5 to 6; 8 to 9; 10:45 to 12.
WSBF, St. Louis, Mo., 273 (CST)—12 M to 1 PM; 3 to 4; 7:30 to 10:30; 12 to 1 AM.
WWJ, Detroit, Mich., 352.7 (EST)—8 AM to 8:30; 9:30 to 10:30; 11:55 to 1:30 PM; 3 to 4; 6 to 10.
KDKA, Pittsburgh, Pa., 309 (EST)—6 AM to 7; 9:45 to 12:15 PM; 2:30 to 3:20; 5:30 to 10.
KFAE, State College of Wash., 348.6 (PST)—7:30 PM to 9.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 11.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 5:15 to 6:15; 9:30 to 12:30.
KFNF, Shenandoah, Iowa, 266 (CST)—12:15 PM to 1:15; 3 to 4; 6:30 to 10.
KFOA, Seattle, Wash., 455 (PST)—12:45 PM to 1:30; 4 to 5:15; 6 to 10.
KGO, Oakland, Cal., 361.2 (PST)—9 AM to 10:30; 11:30 AM to 1 PM; 1:30 to 6; 6:45 to 7; 8 to 1 AM.
KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30; 5 to 8.
KHJ, Los Angeles, Cal., 405.2 (PST)—7 AM to 7:15; 12 M to 1:30 PM; 5:30 to 10.
KJR, Seattle, Wash., 384.4 (PST)—1 PM to 2:45; 6 to :30; 7 to 11.
KNX, Hollywood, Cal., 337 (PST)—12 M to 1 PM; 4 to 5; 6:30 to 12.
KOB, State College of New Mexico, 348.6 (MST)—11:55 AM to 12:30 PM; 7:30 to 8:30; 9:55 to 10:10.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 10.
KPO, San Francisco, Cal., 429 (PST)—10:30 AM to 12 M; 1 PM to 2; 2:30 to 3:30; 4:30 to 10.
KSD, St. Louis, Mo., 545.1 (CST)—7:30 PM to 10.
KTHS, Hot Springs, Ark., 374.8 (CST)—12:30 PM to 1; 8:30 to 10.

Features of the Week

FRIDAY, AUGUST 14

WWJ, Detroit, Mich., 352.7 (EST)—8 PM to 9 PM, Goldman's Band concert from N. Y.
WEAF, New York City, 492 (ESTDS)—9:15 to 10:15, Goldman Band Concert.
WHT, Chicago, Ill., 238 (CSTDS)—8:45 to 10:15 PM, Elmer Kaiser's Review Park Ballroom orch.
WGBS, New York City, 315.6 (ESTDS)—7 PM to 7:10, Herman Bernard, "Your Radio Problem."
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—7:30 PM to 8:30, dinner music by the Hotel Adelphia Roof Garden orch.

SATURDAY, AUGUST 15

WEAF, New York City, 492 (ESTDS)—11 PM to 12 PM. Vincent Lopez orch.
KGW, Portland, Ore., 491.5 (PST)—10 PM to 12 PM. dance music from Portland Hotel by Jackie Souders' orch.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.

SUNDAY, AUGUST 16

WEAF, New York City, 492 (ESTDS)—9:15 PM to 10:15, Goldman Band Concert.
WBBM, Chicago, Ill., 226 (CST)—12 PM to 2 AM—Sunday, Midnight Nut Club Feature, Sanovar Orch.

MONDAY, AUGUST 17

WWJ, Detroit, Mich., 352. (EST)—8 PM to 9, Goldman Band Concert from N. Y.
WEAF, New York City, 492 (ESTDS)—9:15 PM to 10:15, Goldman Band concert; 11 to 12, Jack Alben and his Hotel Bossert orchestra.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—7:30 PM to 8:30, dinner music by the Hotel Adelphia Roof Garden orch.

TUESDAY, AUGUST 18

WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WEAF, New York City, 492 (ESTDS)—9 PM to 10. "Everday Hour,'; 11 to 12 PM Vincent Lopez Hotel Pennsylvania orchestra.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—7:30 PM to 8:30, dinner music by the Hotel Adelphia Roof Garden orch.
WEEI, Boston, Mass., 476 (ESTDS)—10 PM to 11—From New York, WEAF Grand Opera Company.

WEDNESDAY, AUGUST 19

WHO, Des Moines, Ia., 526 (CST)—10 to 11:30 PM—The Barret-Philbreck Orch.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WEEI, Boston, Mass., 476 (ESTDS)—8:30 PM to 9—"Earl Nelson and His Uke," courtesy Radio Equipment Company.

THURSDAY, AUGUST 20

WEAF, New York City, 492 (ESTDS)—11 PM to 12 PM. Vincent Lopez Hotel Pennsylvania orch.
WGR, Buffalo, N. Y., 319 (ESTDS)—8 to 11 PM—Joint broadcasting with WEAF, N. Y. City, Atwater Kent Radio Artists, and Goodrich Silvertown Chord Orch.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—7:30 PM to 8:30, dinner music by the Hotel Adelphia Roof Garden orch.

KYW, Chicago, Ill., 536 (CSTDS)—6:30 AM to 7:30; 10:55 to 1 PM; 2:15 to 3:30; 6:02 to 7.

TUESDAY, AUGUST 18

WAAM, Newark, N. J., 263 (ESTDS)—11 AM to 12 M; 7 PM to 11.
WAHG, Richmond Hill, N. Y., 316 (ESTDS)—12 PM to 1:05 AM.
WAMB, Minneapolis, Minn., 243.8 (CST)—12 M to 1 PM; 10 to 12.
WBBM, Chicago, Ill., 226 (CST)—8 PM to 12.
WBOQ, Richmond Hill, N. Y., 236 (ESTDS)—3:30 PM to 6:30.
WBZ, Springfield, Mass., 333.1 (ESTDS)—6 PM to 11.
WCAE, Pittsburgh, Pa., 461.3 (ESTDS)—12:30 PM to 1:30; 4:30 to 5:30; 6:30 to 11.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (CST)—9:30 AM to 12 M; 1:30 PM to 4; 5:30 to 10.
WDAF, Kansas City, Kansas, 365.6 (CST)—3:30 PM to 7; 11:45 to 1 AM.
WEAF, New York City, 492 (ESTDS)—6:45 AM to 7:45; 11 to 12 M; 4 PM to 5; 6 to 12.
WEAR, Cleveland, O., 390 (EST)—11:30 AM to 12:10 PM; 7 to 10; 10 to 11.
WEEI, Boston, Mass., 476 (ESTDS)—6:45 AM to 8; 1 PM to 2; 6:30 to 10.
WFAA, Dallas, Texas, 457.9 (CST)—10:30 AM to 11:30; 12:30 PM to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30; 11 to 12.
WFBH, New York City, 272.6 (ESTDS)—2 PM to 6:30; 11:30 to 12:30 AM.
WGBS, New York City, 316 (ESTDS)—10 AM to 11; 1:30 PM to 3; 6 to 11:30.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:15.
WGES, Chicago, Ill., 250 (CSTDS)—5 PM to 8; 10:30 to 1 AM.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 3:30 PM; 5:30 to 11:30.
WGR, Buffalo, N. Y., 319 (ESTDS)—11 AM to 12:45 PM; 7:30 to 11.
WGY, Schenectady, N. Y., 379.5 (EST)—11 PM to 2:30; 5:30 to 7:30; 9:15 to 11:30.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:15 PM; 4 to 5; 6 to 7:30.
WHAS, Louisville, Ky., 399.8 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 360 (ESTDS)—12:30 PM to 1; 2:15 to 3:15; 4 to 5:30; 7:30 to 10:45; 11:30 to 12:30 AM.
WHO, Des Moines, Iowa, 526 (CST)—12:15 PM to 1:30; 7:30 to 9; 11 to 12.
WHT, Chicago, Ill., 400 (CSTDS)—11 AM to 2 PM; 7 to 8:30; 10:30 to 1 AM.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—7 AM to 8; 1 PM to 2; 3 to 4:30; 6 to 11.
WJY, New York City, 405 (ESTDS)—7:30 PM to 1:30.
WJZ, New York City, 455 (ESTDS)—10 AM to 11; 1 PM to 2; 4 to 6; 7 to 11.
WKRC, Cincinnati, O., 326 (EST)—6 PM to 12.
WLIT, Philadelphia, Pa., 395 (EST)—11 AM to 12:30 PM; 2 to 3; 4:30 to 7.
WLW, Cincinnati, O., 422.3 (EST)—10:45 AM to 1 PM; 1:30 to 2:30; 3 to 5; 6 to 11.
WMCA, New York City, 341 (ESTDS)—11 AM to 12 M; 6:30 PM to 12.
WNYC, New York City, 526 (ESTDS)—3:45 PM to 5; 6:50 to 11.
WOAW, Omaha, Neb., 526 (CST)—12:30 PM to 1:30; 5:45 to 11.
WOC, Davenport, Iowa, 484 (CST)—12:57 PM to 2; 3 to 3:30; 5:45 to 10.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—11 AM to 1 PM; 4.40 to 5; 10:55 to 11:02.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 PM to 4; 6:15 to 7:30.
WPG, Atlantic City, N. J., 299.8 (ESTDS)—7 PM to 11.
WQJ, Chicago, Ill., 448 (CST)—11 AM to 12 M; 3 PM to 4; 7 to 8; 10 to 2 AM.
WRC, Washington, D. C., 469 (EST)—4:30 PM to 5:30; 6:45 to 11.
WREO, Lansing, Michigan, 285.5 (EST)—8:15 PM to 11.
WRNY, New York City, 258.5 (ESTDS)—11:59 AM to 2 PM; 4:30 to 5; 8 to 11.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 2:30 to 3:30; 5 to 6; 8 to 9; 10:45 to 12.
WSBF, St. Louis, Mo., 273 (CST)—12 M to 1 PM; 3 to 4; 8 to 10; 11:30 to 1 AM.
WWJ, Detroit, Mich., 352.7 (EST)—8 AM to 8:30; 9:30 to 10:30; 11:55 to 1:30 PM; 3 to 4; 6 to 10.
KDKA, Pittsburgh, Pa., 309 (EST)—9:45 PM to 12 M; 1:30 PM to 3:20; 5:30 to 10:45.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 11.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 5:15 to 6:15; 9:30 to 12:30.
KFMQ, Fayettville, Ark., 299.8 (CST)—9 PM to 10.
KFOA, Seattle, Wash., 455 (PST)—12:30 PM to 1:30; 4 to 5:15; 6 to 11.
KGO, Oakland, Cal., 361.2 (PST)—11:30 AM to 1 PM; 1:30 to 3; 4 to 6:45; 8 to 1 AM.
KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30 PM; 5 to 11.
KHJ, Los Angeles, Cal., 405.2 (PST)—7 AM to 7:15; 12 M to 3:20 PM; 5:30 to 11.
KJR, Seattle, Wash., 384.4 (PST)—9 AM to 6:30 PM; 8:30 to 1 AM.
KNX, Hollywood, Cal., 337 (PST)—9 AM to 10; 1 PM to 2; 4 to 5; 6:30 to 12.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 9; 11 to 12 M.
KPO, San Francisco, Cal., 429 (PST)—7 AM to 7:45; 10 to 12 M; 1 PM to 2; 3:30 to 11.
KSD, St. Louis, Mo., 541.1 (CST)—6 PM to 7.
KTHS, Hot Springs, Ark., 374.8 (CST)—12:30 PM to 1; 8:30 to 10:30.
KYW, Chicago, Ill., 536 (CSTDS)—6:30 AM to 7:30; 10:30 to 1 PM; 2:15 to 4; 6:02 to 11:30.
CNRA, Moncton, New Brunswick, Canada, 313 (EST)—9:30 PM to 11.
CNRR, Regina, Saskatchewan, Canada—8 PM to 11.

(Continued on page 24)

By Dr. J. H. DELLINGER

Chief of Radio Laboratory, Bureau of Standards

"The Principal Difficulty in Which Broadcasting Finds Itself Is the Existence of Too Many Stations,"—"We Now Have Not So Much the Invention of Devices as the Perfection of Them"—"Substantial Progress Has Been Going on All Along the Line of Radio Engineering."

"Who Shall Pay for Broadcasting Has Solved Itself"—"Of the 500 Stations One-half Are Owned and Operated by Commercial Interests Profiting from the Sale of Radio Apparatus and the Broadcasting by the Other Half Is for Some Form or Aspect of Advertising."

THE extraordinary growth of radio in the two years following the first successful broadcasting on a commercial scale in 1921 has been followed by a period of continuing and substantial progress. Probably one-third to one-half of the people in the United States now have access to the radio programs through receiving apparatus. The type of progress which is now making this possible is not merely empirical but is more largely characterized by actual engineering development. We now have not so much invention of devices as the perfection of them. This statement is very general. There have, of course, been triumphs of engineering in the past history of radio, and on the other hand the process of "cut and try" will continue to be used in the future. Nevertheless, broadly speaking, radio engineering has now taken definite form and is the tool by which progress in radio is being wrought.

Much Progress Made

Substantial progress has been going on all along the line of radio engineering. Thus, in the development of new and improved radio communication methods or systems, we have great extension of the available frequency range, marked improvements in directive radio transmission, advances in the perfection of selective radio systems, and engineering development of line-radio or carrier-current communication. Among radio devices and applications of radio there is outstanding progress on radio beacons, on the uses of radio for aircraft navigation, on direction finders, and on radio picture transmission and vision. In the field of research and study of the problems of radio we have important progress going on in radio measurements, in standardization of apparatus, in the study and mitigation of the vagaries of wave propagation and atmospheric disturbances, and in the wide reaches of the interference problem.

The Laws Applicable

Nowhere has the interference problem been more acute than in radio broadcasting. When broadcasting began it was all carried on on a single frequency or wavelength. The resulting interference soon made this impossible and the service has evolved until at present broadcasting has exclusive use of the frequency band from 550 to 1,500 kilocycles (545 to 200 meters).

This service has developed in the last four years without any new legislation.

As everyone knows, radio is regulated in the United States under two laws of 1912, one of them being the Ship Radio Act requiring radio transmitting apparatus on every ship carrying fifty or more persons, and the other being the Act to Regulate Radio Communication. The latter law provides for the licensing of radio stations and operators, specifies the frequencies to be used by ship stations, provides for the secrecy of private messages, and prohibits fraudulent signals and wilful interference. The law is administered, regulations are formulated and stations are inspected by the Department of Commerce. Contrary to conditions in other countries, this law contains little that is restrictive and permits an almost unhampered growth of radio broadcasting. This growth has taken place almost entirely through private initiative. It has been largely directed through the National Radio Conference called by Secretary of Commerce Herbert Hoover in the years of 1922, 1923 and 1924.

Freedom in Broadcasting

The radio broadcasting system of the United States can be characterized as one of extreme freedom. Anyone is free to erect a broadcasting station and no license or regulation other than patent rights is imposed upon the sale, purchase and use of receiving apparatus. This accounts in large measure for the remarkable growth of radio broadcasting. It is also responsible for the principal difficulty in which broadcasting finds itself at present, the existence of too many broadcasting stations. The Third National Radio Conference, held in October, 1924, made a series of recommendations with a view to reducing interference and otherwise improving broadcasting, and these recommendations have been adopted as the guiding policy of the Department of Commerce in regulating radio communication.

The Frequency Rules

The broadcasting band of frequencies has been divided into two parts, the range from 550 to 1,070 kilocycles being assigned to what are known as Class B stations, and the range from 1,090 to 1,500 kilocycles being assigned to Class A stations. The Class B stations are those which use one-half kilowatt or over, and the Class A stations in general use less than one-half kilowatt, although a few have been licensed to use as high as two kilowatts. There are approximately 100 of the Class B and 400 Class A stations. The frequencies of broadcasting stations are spaced 10 kilocycles apart. It has been found in practice that this is the minimum separation which permits satisfactory reception without interference. Rules for still greater frequency separations at certain distances are also observed. Allowing 100 kilocycles per station it will be seen that there are 53 frequencies available in the frequency range used for Class B stations. Since there are approximately 100 such stations, it follows that each station can not have an exclusive frequency, but must share its frequency with another station. No way has yet been found to avoid this undesirable duplicate assignment of frequencies, and this is why the stations alternate in the use of the frequencies, as for instance by transmitting on alternate nights.

Whistling Interference Reduced

The small separation between station frequencies requires that the frequencies be maintained with very great constancy. This requirement has been kept in view by the Government and by the transmitting stations themselves, and as a result of considerable effort devoted to this end the stations maintain their frequencies with quite satisfactory constancy. Whistling interference produced by the heterodyne action between two station frequencies, while common two years ago, is now comparatively rare. Coincident with this advance there has been improvement in receiving apparatus. Many listeners are still as greatly interested in receiving from distant stations as from nearby ones, and this has given rise to a demand for very selective receiving sets.

The pre-emption of the frequency band mentioned by broadcasting has made it necessary that ship radio communication relinquish the use of certain frequencies formerly used in this band. As a result ship traffic is now carried on at frequencies between 120 and 190 and between 250 and 500 kilocycles. There has been a general reassignment of frequency bands to different services. Government services use the bands 95 to 120 and 190 to 230 kilocycles. Point-to-point land and transoceanic commercial radio communication is carried on below 95 kilocycles.

No Censorship

There has been considerable discussion over the question of regulating the character of programs sent out by broadcasting stations. The Government has consistently opposed censorship, and the result is that the stations are entirely free in their choice of material. The station managements are, in point of fact, very responsive to the public reaction to their programs. This makes for steady improvement in the character of material and in the type of stations doing the broadcasting. Unquestionably the Class B stations with their higher power, greater investment of capital and the maintenance of higher standards of equipment and program are the most popular.

Interconnection A Big Advance

The interconnection of stations so as to provide for simultaneous broadcasting of the same program by several stations has been one of the most important developments of the past two years. It has made possible a wide extension in the knowledge of national events; it makes the talent of the great cities available to everyone. The interconnection of a chain of stations is a matter of regular daily procedure. In a few cases there has been nationwide simul-

(*Concluded on page* 31)

A Quest For Better Quality

RF Stage Connected to Two Tubes in Parallel —First Audio Stage Reflexed in One Case, Last Audio in the Other, to See Which Reduces Distortion More Effectively —Does an RF or an AF Overload Cause the Greater Distortion?

By Sidney E. Finkelstein
Associate, Institute of Radio Engineers

SIDNEY E. FINKELSTEIN

FOR the fan who has made many sets some variations on the accepted themes are very inviting, hence two circuits are presented that offer encouragement to those who like to work out solutions from suggested data.

The first circuit (Fig. 1) consists of a stage of tuned radio-frequency amplification, with its two tubes connected in parallel, a regenerative detector, the first stage of audio reflexed in the parallel-connected tubes, the second stage of audio being "solo."

The other circuit (Fig. 2), using the same principle, makes the last audio stage the reflexed one. The parallel connection of the tubes in the reflexed stage is retained.

Only one reason for connecting tubes in parallel may be advanced—to make them share equally the load of the stage in which they are connected. With RF amplification so popular often there is too much of it, so that distortion arises from RF causes, no less than from an overburden of audio current.

As the test is one for reducing the overload, if any, two audio stages must be employed. Some may find that the hook-ups as suggested will improve the quality of reception. At least experimenters may establish to their own satisfaction which of the two methods, if either, gives them better results in quality, and possibly even greater volume than obtained heretofore, when the four tubes were hooked up simply in straight fashion.

Constructors who have test boards will find the circuits very interesting subjects of experiment. The change involved in making one into the other is slight.

The set, in point of distance-getting, will not accomplish any more than the regulation hook-up. But if a fan is troubled with distorted reception, instead of introducing resistances across audio transformers, or condensers that cut down the volume, he may try either or both of the methods outlined, and see if he can not get very clear reception without any reduction in volume.

L1L2 is a radio-frequency transformer and C1 is a variable condenser of correct capacity to tune the secondary L2 throughout the band of broadcasting. L3L4L5 is a 3-circuit tuning coil in which L5 is the tickler. C2 tunes L4. C3 is a by-pass condenser, about .001 mfd. So is C5. R4 is a grid leak, about 2 megohms. The tubes are numbered 1, 2, 3 and 4.

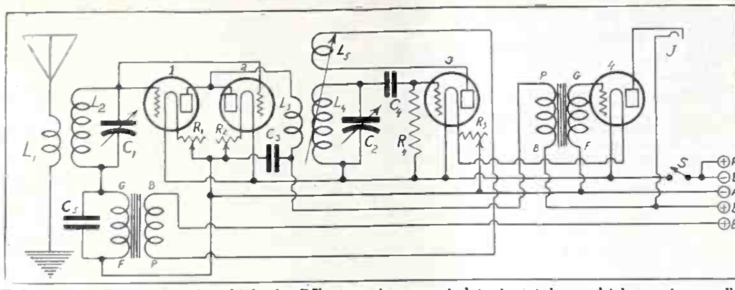


FIG. 1, a 4-tube receiver in which the RF stage is connected to two tubes, which are in parallel, the detector is regenerative and the first audio stage is reflexed in the parallel stage. The object of making this exprimient is to determine whether overloading of tubes, which results in distortion, may be remedied in this manner without requiring an additional tube, despite the parallel connection. Hence reflex is introduced.

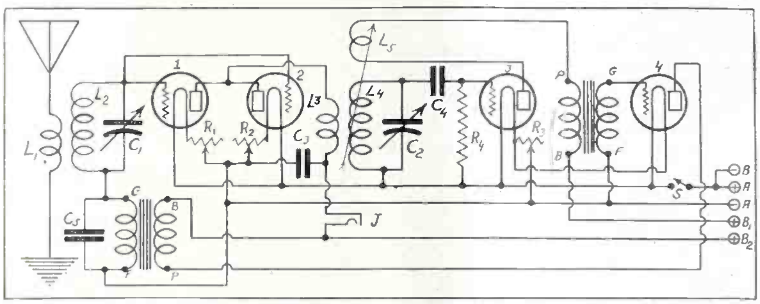


FIG. 2, the same circuit as that shown in Fig. 1, except that the second audio stage is the reflexed one, instead of the first. By trying out the both methods and comparing results one may determine whether overloading at radio or at audio frequencies is the more serious defect in a distorting receiver. Of course bad audio transformers would render the tests of little value.

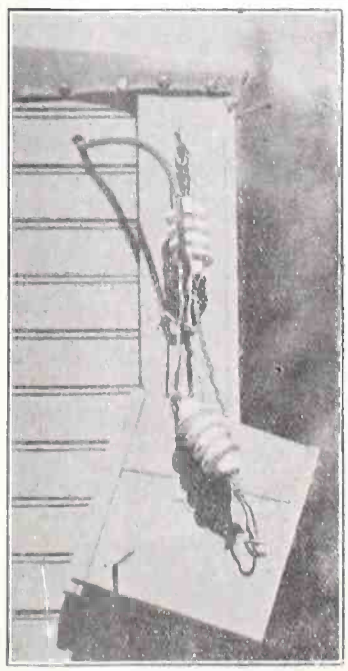
In effect tubes 1 and 2 represent only one stage in either diagram. The input is to the two grids and the output is from the two plates. These two tubes should be of the same type.

The RF load on the tube is partly determined by the number of turns on the primary L3. Generally speaking, the lesser the inductance and coupling, the lesser the tendency to overload. But unless one has a ratio of at 4-to-1 there may be losses, i. e., insufficiency transfer of energy. Assuming, therefore, one has the type of windings most commonly used, where that ratio is used, or something near it, there may be still quite a tendency to ask too much RF work of the first tube. Hence we will use two tubes in parallel for accomplishing only the same quantitative results. Now, not to require the use of any more tubes than would the standard hook-up, we must resort to reflexing. That often causes difficulties and if the reflexing isn't a careful wiring job, with proper regard for position and length of leads, all attempts to attain improved results are almost certain to fail. Hence be careful of your reflex work.

Now, the last audio tube handles the heavier audio load. Maybe that is the one that should be reflexed, since the signals are to be delivered into the parallel-connected stage, which it is assumed are able to handle them best. But the experimenter may find that the audio load is not the troublesome one. The radio load having been shared satisfactorily between the two tubes (1 and 2), the reflex idea may be embodied solely for the object of avoiding the extra tube, and not for remedying any condition due to an audio overload. Therefore, in such a case, the first audio stage would be properly reflexed. Also the leads would be shorter that way.

Fans who do not care much about the cost entailed may omit the reflexing entirely and use either parallel-connected tubes in the radio stage or in the last audio stage or in both places, as an experiment.

The two sets shown in the diagrams work well, as do the two others suggested. The problem is for the experimenter to decide whether the parallel idea is worth while and if so, whether for radio or audio reasons, or for a combination of both.



NOVEL antenna used by Edward A. Keltzer on his auto trips. Wound on a reel, the aerial is cut out of the way, while traveling. When wanted, it need only be pulled out and attached to any convenient tree. (Underwood & Underwood)

THE KEY TO THE AIR

KEY

Abbreviations: EST, Eastern Standard Time; CST, Central Standard Time; MST, Mountain Standard Time; PST, Pacific Standard Time; DS, Daylight Saving Time.

How to tune in a desired distant station at just the right time—Choose your station from the list published herewith. See what time division the station is under (EST, CST, etc.); then consult the table below. Add to or subtract, as directed from the time as given on the PROGRAM. The result will be the same BY YOUR CLOCK that you should tune in, unless daylight saving time intervenes, as explained below.—The table:

If you are in	*And want a station in*	*Subtract*	*Add*
EST	CST	..	1 hr.
EST	MST	..	2 hrs.
EST	PST	..	3 hrs.
CST	EST	1 hr.	..
CST	MST	..	1 hr.
CST	PST	..	2 hrs.
MST	EST	2 hrs.	..
MST	CST	1 hr.	..
MST	PST	..	1 hr.
PST	EST	3 hrs.	..
PST	CST	2 hrs.	..
PST	DST	1 hr.	..

If you are under DST and the station you want is under that time, too, or if both are under ST, the above table will hold.

If you are under DST, and the station operates under ST, add one hour to the table result.

If the station uses DST, and you are under ST, subtract one hour from the table result.

FRIDAY, AUGUST 14

WAAM, Newark, N. J., 263 (ESTDS)—11 AM to 12.
WAHG, Richmond Hill, N. Y., 316 (ESTDS)—12 to 1:05 PM; 8 to 12 PM.
WAMD, Minneapolis, Minn., 243.8 (SCT)—12 to 1 PM; 10 to 12.
WBBM, Chicago, Ill., 226 (CST)—8 to 10 PM.
WBBR, New York City, 272.6 (ESTDS)—8 PM to 10.
WBOQ, Richmond Hill, N. Y., 236 (ESTDS)—7:30 PM to 11:30.
WBZ, Springfield, Mass., 333.1 (ESTDS)—6 PM to 11.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (CST)—9:30 AM to 12 M; 1:30 to 4; 5:30 to 10.
WCAE, Pittsburgh, Pa., 461.3 (ESTDS)—12:30 to 1:30 PM; 4:30 to 5:30; 6:30 to 11.
WDAF, Kansas City, Kansas, 365.6 (CST)—3:30 to 7 M; 8 to 10; 11:45 to 1 AM.
WEAF, New York City, 492 (ESTDS)—6:45 AM to 7:45; 11 to 12; 4 PM to 5; 6 to 12.
WEAR, Cleveland, O., 390 (EST)—11:30 AM to 12:10 PM; 3:30 to 4:10; 8 to 11.
WEAO, Ohio State University, 293.9 (EST)—8 PM to 10.
WEEI, Boston, Mass., 476 (ESTDS)—6:45 AM to 7:45; 2 PM to 3:15; 5:30 to 10.
WEMC, Berrien Springs, Mich., 286 (CST)—9 PM to 11.
WFAA, Dallas, Texas, 475.9 (CST)—10:30 AM to 11:30; 12:30 PM to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30.
WFBH, New York City, 272.6 (ESTDS)—2 PM to 6.
WGBS, New York City, 316 (ESTDS)—10 AM to 11; 1:30 PM to 4; 6 to 11.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:15; 8 to 11.
WGES, Chicago, Ill., 250 (CSTDS)—5 PM to 7; 10:30 to 1 AM.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 3:30 PM; 5:30 to 11:30.
WGR, Buffalo, N. Y., 319 (ESTDS)—12 M to 12:45 PM; 7:30 to 11.
WGY, Schenectady, N. Y., 379.5 (EST)—1 PM to 2; 5:30 to 10:30.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:15 PM; 4 to 5; 6 to 7:30; 8:30 to 10.
WHAS, Louisville, Ky., 399.8 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 360 (ESTDS)—12:30 PM to 1; 2:15 to 5; 7 to 11; 12 to 12:30 AM.
WHO, Des Moines, Iowa, 526 (CST)—7 PM to 9; 11 to 12; 12:30 to 1:30; 4:30 to 5:30; 6:30 to 9:30.
WHT, Chicago, Ill., 400 (CSTDS)—11 AM to 2 PM; 7 to 8:30; 8:45 to 10:05; 10:30 to 1 AM.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—7 AM to 8; 1 PM to 2; 3 to 4:50; 6 to 7.
WJY, New York City, 405 (ESTDS)—7:30 PM to 11:30.
WJZ, New York City, 455 (ESTDS)—10 AM to 11; 1 PM to 2; 4 to 6; 7 to 10:30.
WLIT, Philadelphia, Pa., 395 (EST)—12:02 PM to 12:30; 2 to 3; 4:30 to 6; 7:30 to 1 AM.
WLW, Cincinnati, O., 422.3 (EST)—10:45 AM to 12:15; 1:30 PM to 2:30.
WMCA, New York City, 341 (ESTDS)—11 AM to 12M; 6:30 PM to 12.
WNYC, New York City, 526 (ESTDS)—3:45 PM to 4:45; 6:20 to 11.
WOAW, Omaha, Neb., 526 (CST)—12:30 PM to 1; 5:45 to 7:10; 9 to 11.
WOC, Davenport, Iowa, 484 (CST)—12:57 PM to 2; 3 to 3:30; 5:45 to 12.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 PM to 4; 6:15 to 7.
WPAK, Fargo, N. D., 283 (CST)—7:30 PM to 9.
WPG, Atlantic City, N. J., 299.8 (ESTDS)—7 PM to 8:30; 10 to 12.
WQJ, Chicago, Ill., 448 (CST)—11 AM to 12 M; 3 PM to 4; 7 to 8; 10 to 2 AM.
WRC, Washington, D. C., 469 (EST)—4:30 PM to 5; 6:45 to 12.
WREO, Lansing, Michigan, 285.5 (EST)—10 PM to 11.
WRNY, New York City, 258.5 (ESTDS)—11:59 to 2 PM; 7:59 to 9:45.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 2:30 to 3:30; 5 to 6; 8 to 9; 10:45 to 12.
WSBF, St. Louis, Mo., 273 (CST)—12 M to 1 PM; 3 to 4; 7:30 to 10; 12 PM to 1 AM.
WWJ, Detroit, Mich., 352.7 (EST)—8 AM to 8:30; 9:30 to 10:30; 11:55 to 1:30; 3 to 4; 6 to 7; 8 to 10.
KDKA, Pittsburgh, Pa., 309 (EST)—6 AM to 7; 9:45 to 12:20 PM; 1:30 to 3:20; 3:30 to 11.
KFAE, State College of Wash., 348.6 (PST)—7:30 PM to 9.
KFDY, Brookings, S. D., 273 (MST)—8 PM to 9.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 10.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 9:30 to 12.
KFNF, Shenandoah, Iowa, 266 (CST)—12:15 PM to 1:15; 3 to 4; 6:30 to 10.
KFOA, Seattle, Wash., 455 (PST)—12:30 PM to 1:30; 4 to 5:15; 6 to 11.
KGO, Oakland, Cal., 361.2 (PST)—11:10 AM to 1 PM; 1:30 to 3; 4 to 7.
KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30 PM; 5 to 11.
KHJ, Los Angeles, Cal., 405.2 (PST)—7 AM to 7:15; 12 M to 3:30 PM; 5:30 to 11:30.
KJR, Seattle, Wash., 484.4 (PST)—10:30 AM to 11:30 AM; 1 PM to 6:30; 8:30 to 11.
KNX, Hollywood, Cal., 337 (PST)—11:30 AM to 12:30 PM; 1 to 2; 4 to 5; 6:30 to 12.
KOB, State College of New Mexico, 348.6 (MST)—11:55 AM to 12:30 PM; 7:30 to 8:30; 9:55 to 10:10.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 8:45; 11 to 12 M.
KPO, San Francisco, Cal., 429 (PST)—7:30 AM to 8; 10:30 to 12 M; 1 PM to 2; 4:30 to 11.
KSD, St. Louis, Mo., 545.1 (CST)—4 PM to 5.
KTHS, Hot Springs, Ark., 374.8 (CST)—12:30 PM to 1; 8:20 to 10.
KYW, Chicago, Ill., 536 (CSTDS)—6:30 AM to 7:30; 10:55 to 1 PM; 2:25 to 3:30; 6:02 to 7:20; 9 to 1:30 AM.
CNRA, Moncton, Canada, 313 (EST)—8:30 PM to 10:30.
CNRE, Edmonton, Canada, 516.9 (MST)—8:30 PM to 10:30.
CNRS, Saskatoon, Canada, 400 (MST)—2:30 PM to 3.
CNRT, Toronto, Canada, 357 (EST)—6:30 PM to 11.

SATURDAY, AUGUST 15

WAAM, Newark, N. J., 263 (EST)—7 PM to 11.
WAHG, Richmond Hill, N. Y., 316 (ESTDS)—12 to 2 AM.
WAMD, Minneapolis, Minn., 243.8 (CST)—12 M to 1 PM; 10 to 12.
WBBM, Chicago, Ill., 226 (CST)—8 PM to 1 AM.
WBBR, New York City, 272.6 (ESTDS)—8 PM to 9.
WBOQ, Richmond Hill, N. Y., 236 (ESTDS)—3:30 PM to 6:30.
WBZ, Springfield, Mass., 333.1 (ESTDS)—11 AM to 12:30 PM; 7 to 9.
WCAE, Pittsburgh, Pa., 461.3 (ESTDS)—10:45 AM to 12M; 3 PM to 4; 6:30 to 7:30.
WCBD, Zion, Ill., 344.6 (CST)—8 PM to 10.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (CST)—9:30 AM to 12:30 PM; 2:30 to 5; 6 to 10.
WEAF, New York City 492 (ESTDS)—6:45 AM to 7:45; 4 PM to 5; 6 to 12.
WEEI, Boston, Mass., 476 (ESTDS)—6:45 AM to 7 AM.
WEAR, Cleveland, O., 390 (EST)—11:30 AM to 12:10 PM; 3:30 to 4:10; 7 to 8.
WEMC, Berrien Springs, Mich., 286 (CST)—11 AM to 12:30 PM; 8:15 to 11.
WFAA, Dallas, Texas, 475.9 (CST)—12:30 PM to 1; 6 to 7; 8:30 to 9:30; 11 to 12:30 AM.
WFBH, New York City, 272.6 (ESTDS)—2 PM to 7:30; 11:30 to 12:30 AM.
WGBS, New York City, 316 (ESTDS)—10 AM to 11; 1:30 PM to 3; 6 to 12.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:15.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 2:30 PM; 3 to 5:57; 6 to 11:30.
WGR, Buffalo, N. Y., 319 (ESTDS)—8:45 to 10:15 PM, U. S. Army Band.
WGY, Schenectady, N. Y., 379.5 (EST)—7:30 PM to 10.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:30 PM; 4 to 5; 6 to 7:30.
WHAS, Louisville, Ky., 399.8 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 360 (ESTDS)—2:15 PM to 5; 7:30 to 10.
WHO, Des Moines, Iowa, 526 (CST)—11 AM to 12:30 PM; 4 to 5:30; 7:30 to 8:30.
WHT, Chicago, Ill., 400 (CSTDS)—11 AM to 2 PM; 7 to 8:30; 10:30 to 1 AM.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—7 AM to 8; 10:20 to 11; 1 PM to 2; 3 to 4; 6 to 11:30.
WJY, New York City, 405 (ESTDS)—2:30 PM to 5; 8 to 10:30.
WJZ, New York City, 455 (ESTDS)—9 AM to 12:30 PM; 2:30 to 4; 7 to 10.
WKRC, Cincinnati, O., 326 (EST)—10 to 12 M.
WLWC, Cincinnati, O., 422.3 (EST)—9:30 AM to 12:30 PM; 7:30 to 10.
WMAK, Lockport, N. Y., 265.5 (EST)—10:25 AM to 12:30 PM.
WMCA, New York City, 341 (ESTDS)—3 to 5 PM; 6:30 to 2.
WNYC, New York City, 526 (ESTDS)—1 to 3 PM; 7 to 11.
WOAW, Omaha, Neb., 526 (CST)—10 AM to 1; 2:15 to 4; 9 to 11.
WOC, Davenport, Iowa, 484 (CST)—12:57 PM to 2; 5:45 to 7:10; 9 to 12.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—11 AM to 1 PM; 4:40 to 5; 10:55 to 11:02.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 PM to 4; 6:15 to 7:30; 8 to 11.
WQJ, Chicago, Ill., 448 (CST)—11 AM to 12 M; 3 PM to 4; 7 to 8; 10 to 3 AM.
WPG, Atlantic City, N. J., 299.8 (CST)—7 PM to 12.
WRC, Washington, D. C., 469 (EST)—4:30 to 5:30 PM; 6:45 to 12.
WREO, Lansing, Michigan, 285.5 (EST)—10 PM to 12.
WRNY, New York City, 258.5 (ESTDS)—11:59 to 2 PM; 7:59 to 9:30; 12 M to 1 AM.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 3 to 4; 5 to 6; 10:45 to 12.
WWJ, Detroit, Mich., 352.7 (EST)—8 AM to 8:30; 9:30 to 10; 11:55 to 1:30 PM; 3 to 4.
KDKA, Pittsburgh, Pa., 309 (EST)—10 AM to 12:30 PM; 1:30 to 6:30; 8:45 to 10.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 11.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 9:30 to 12:30.
KFNF, Shenandoah, Iowa, 268 (CST)—12:15 PM to 1:15; 3 to 4; 6:30 to 10:30.
KFOA, Seattle, Wash., 455 (PST)—Silent.
KGO, Oakland, Cal., 361.2 (PST)—11 AM to 12:30 PM; 3:30 to 5:45; 7:30 to 9.
KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30 PM; 6 to 7; 10 to 11.
KHJ, Los Angeles, Cal., 405.2 (ESTDS)—7 AM to 7:30; 10 to 1:30 PM; 2:30 to 3:30; 5:30 to 2 AM.
KJR, Seattle, Wash., 484.4 (PST)—1 PM to 2:45; 6 to 6:30; 8:30 to 10.
KNX, Hollywood, Cal., 337 (PST)—1 PM to 2; 6:30 to 2 AM.
KOA, Denver, Colo., 322.4 (MST)—11:30 AM to 1 PM; 7 to 10.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 9.
KPO, San Francisco, Cal., 429 (PST)—8 AM to 12M; 2 PM to 3; 6 to 10.
KSD, St. Louis, Mo., 545.1 (CST)—7 PM to 8:30.
KTHS, Hot Springs, Ark., 374.8 (CST)—12:30 PM to 1; 8:30 to 10:30.
KYW, Chicago, Ill., 536 (CSTDS)—11 AM to 12:30 PM; 4 to 5; 7 to 8.
CKAC, Montreal, Canada, 411 (EST)—4:30 PM to 5:30.
CNRO, Ottawa, Ontario, Canada, 435 (EST)—7:30 PM to 10.
PWX, Havana, Cuba, 400 (EST)—8:30 PM to 11:30.

SUNDAY, AUGUST 16

WBBM, Chicago, Ill., 226 (CST)—4 PM to 6; 8 to 10.
WBBR, New York City, 272.6 (ESTDS)—10 AM to 12 M; 9 PM to 11.
WCCO, St. Paul and Minneapolis, Minn., 416 (CST)—11 AM to 12:30 PM; 4:10 to 5:10; 7:20 to 10.
WDAF, Kansas City, Kansas, 365.6 (CST)—4 PM to 5:30.
WEAF, New York City, 492 (ESTDS)—3 PM to 5; 7:20 to 10:15.
WEAR, Cleveland, O., 390 (EST)—3:30 PM to 5; 7 to 8; 9 to 10.
WFBH, New York City, 272.6 (ESTDS)—5 PM to 7.
WGBS, New York City, 316 (ESTDS)—3:30 PM to 4:30; 9:30 to 10:30.
WGCP, New York City, 252 (ESTDS)—8 PM to 11.
WGN, Chicago, Ill., 370 (CST)—11 AM to 12:45 PM; 2:30 to 5; 9 to 10.
WGR, Buffalo, N. Y., 379.5 (EST)—9:30 AM; 7:15 to 8 PM.
WGY, Schenectady, N. Y., 379.5 (EST)—9:30 AM to 12:30 PM; 2:35 to 3:45; 6:30 to 10:30.
WHAD, Milwaukee, Wis., 275 (CST)—3:15 PM to 4:15.
WHN, New York City, 360 (ESTDS)—1 PM to 1:30; 3 to 6; 10 to 12.
WHT, Chicago, Ill., 238 (CSTDS)—9:30 AM to 1:15 PM; 5 to 9.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—10:45 AM to 12:30 PM; 4:15 to 5:30.
WKRC, Cincinnati, O., 326 (EST)—6:45 PM to 11.
WMCA, New York City, 341 (ESTDS)—11 AM to 12:15 PM; 7 to 7:30.
WNYC, New York City, 526 (ESTDS)—9 PM to 11.
WOCL, Jamestown, N. Y., 275.1 (EST)—9 PM to 11.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—10:45 AM to 12:30 PM; 2:30 to 4.
WPG, Atlantic City, N. J., 209.8 (ESTDS)—3:15 PM to 5; 9 to 11.
WQJ, Chicago, Ill., 448 (CST)—10:30 AM to 12:30 PM; 3 PM to 4; 8 to 10.
WREO, Lansing, Michigan, 285.5 (EST)—10 AM to 11.
WRNY, New York City, 258.5 (ESTDS)—3 PM to 5; 7:59 to 10.
WSBF, St. Louis, Mo., 273 (CST)—9 to 11 PM.
WWJ, Detroit, Mich., 352.7 (EST)—11 AM to 12:30 PM; 2 to 4; 6:20 to 9.
KDKA, Pittsburgh, Pa., 309 (EST)—9:45 AM to 10:30; 11:55 to 12 M; 2:30 PM to 5:30; 7 to 11.
KFNF, Shenandoah, Iowa, 266 (CST)—10:45 AM to 12:30 PM; 2:30 to 4:30; 6:30 to 10.
KOA, Denver, Col., 322.4 (MST)—10:55 AM to 1 PM; 4 PM to 5:30; 7:45 to 10.
KOIL, Council Bluffs, Iowa, 278 (CST)—11 AM to 12:30 PM; 7:30 to 9.
KGW, Portland, Oregon, 491.5 (PST)—10:30 AM to 12:30 PM; 6 to 9.
KHJ, Los Angeles, Cal., 405.2 (ESTDS)—10 AM to 12:30 PM; 6 to 9.
KJR, Seattle, Wash., 384.4 (PST)—11 AM to 12:30 PM; 3 to 4:30; 7:15 to 9.
KTHS, Hot Springs, Ark., 374.8 (CST)—11 AM to 12:30 PM; 2:30 to 3:40; 8:40 to 11.

MONDAY, AUGUST 17

WAAM, Newark, N. J., 263 (ESTDS)—11 AM to 12 M; 7 PM to 11.

WAHG, Richmond Hill, N. Y., 316 (ESTDS)—12 M to 1:05 PM; 8 to 2 AM.
WAMB, Minneapolis, Minn., 243.8 (CST)—10 PM to 12.
WBBM, Chicago, Ill., 226 (CST)—6 PM to 7.
WBBR, New York City, 272.6 (ESTDS)—8 PM to 9.
WBZ, Springfield, Mass., 333.1 (ESTDS)—6 PM 11:30.
WCAE, Pittsburgh, Pa., 461.3 (ESTDS)—12:30 PM to 1:30; 4:30 to 5:30; 6:30 to 12.
WCBD, Zion, Ill., 344.6 (CST)—8 PM to 10.
WCCO, St. Paul and Minneapolis, Minn., 416 (CST)—9:30 AM to 12 M; 1:30 PM to 6:15.
WDAF, Kansas City, Kansas, 365.6 (CST)—3:30 PM to 7; 8 to 10; 11:45 to 1 AM.
WEAF, New York City, 492 (ESTDS)—6:45 AM to 7:45; 4 PM to 5; 6 to 11:30.
WEAR, Cleveland, O., 300 (EST)—11:30 AM to 12:10 PM; 3:30 to 4:10; 7 to 8.
WEEI, Boston, Mass., 476 (ESTDS)—6:45 AM to 8; 3 PM to 4; 5:30 to 10.
WEMC, Berrien Springs, Mich., 286 (CST)—8:15 PM to 11.
WFAA, Dallas, Texas, 475.9 (EST)—10:30 AM to 11:30; 12:30 PM to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30.
WFBH, New York City, 272.6 (ESTDS)—2 PM to 6:30.
WGBS, New York City, 316 (ESTDS)—10 AM to 11; 1:30 to 3:10; 6 to 7:30.
WGES, Chicago, Ill., 250 (CSTDS)—5 PM to 8.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:18; 8 to 10:45.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 3:30 PM; 3:30 to 5:57.
WGR, Buffalo, N. Y., 319 (ESTDS)—12 M to 12:30 PM; 2:30 to 4:30; 7:30 to 11.
WGY, Schenectady, N. Y., 379.5 (EST)—1 PM to 2; 5:30 to 8:30.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:15 PM; 4 to 5; 6 to 7:30; 8 to 10.
WHAS, Louisville, Ky., 399.8 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 360 (ESTDS)—2:15 PM to 5; 6:30 to 12.
WHO, Des Moines, Iowa, 526 (CST)—12:15 PM to 1:30; 7:30 to 9; 11:15 to 12.
WHT, Chicago, Ill., 400 (CSTDS)—11 AM to 2 PM; 7 to 8:30, 10:30 to 1 AM.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—7 AM to 8; 1 PM to 2; 3 to 8.
WJZ, New York City, 455 (ESTDS)—10 AM to 11; 1 PM to 2; 4 to 5:30; 6 to 6:30; 7 to 11.
WKRC, Cincinnati, O., 326 (EST)—8 PM to 10.
WLIT, Philadelphia, Pa., 395 (EST)—12:02 PM to 1; 2 to 3; 4:30 to 6; 7:30 to 11:30.
WLW, Cincinnati, O., 422.3 (EST)—10:45 AM to 12:15 PM; 1:30 to 2:30; 3 to 5; 6 to 10.
WMAK, Lockport, N. Y., 265.5 (EST)—8 PM to 12.
WMCA, New York City, 341 (ESTDS)—11 AM to 12 M; 6:30 PM to 12.
WNYC, New York City, 526 (ESTDS)—3:15 PM to 4:15; 6:20 to 11.
WOAW, Omaha, Neb., 526 (CST)—12:30 PM to 1:30; 5:45 to 10:30.
WOC, Davenport, Iowa, 484 (CST)—12:57 PM to 2; 3 to 3:30; 5:45 to 6.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—11 AM to 1 PM; 4:40 to 6; 7:30 to 11.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 to 4; 6:15 to 11:30.
WPAK, Fargo, N. D., 283 (CST)—7:30 PM to 9.
WPG, Atlantic City, N. J., 299.8 (ESTDS)—7 PM to 11.
WQJ, Chicago, Ill., 488 (CST)—11 AM to 12 M; 3 PM to 4.
WRC, Washington, D. C., 469 (EST)—1 PM to 2; 4 to 6.
WREO, Lansing, Michigan, 285.5 (EST)—10 PM to 11.
WRNY, New York City, 258.5 (ESTDS)—11:59 AM to 2 PM; 7:30 to 11.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 2:30 to 3:30; 5 to 6; 8 to 9; 10:45 to 12.
WSBF, St. Louis, Mo., 273 (CST)—12 M to 1 PM; 3 to 4; 7:30 to 10:30; 12 to 1 AM.
WWJ, Detroit, Mich., 352.7 (EST)—8 AM to 8:30; 9:30 to 10:30; 11:55 to 1:30 PM; 3 to 4; 6 to 10.
KDKA, Pittsburgh, Pa., 309 (EST)—6 AM to 7; 9:45 to 12:15 PM; 2:30 to 3:20; 5:30 to 10.
KFAE, State College of Wash., 348.6 (PST)—7:30 PM to 9.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 11.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 5:15 to 6:15; 9:30 to 12:30.
KFNF, Shenandoah, Iowa, 266 (CST)—12:15 PM to 1:15; 3 to 4; 6:30 to 10.
KFOA, Seattle, Wash., 455 (PST)—12:45 PM to 1:30; 4 to 5:15; 6 to 10.
KGO, Oakland, Cal., 361.2 (PST)—9 AM to 10:30; 11:30 AM to 1 PM; 1:30 to 6; 6:45 to 7; 8 to 1 AM.
KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30; 5 to 8.
KHJ, Los Angeles, Cal., 405.2 (PST)—7 AM to 7:15; 12 M to 1:30 PM; 5:30 to 10.
KJR, Seattle, Wash., 384.4 (PST)—1 PM to 2:45; 6 to :30; 7 to 11.
KNX, Hollywood, Cal., 337 (PST)—12 M to 1 PM; 4 to 5; 6:30 to 12.
KOB, State College of New Mexico, 348.6 (MST)—11:55 AM to 12:30 PM; 7:30 to 8:30; 9:55 to 10:10.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 10.
KPO, San Francisco, Cal., 429 (PST)—10:30 AM to 12 M; 1 PM to 2; 2:30 to 3:30; 4:30 to 10.
KSD, St. Louis, Mo., 545.1 (CST)—7:30 PM to 10.
KTHS, Hot Springs, Ark., 374.8 (CST)—12:30 PM to 1; 8:30 to 10.

Features of the Week

FRIDAY, AUGUST 14

WWJ, Detroit, Mich., 352.7 (EST)—8 PM to 9 PM, Goldman's Band concert from N. Y.
WEAF, New York City, 492 (ESTDS)—9:15 to 10:15, Goldman Band Concert.
WHT, Chicago, Ill., 238 (CSTDS)—8:45 to 10:15 PM, Elmer Kaiser's Review Park Ballroom orch.
WGBS, New York City, 315.6 (ESTDS)—7 PM to 7:10, Herman Bernard, "Your Radio Problem."
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—7:30 PM to 8:30, dinner music by the Hotel Adelphia Roof Garden orch.

SATURDAY, AUGUST 15

WEAF, New York City, 492 (ESTDS)—11 PM to 12 PM. Vincent Lopez orch.
KGW, Portland, Ore., 491.5 (PST)—10 PM to 12 PM. dance music from Portland Hotel by Jackie Souders' orch.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.

SUNDAY, AUGUST 16

WEAF, New York City, 492 (ESTDS)—9:15 PM to 10:15, Goldman Band Concert.
WBBM, Chicago, Ill., 226 (CST)—12 PM to 2 AM—Sunday, Midnight Nut Club Feature, Sanovar Orch.

MONDAY, AUGUST 17

WWJ, Detroit, Mich., 352. (EST)—8 PM to 9, Goldman Band Concert from N. Y.
WEAF, New York City, 492 (ESTDS)—9:15 PM to 10:15, Goldman Band concert; 11 to 12, Jack Alben and his Hotel Bossert orchestra.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—7:30 PM to 8:30, dinner music by the Hotel Adelphia Roof Garden orch.

TUESDAY, AUGUST 18

WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WEAF, New York City, 492 (ESTDS)—9 PM to 10. "Everday Hour,'; 11 to 12 PM Vincent Lopez Hotel Pennsylvania orchestra.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—7:30 PM to 8:30, dinner music by the Hotel Adelphia Roof Garden orch.
WEEI, Boston, Mass., 476 (ESTDS)—10 PM to 11—From New York, WEAF Grand Opera Company.

WEDNESDAY, AUGUST 19

WHO, Des Moines, Ia., 526 (CST)—10 to 11:30 PM—The Barret-Philbreck Orch.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WEEI, Boston, Mass., 476 (ESTDS)—8:30 PM to 9—"Earl Nelson and His Uke," courtesy Radio Equipment Company.

THURSDAY, AUGUST 20

WEAF, New York City, 492 (ESTDS)—11 PM to 12 PM. Vincent Lopez Hotel Pennsylvania orch.
WGR, Buffalo, N. Y., 319 (ESTDS)—8 to 11 PM—Joint broadcasting with WEAF, N. Y. City, Atwater Kent Radio Artists, and Goodrich Silvertown Chord Orch.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—3 PM to 4. "Song of the Surf,"—surf sounds of Atlantic Ocean, picked up by special microphone, underneath the breakers of Steel Pier at Atlantic City, N. J.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—7:30 PM to 8:30, dinner music by the Hotel Adelphia Roof Garden orch.

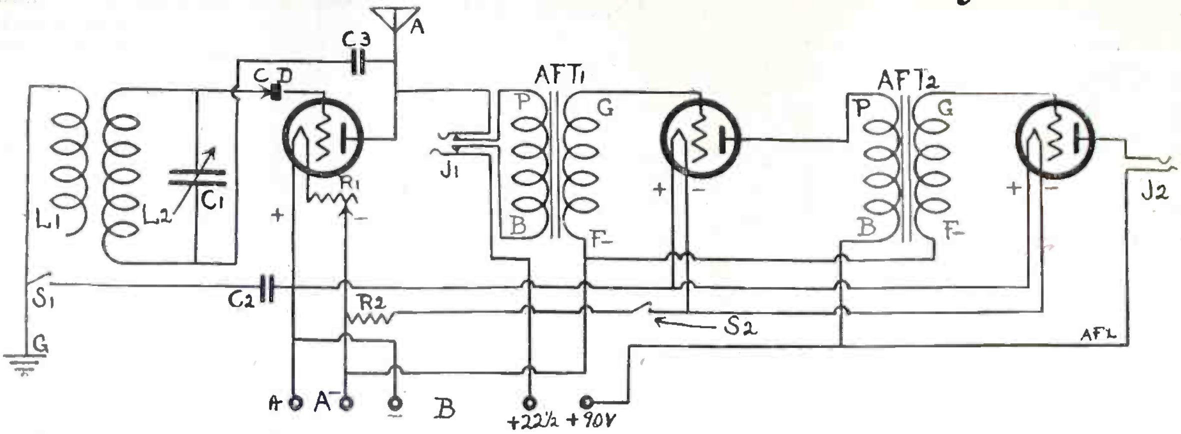
KYW, Chicago, Ill., 536 (CSTDS)—6:30 AM to 7:30; 10:55 to 1 PM; 2:15 to 3:30; 6:02 to 7.

TUESDAY, AUGUST 18

WAAM, Newark, N. J., 263 (ESTDS)—11 AM to 12 M; 7 PM to 11.
WAHG, Richmond Hill, N. Y., 316 (ESTDS)—12 PM to 1:05 AM.
WAMB, Minneapolis, Minn., 243.8 (CST)—12 M to 1 PM; 10 to 12.
WBBM, Chicago, Ill., 226 (CST)—8 PM to 12.
WBOQ, Richmond Hill, N. Y., 236 (ESTDS)—3:30 PM to 6:30.
WBZ, Springfield, Mass., 333.1 (ESTDS)—6 PM to 11.
WCAE, Pittsburgh, Pa., 461.3 (ESTDS)—12:30 PM to 1:30; 4:30 to 5:30; 6:30 to 11.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (CST)—9:30 AM to 12 M; 1:30 PM to 4; 5:30 to 10.
WDAF, Kansas City, Kansas, 365.6 (CST)—3:30 PM to 7; 11:45 to 1 AM.
WEAF, New York City, 492 (ESTDS)—6:45 AM to 7:45; 11 to 12 M; 4 PM to 5; 6 to 12.
WEAR, Cleveland, O., 390 (EST)—11:30 AM to 12:10 PM; 7 to 10; 10 to 11.
WEEI, Boston, Mass., 476 (ESTDS)—6:45 AM to 8; 1 PM to 2; 6:30 to 10.
WFAA, Dallas, Texas, 457.9 (CST)—10:30 AM to 11:30; 12:30 PM to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30; 11 to 12.
WFBH, New York City, 272.6 (ESTDS)—2 PM to 6:30; 11:30 to 12:30 AM.
WGBS, New York City, 316 (ESTDS)—10 AM to 11; 1:30 PM to 3; 6 to 11:30.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:15.
WGES, Chicago, Ill., 250 (CSTDS)—5 PM to 8; 10:30 to 1 AM.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 3:30 PM; 5:30 to 11:30.
WGR, Buffalo, N. Y., 319 (ESTDS)—11 AM to 12:45 PM; 7:30 to 11.
WGY, Schenectady, N. Y., 379.5 (EST)—11 PM to 2:30; 5:30 to 7:30; 9:15 to 11:30.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:15 PM; 4 to 5; 6 to 7:30.
WHAS, Louisville, Ky., 399.8 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 360 (ESTDS)—12:30 PM to 1; 2:15 to 3:15; 4 to 5:30; 7:30 to 10:45; 11:30 to 12:30 AM.
WHO, Des Moines, Iowa, 526 (CST)—12:15 PM to 1:30; 7:30 to 9; 11 to 12.
WHT, Chicago, Ill., 400 (CSTDS)—11 AM to 2 PM; 7 to 8:30; 10:30 to 1 AM.
WIP, Philadelphia, Pa., 508.2 (ESTDS)—7 AM to 8; 1 PM to 2; 3 to 4:30; 6 to 11.
WJY, New York City, 405 (ESTDS)—7:30 PM to 1:30.
WJZ, New York City, 455 (ESTDS)—10 AM to 11; 1 PM to 2; 4 to 6; 7 to 11.
WKRC, Cincinnati, O., 326 (EST)—6 PM to 12.
WLIT, Philadelphia, Pa., 395 (EST)—11 AM to 12:30 PM; 2 to 3; 4:30 to 7.
WLW, Cincinnati, O., 422.3 (EST)—10:45 AM to 1 PM; 1:30 to 2:30; 3 to 5; 6 to 11.
WMCA, New York City, 341 (ESTDS)—11 AM to 12 M; 6:30 PM to 12.
WNYC, New York City, 526 (ESTDS)—3:45 PM to 5; 6:50 to 11.
WOAW, Omaha, Neb., 526 (CST)—12:30 PM to 1:30; 5:45 to 11.
WOC, Davenport, Iowa, 484 (CST)—12:57 PM to 2; 3 to 3:30; 5:45 to 10.
WOO, Philadelphia, Pa., 508.2 (ESTDS)—11 AM to 1 PM; 4.40 to 5; 10:55 to 11:02.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 PM to 4; 6:15 to 7:30.
WPG, Atlantic City, N. J., 299.8 (ESTDS)—7 PM to 11.
WQJ, Chicago, Ill., 448 (CST)—11 AM to 12 M; 3 PM to 4; 7 to 8; 10 to 2 AM.
WRC, Washington, D. C., 469 (EST)—4:30 PM to 5:30; 6:45 to 11.
WREO, Lansing, Michigan, 285.5 (EST)—8:15 PM to 11.
WRNY, New York City, 258.5 (ESTDS)—11:59 AM to 2 PM; 4:30 to 5: 8 to 11.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 2:30 to 3:30; 5 to 6; 8 to 9; 10:45 to 12.
WSBF, St. Louis, Mo., 273 (CST)—12 M to 1 PM; 3 to 4; 8 to 10; 11:30 to 1 AM.
WWJ, Detroit, Mich., 352.7 (EST)—8 AM to 8:30; 9:30 to 10:30; 11:55 to 1:30 PM; 3 to 4; 6 to 10.
KDKA, Pittsburgh, Pa., 309 (EST)—9:45 PM to 12 M; 1:30 PM to 3:20; 5:30 to 10:45.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 11.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 5:15 to 6:15; 9:30 to 12:30.
KFMQ, Fayettville, Ark., 299.8 (CST)—9 PM to 10.
KFOA, Seattle, Wash., 455 (PST)—12:30 PM to 1:30; 4 to 5:15; 6 to 11.
KGO, Oakland, Cal., 361.2 (PST)—11:30 AM to 1 PM; 1:30 to 3; 4 to 6:45; 8 to 1 AM.
KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30 PM; 5 to 11.
KHJ, Los Angeles, Cal., 405.2 (PST)—7 AM to 7:15; 12 M to 3:20 PM; 5:30 to 11.
KJR, Seattle, Wash., 384.4 (PST)—9 AM to 6:30 PM; 8:30 to 1 AM.
KNX, Hollywood, Cal., 337 (PST)—9 AM to 10; 1 PM to 2; 4 to 5; 6:30 to 12.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 9; 11 to 12 M.
KPO, San Francisco, Cal., 429 (PST)—7 AM to 7:45; 10 to 12 M; 1 PM to 2; 3:30 to 11.
KSD, St. Louis, Mo., 541.1 (CST)—6 PM to 7.
KTHS, Hot Springs, Ark., 374.8 (CST)—12:30 PM to 1; 8:30 to 10:30.
KYW, Chicago, Ill., 536 (CSTDS)—6:30 AM to 7:30; 10:30 to 1 PM; 2:15 to 4; 6:02 to 11:30.
CNRA, Moncton, New Brunswick, Canada, 313 (EST)—9:30 PM to 11.
CNRR, Regina, Saskatchewan, Canada—8 PM to 11.

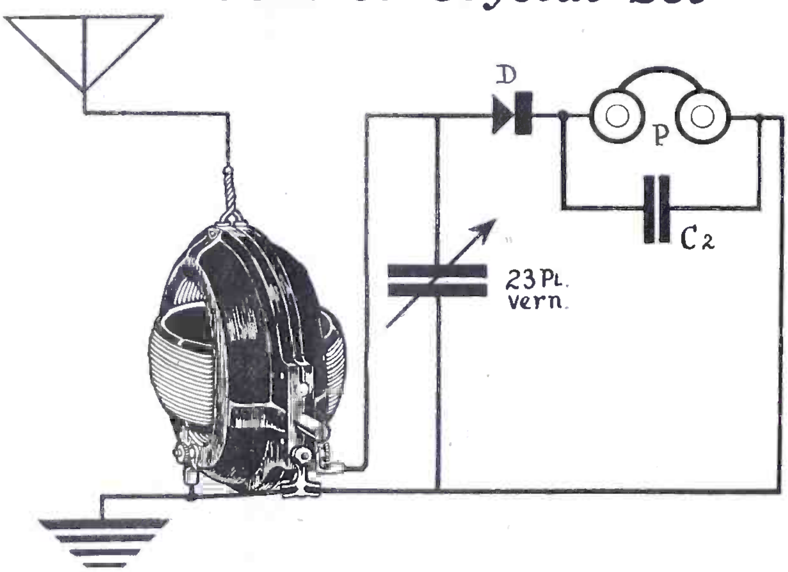
(Continued on page 24)

Can You Solve These Functional Mysteries?

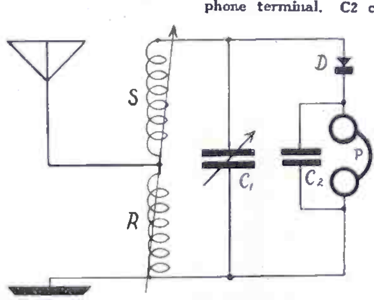


A CRYSTAL may be used as a grid leak, but it will not always be as efficient as a regular leak. In the above circuit what function does C3 perform? Is the crystal properly placed? Is C3 a grid condenser? Where is the leakage path? Can a leak occur across C3 into plate and aerial? Is this efficient? Send your answers to Mystery Editor, Radio World, 1493 Broadway, New York City.

A 2-Control Crystal Set

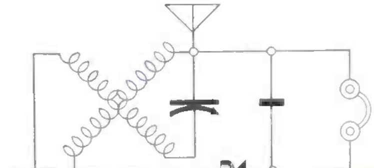


THE MIDTAP SET in picture form. The aerial connects to the midtap. This is where stator (upright) and rotor (horizontal) windings meet metallically. The other rotor terminal goes to ground and continues to the rotor plates of the variable condenser. A lug is shown supporting this lead but it represents no coil connection. The lead continues to one side of the phones. The other coil terminal (beginning at stator) goes to crystal (D) and to condenser stator. The free side of D goes to one phone terminal. C2 connection is across phones.



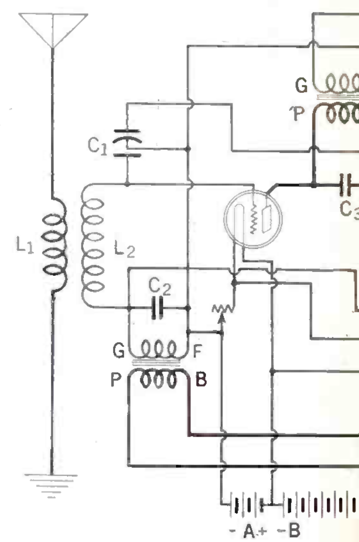
A CRYSTAL SET, selective enough if you are not less than 4 miles from a station. The coil is a variometer. Aerial goes to the midtop (where stator and rotor are joined). Ground goes to the end of the rotor. The other stator terminal is connected to one side of the crystal (D). A .002 mfd. fixed condenser (C2) bridges the phones. C1 is .0005 mfd., stator to aerial side of crystal, rotor to ground.

Is Split Rotor More Selective?



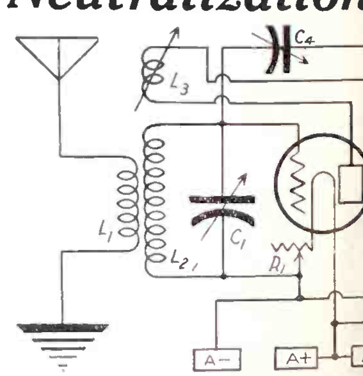
THIS Crystal Set uses a split variometer (i.e., rotor and stator windings not connected). "In a great many cases," says George Hammel, of 2822 Darwin Avenue, Los Angeles, Cal., "the volume is equal to that of a 1-tube set. The antenna should be short, about 70 feet."

A 1-Control F



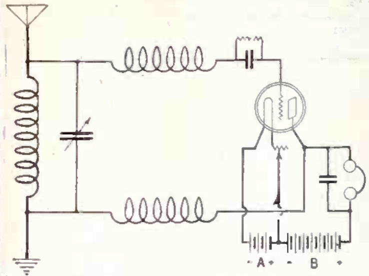
A 1-CONTROL REFLEX C1 is the tuning cont
or two .0005 mfd. condensers with rotor shafts c
A crystal detector is used. There are two RF
audio step. This set is experimental and wi

Neutralization



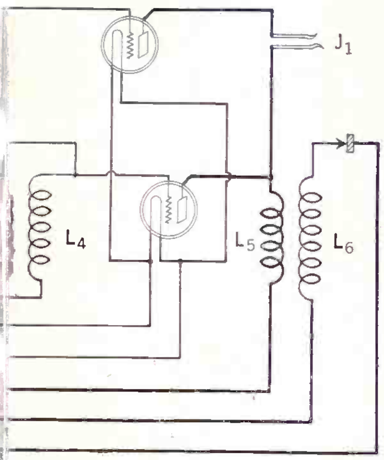
HOW TO CONNECT a neutralizing condenser i
C4 is the neutralizer. The tap on L5 is at a po
has 43, both on a 3⅛" diameter, 4" high, the
2½" diameter, 2¼" high. L4 has 10 turns, L5 h
with tap nearer the end that goes to grid co
single-circuit jack, F

A 1-Dial Set



THE HARTLEY IDEA employed in a broadcast receiver. The aerial coil has 35 turns of No. 22 SCC wire on a 3½" diameter tubing. The other coils have 20 turns each and are not in inductive relationship. The variable condenser is .0005 mfd. For smaller condensers put more turns on the aerial coil.

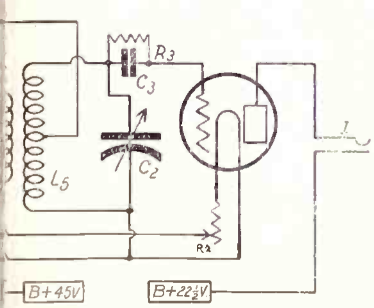
flex Receiver



0. 1

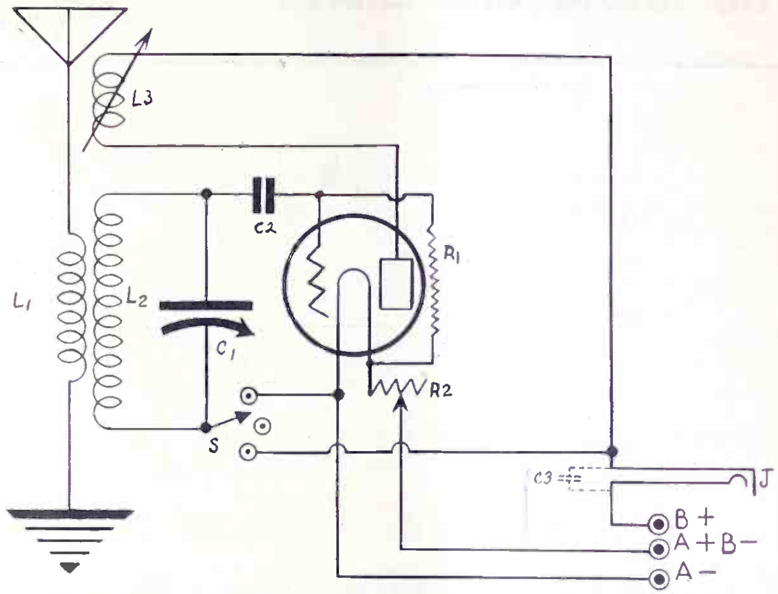
.001 mfd. condenser in two sections of .0005 each, ed. L1L2, L3L4 are RFT. L5L6 is a fixed RFT. s, detector, one reflexed audio stage and one free trouble at first. Only experts should try to it.

f a 2-Tube Set

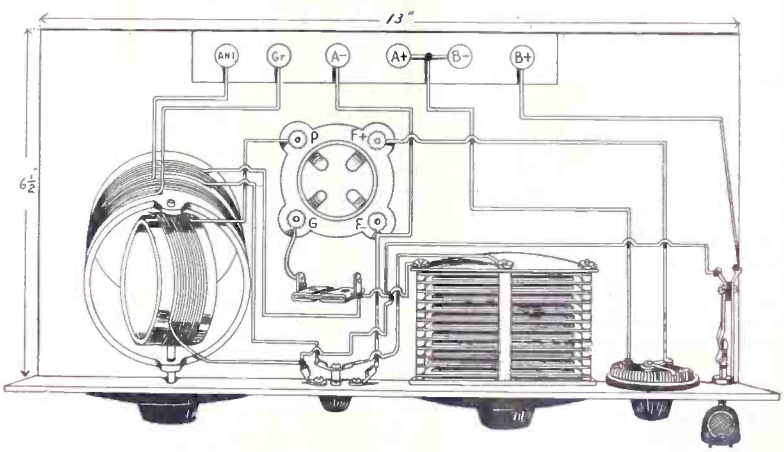


et that has one RF stage ahead of the detector. the total number of turns. L1 has 10 turns, L2 ing No. 24 DSC. L3 consists of 30 turns on a tapped at the tenth turn. Then L5 is connected er. C3R3 is the grid leak-condenser unit, J a R2 are rheostats.

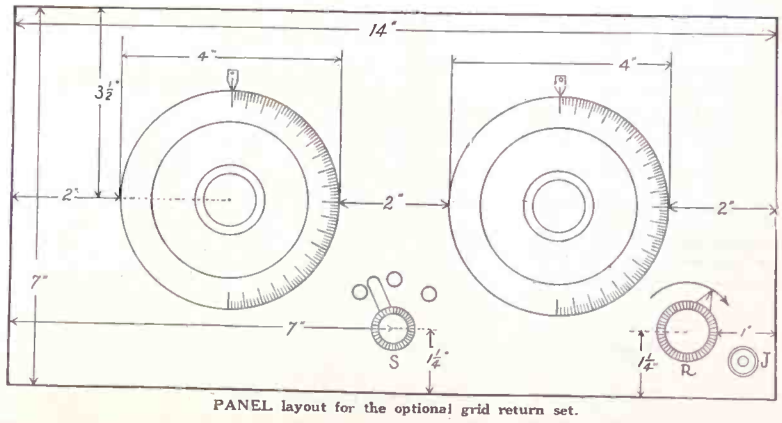
An Optional Grid Return



OPTIONAL GRID RETURN—This is a 3-circuit tuner. The switch S changes the grid return from minus A to the battery side of L3, the tickler. This affects the degree of regeneration. Try one grid return to A plus instead of to A minus, also the other to the plate, instead of to the battery end of L3. C2 is the grid condenser (always .00025 mfd.), R1 a 2-meg. grid leak, R2 a rheostat. C3, .001 mfd., is optional. J is a single-circuit jack



THE ASSEMBLY of the optional grid return set.



PANEL layout for the optional grid return set.

THE RADIO UNIVERSITY

A QUESTION and Answer Department conducted by RADIO WORLD for its Readers by its staff of Experts. Address Letters to The Radio University, RADIO WORLD, 1493 Broadway, New York City.

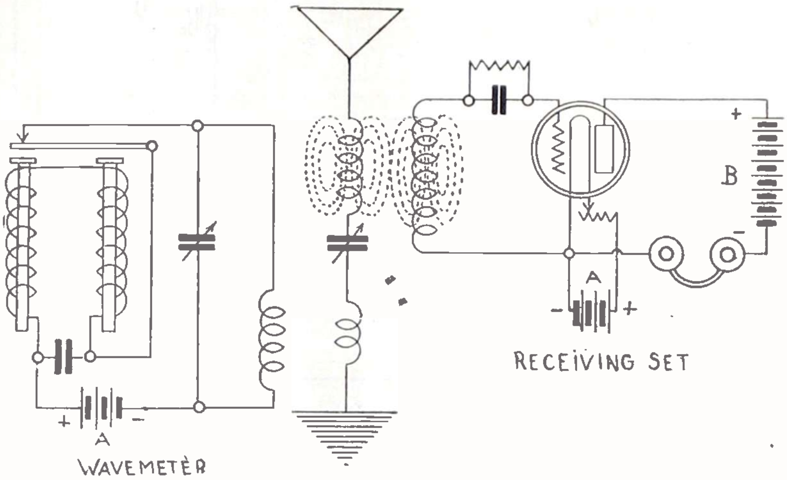


FIG. 179, showing the wavemeter placed in inductive relation to a receiver. The coil in the wavemeter has 50 turns of No. 22 DCC wire wound on a 3" tubing. The condenser used is a .0005 mfd. variable. The condenser which is shunted across the buzzer magnets is a .1 mfd. condenser. The A battery is composed of two batteries connected up in series, giving a total of 4½ volts. The coil in the ground of the receiver is a 3-turn aperiodic coil. For data on calibrating a receiver see June 6 issue of RADIO WORLD.

WOULD YOU please republish the diagram of the wavemeter. Also state the constants.—F. Parsons, South Side, Denver.

See Fig. 179.

* * *

I AM working on a B battery unit of the chemical type. I would like to know the place where I can purchase some tantalum lead. (2) What strength is the acid?—H. Leonard, 413 W. Johnson St., Sedalia, Mo.

(1) The lead may be purchased from Eimer and Amend, 18th St. and 3rd Ave., N. Y. City. (2) The strength of the acid is dependent upon the type of lead that is purchased. When you purchase the lead, ask the clerk to find out what strength of acid is required for that particular piece of lead that you get. The strength for the various pieces of lead is different.

* * *

I WOULD like to build The Diamond. I have two .00035 mfd. and one .0005 mfd. condensers. (1) Can they be employed in the set? (2) If they can, what are the number of turns on the coils?—W. Weigel, 134 E. College Ave., York, Pa.

(1) Use the .00035 mfd. condenser for tuning the secondary of the first RFT. The number of turns are: primary, 10 turns on a 3½" diameter tubing, 4" high, using No. 22 SCC wire; secondary, 52 turns, on the same tubing and with same kind of wire. Use the .0005 mfd. condenser to tune the secondary of the three-circuit tuner. The primary has 14 turns, wound on a 3½" tubing with No. 22 DCC wire; secondary has 45 turns wound on the same tubing with the same kind of wire as for the primary. The tickler is wound on a tubing 2½" in diameter, 2" high and contains 38 turns of No. 22 DCC wire. There is no use for the other condenser.

* * *

WHICH WOULD give the best results in the RF and the AF stages, the fixed resistances or the rheostats? (2) What effect is there when there are not enough turns on the primary or too many turns? (3) Could I wire up a set for a friend without infringing any patents?—G. V. McCray, 305 W. Bendall St., Knox, Ind.

(1) The results would be about the same. (2) There is less coupling had when there are less turns on the primary of the coils, while if there are more turns on the primary the coupling will be much greater (more interchange of energy between the coils, sometimes too much). (3) Yes.

* * *

I HAVE just completed The Diamond of the Air and am having a great deal of trouble controlling the oscillations. The grid connection of the detector tube is in line with the primary of the tuning coil and is only about ½" in back of it. Do you consider that the grid connection, being so close to the primary, responsible for the trouble.—O. H. Weiss, 8448-85th Avenue, Woodhaven, N. Y.

No. Your antenna is too short. Are the rotors of the variable condensers grounded or run to the low potential side? Reverse the secondary of your RFT. Reverse the tickler leads. Decrease the number of turns on the tickler coil. Decrease the number of resistance of the grid leak. Be sure the coils are not interacting. Tip one of the coils a little. Use less B battery on RF tube.

* * *

IN REFERENCE to the Anti-Radiation Toroid Set, which was published in the July 25 issue of RADIO WORLD, I would like to know if I could use the Erla Toroid coil. The Erla people recommend a .00035 mfd. condenser with their coil, while Capt. O'Rourke recommends a .0005 condenser. Which can I use? (2) What ratio are the AFT used in this set? (3) Do you think that the UV199 tubes will work O. K.?—D. C. Elliott, 409 W. 71st St., Chicago, Ill.

(1) Use the Erla coil with a .00035 condenser. (2) They are of a low ratio (3-to-1). (3) Yes.

* * *

AFTER READING of the splendid results obtained with The Diamond, I am very anxious to build it. I would like to know whether I can use a Transcontinental low-loss 3-circuit tuner successfully. (2) Can I use the primary and secondary of the same tuner as a radio-frequency transformer? (3) Does it make any difference if the primary is wound on the lower end of the coil or the upper?—E. Faltz, 3133 Cottage Ave., Toledo, O.

(1) Yes. (2) Yes, provided you discard the tickler. (3) No.

* * *

WOULD I be able to receive New York City on a crystal set? I am 152 miles from N. Y. (2) I have a 2-tube regenerative set and am having trouble with it because it squeals when I move near it.—Clarence R. Collins, Box 56, Mapleville, R. I.

(1) No. (2) Decrease the plate voltage on detector tube, ground the rotor of the variable condenser; decrease the number of turns on plate coil; increase the length of the antenna; reverse secondary windings; reverse connections to tuning condenser.

* * *

PLEASE GIVE information to make a .0005 mfd. double variable condenser. Would insulating half of the stator be alright?—Victor Brouillette, 63 Orleans St., Lowell, Mass.

It is too difficult a proposition for the layman to tackle.

* * *

I HAVE read in the July 18 issue of RADIO WORLD, dope on the 3-Tube Marconi Receiver. Would I be safe in building the set using parts such as the following: National DX Condenser with Velvet Vernier dials; Bretwood Variable Grid Leak; Cico or Yaxley Jacks; Marshall-stats for the Vernier Rheostat, and Celatsite-busbar? (2) Can I use the Rauland-

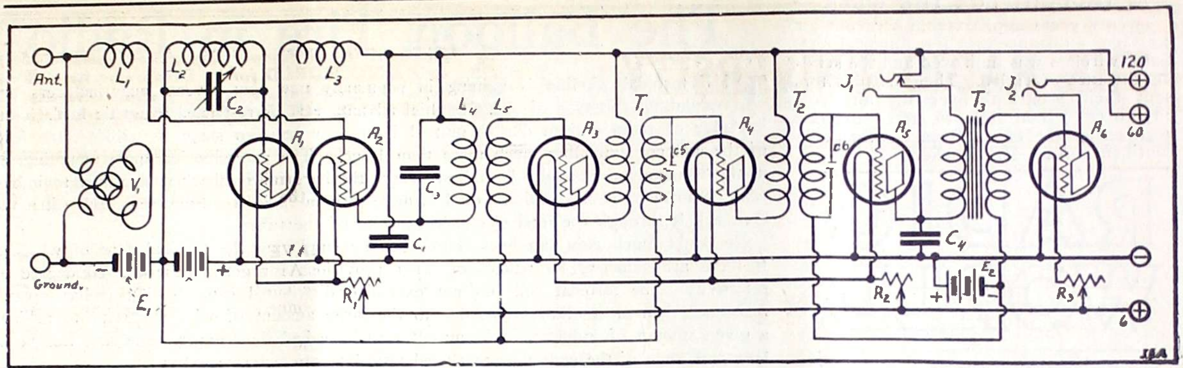


FIG. 180, showing the 6-Tube Super-Heterodyne, employing a variometer for wavelength control, and a .0005 mfd. variable condenser as an oscillator control L2, the grid coil and oscillating inductance, consists of 45 turns of No. 24 double cotton covered wire wound on a bakelite tubing, 3½" in diameter, 4" high. The tickler coil, L3, consists of 40 turns of the same kind of wire and wound on the same tubing. L1 is a coupling coil consisting of 7 turns, wound on the same tubing. The order of winding is the same as in the diagram, from left to right. L4, L5 and C3 constitute the intermediate frequency filter, which is tuned to about 50,000 cycles. L4 consists of 222 turns of No. 28 DCC wire wound on a spool 1" long and 2" in diameter. L5 consists of 1,100 turns of No. 36 double cotton covered wire wound over the primary L4. A thin layer of paper separates the two windings. C3 has a capacity of .004 mfd. T1 and T2 are both commercial intermediate frequency transformers. They should be the same in design and construction. C5 and C6 are both .0001 mfd. fixed condensers. T3 is the audio-frequency transformer. R1, R2, when using UV201A tubes should have a resistance of 10 ohms. R3 is a rheostat having a resistance of 20 ohms. C4 is a .001 mfd. condenser. E1 and E2 are both 4½-volt C batteries.

Lyric R-500 type as AFT? (3) What do you mean by the following: "No holding material of any type whatsoever should be used on these coils." (4) Can you supply me with a blue-print and assembly drawings for this set? (5) In the RADIO WORLD, May 9th, there is a Wiring Diagram, for the Marconi Direction Finder (page 15) that interests me very much. Seems to me that this could be used as a loop. (6) Where can I procure the Genuine Sangamo Kits, blue-prints, diagrams for the Pressley Super-Heterodyne?—Ray Swarr, 303 Bartlett Bldg., Los Angeles, Cal., care M. M. Gordon.

(1) Yes. (2) Yes. (3) No collodion or shellac. (4) No. (6) Rossiter, Tyler & McDonell, 136 Liberty St., New York City.

* * *

I HAVE built the Great 4-Tube DX Set, designed by Capt. P. V. O'Rourke, in the March 21st issue of RADIO WORLD. I get wonderful results, i. e., distance and volume up to about 450 meters. The higher wavelength stations are barely audible. (2) Are 112 volts too much for Acme audio transformers?—W. F. Blackman, 470 London St., San Francisco, Cal.

(1) Put a .001 mfd. fixed mica condenser in series with the antenna or lengthen the aerial. (2) No.

* * *

I AM building The Diamond, using two .001 variable condensers. I want to use tubing 1¾" in diameter and have all coils wound with same size silk covered wire. (1) What size should be used. (2) How long should the tubes be?—A. S. Huffins, Gibsonville, O.

(1) Use No. 26 SCC wire. The tubing should be 10" in length. The primary (first RFT) has 15 turns, the secondary has 50 turns. The tickler is wound on a form 1" in diameter and 1" long. It contains 40 turns and is wound in the following fashion: Fill up the form with all the windings that you can jam on and continue winding, and make another layer (on top of one just wound) until the total number of turns are had.

* * *

IN THE description of the Metropolitan Local Sets in the Aug. 1 issue of RADIO WORLD, you spoke of using a new crystal Carborundum. Will you please advise me where I can get this crystal?—Hervey Kuhl, 191 Main St., Flemington, N. J.

Write to the Carborundum Company, Niagara Falls, N. Y.

* * *

I HAVE a Superdyne. I added one more audio stage. It is some set. The only thing that bothers me is the local station, KPRC, which is about eight blocks away. The only way that I can tune them out is by disconnecting both aerial and ground and use the bed springs.

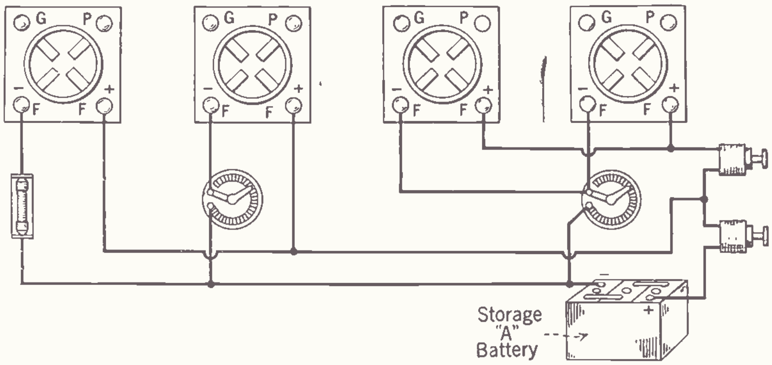


FIG. 181, showing a picture diagram of how to do the filament wiring of a 4-tube set as specified by Mr. Uisies. The two tubes at the right are the AF amplifiers, the next is the detector, and the last tube is the RF amplifier. There is a switch to turn off the two AF amplifiers, and a switch to turn off the detector tube as well as the RF tube at the same time.

By doing this I can get good DX with fair volume on horn, but KPRC interferes a little even then. (1) Can I expect to get good results (DX and volume) by using a loop? (2) Just how many turns should be on the loop and how should I connect the loop on the set to get the best results?—G. T. Ross, Houston, Tex.

No, not on the Superdyne with regenerated RF stage. (1) Make a short indoor antenna.

* * *

PLEASE GIVE me a picture diagram of how to wire the filaments in a 4-tube set, using a rheostat for the detector, a rheostat for both amplifier tubes, and an Amperite for the radio-frequency amplifier.—U. Uisies, Paldamora, Greece.

See Fig. 181.

WHAT IS the best wire to use in wiring The Diamond of the Air? (2) Where can I purchase the Bruno 55 RF coil in Philadelphia?—Irving Bancroft, 219 Dudley Ave., Narberth, Pa.

(1) Use No. 18 bell wire. (2) Write to the Bruno Radio Company, 222 Fulton St., N. Y. C., and they will give you the information necessary.

* * *

WILL YOU please give me a diagram of a 6-Tube Super-Heterodyne, using a variometer as the control for wavelength?—C. P. Polman, Big Bend, Tex.

See Fig. 180.

* * *

I HAVE three variometers at home

(*Concluded on page 26*)

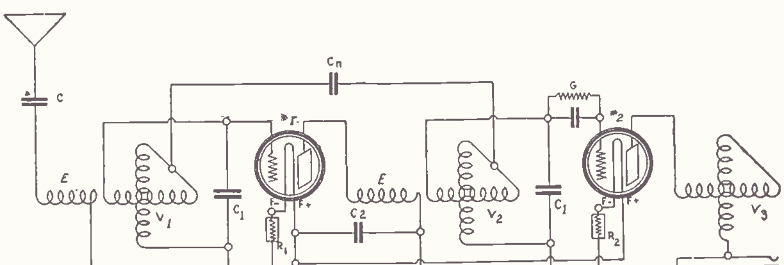


FIG. 183, showing a diagram of a 2-tube receiver, employing three variometers, V1, V2 and V3. E, in both cases is a 14-turn coil, wound on tubing 3½" in diameter, 4" high. C1 is a .0005 mfd. fixed condenser. C2 is a .01 mfd. fixed condenser. C3 is a .001 mfd. fixed condenser. R1, R2 are both Amperites, the type used being dependent upon the type of tube used. C is a .0005 mfd. condenser. This is inserted for the purpose of listening to waves shorter than the fundamental of the antenna can respond to. The grid leak has a resistance of 2 megohms. The grid condenser has a capacity of .00025 mfd. Use UV201A tubes. Cn is the neutralizing condenser, which is variable. This is connected from mid-tap of V1 to mid-tap of V2, (the mid-tap is where the rotor joins the stator).

A THOUGHT FOR THE WEEK

Twenty years ago Marconi sent out air messages a distance of a few hundred feet. Later wireless was improved and the sending distance extended. Then broadcasters sent their programs over the air from city to city; then state to state—and last year across the ocean from Continent to continent. And Mars—when?

RADIO WORLD

Radio World's Slogan: "A radio set for every home."

TELEPHONES: LACKAWANNA 6976 and 2063
PUBLISHED EVERY WEDNESDAY
(Dated Saturday of same week)
FROM PUBLICATION OFFICE
HENNESSY RADIO PUBLICATIONS CORPORATION
ROLAND BURKE HENNESSY, President
M. B. HENNESSY, Vice-President
FRED S. CLARK, Secretary and Manager
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EDITOR, Roland Burke Hennessy
MANAGING EDITOR, Herman Bernard

SUBSCRIPTION RATES

Fifteen cents a copy. $6.00 a year. $3.00 for six months. $1.50 for three months. Add $1.00 a year extra for foreign postage. Canada, 50 cents.

Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address also. State whether subscription is new or a renewal.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11" 462 lines.................$300.00
½ Page, 7¼"x5½" 231 lines................. 150.00
¼ Page, 4½" D. C. 115 lines................. 75.00
1 Column, 2¼"x11" 154 lines................. 100.00
1 Inch 10.00
Per Agate line................................. .75

Times Discount

52 consecutive issues................................ 20%
26 times consecutively or E. O. W. one year...... 15%
4 consecutive issues................................ 10%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum, 10 words. Cash with order. Business Opportunities, 50 cents a line; minimum, $1.00.

Entered as second-class matter, March 28, 1922, at the Post Office at New York, N. Y., under the act of March 3, 1879.

AUGUST 15, 1925

Some Sentiment Left

Arctic's Short-Wave Tests Soon to Be Renewed

Soon the Canadian Government Steamship Arctic will set out from Quebec for the Far North to complete a series of short-wave experimental tests inaugurated last summer between the Arctic and the Canadian members of the American Radio League. Last year successful communication was conducted on wavelengths of 80 and 125 meters while the plan for this Summer contemplates the use of 20, 40 and 80 meters.

The Balloon Tire in Radio

THE toroidal winding is gaining in popularity now that several manufacturers are exploiting this type of coil. Its chief advantage is its restricted magnetic field. Thus interplay of radio current due to mutual inductance between stages is avoided, the field of the coil not extending much more than 1 inch. The necessity for angle mounting, as in the Neutrodyne, is avoided. Indeed, where the harmful feedback is due only to induction, no form of neutralization would be necessary in radio-frequency sets. But often the feedback is through the inter-electrode capacity of the tubes.

No doubt much gain can be accomplished by employing the toroidal type of winding, if there are sufficient RF stages or other provisions for getting the desired degree of selectivity. The toroidal coil has not excessive distributed capacity, but it has greater resistance than most other types, due to the large amount of wire necessary to achieve a given amount of inductance. Manufacturers have had their experts studying this problem, and some of the coils now marketed afford a satisfactory solution.

Aside from radio considerations, however, the toroidal coil owes some of its growth of popularity to the prevalent demand in the automobile field, where balloon tires are all the go. All psychologists who have studied the mind of the body politic have noticed how thought trains sweep from one field of endeavor to another, a preference established in one branch of work being applied to the nearest thing akin to it in the other. In radio the toroidal coil is the only balloon-shaped thing found of valuable use. Hence one may look forward to thousands and thousands of sets equipped with balloon tires—er, that is, toroidal coils!

What Inspired the Hon. Sol

THE HON. SOL BLOOM does not indulge in the purest brand of ingenuousness when he declares his belief in the necessity for taxing private receiving sets and equipment, nor is he altogether convincing when he states that he will try to promote legislation in Washington imposing such a tax.

It is well to note in this connection that the Hon. Sol, who represents a New York district in the lower hall of Congress, was formerly interested—and very successfully, too—in the publishing of music and later in the selling of phonographs. There, of course, is the catch. The Hon. Sol still has a sentimental interest in the business that made him independent, gave him leisure for law-making and the opportunity to shine frequently, if not always effectively, as a Demosthenes.

RADIO WORLD in its August 8 issue contained a news article to the effect that the Hon. Sol had constituted himself an Horatius, and declared with oratorical effect that the broadcasters shall not pass. He has, of course, noticed with deep concern that the music business of the country, especially the sheet music branch, seems to have gone to the dogs. He blames all this on radio, forgetting for the moment that if there were more songs like "Katherina" and fewer like "Won't You Be My Woozy-Toozy on a Rainy Night in June," there might be a different tale to tell when the royalty statements are handed out.

Radio will help the sale of a good song. Nothing will help the sale of a bad song. That is our story, and we shall not change it in face of all the most fervid oratorical tirades that the Hon. Sol. may emit.

List of Short-Wave Stations

THE following short-wave length list has been compiled by the American Radio Relay League for the benefit of radio fans using low-wave receivers:

Meters	Call	Location
20.0	POX	Nauen, Germany
25.0	2YT	Poldhu, England
25.0	AGF	Nauen, Germany
26.0	AGA	Nauen, Germany
30.0	2XI	Schenectady
32.0	2YT	Poldhu, England
35.0	2XI	Schenectady
36.0	LPZ	Buenos Aires
38.0	2XI	Schenectady
40.0	1XAO	Belfast, Ireland
43.0	WIX	New Brunswick, N. J.
47.0	POZ	Nauen, Germany
50.0	NKF	Anacostia, D. C.
56.0	KFKX	Hastings, Neb.
59.8	KDKA	Pittsburgh, Pa.
60.0	1XAO	Belfast, Ireland
60.0	2YT	Poldhu, England
62.0	KDKA	Pittsburgh, Pa.
67.0	8XS	Pittsburgh, Pa.
70.0	POX	Nauen, Germany
71.5	NKF	Anacostia, D. C.
74.0	WIR	New Brunswick, N. J.
75.0	SFR	Paris, France

Meters	Call	Location
75.0	WQM	Rocky Point, L. I.
76.0	POX	Nauen, Germany
83.0	RDW	Moscow, Russia
84.0	NKF	Anacostia, D. C.
85.0	SFR	Paris, France
85.0	8GB	Kahuku, T. H.
86.0	NQC	Belfast, Ireland
90.0	6XO	Poldhu, England
90.0	1XAO	Paris, France
92.0	2YT	San Diego, Cal.
94.0	2YT	Poldhu, England
95.0	SFR	Paris, France
96.0	8XS	Pittsburgh, Pa.
99.0	6XI	Bolinas, Cal.
100.0	POX	Nauen, Germany
100.0	2XI	Schenectady
100.0	NAM	Norfolk, Va.
103.0	WGH	Tuckerton, N. J.
107.0	2XI	Schenectady
112.0	IXAO	Belfast, Ireland
115.0	FL	Paris, France
120.0	IXAO	Belfast, Ireland
146.0	6XO	Kahuku, T. H.

5 Stations Licensed; 26 Resign

Five new Class A broadcasting stations were licensed by the Department of Commerce, while one station was transferred from Class C to A.

NEW CLASS A STATIONS

Station Owner	Key	Meters	Watts
WIBW—Dr. L. L. Dill, Logansport, Ind....	1,360	220	100
WIBX—Grid - Leak, Inc., Utica, N. Y.........	1,460	205.4	5
WRMU—A. H. Grebe & Co., Inc., Motor Yacht Mu-1, New York, N. Y.	1,270	236	100
WCSH—Henry P. Rines, Portland, Maine....	1,170	256	500
KFWP—Rio Grande Radio Supply House, Brownsville, Texas	1,400	214.2	10
The transfer follows:			
WMAF—Round Hills Radio Corp., Dartmouth, Mass.	680	440.9	1,000

STATIONS DELETED

Twenty-six class A broadcasting stations were deleted:

WMAV—Alabama Polytechnic Institute, Auburn, Ala.
KFER—Auto Electric Service Co., Fort Dodge, Ia.
WHBX—J. B. Bowser, 206 Greenwood Ave., Punzsutawney, Pa.
WDM—Church of the Covenant, Washington, D. C.
WRR—City of Dallas, Police & Fire Signal Dept., Dallas, Tex.
WFBK—Dartmouth College, Wilder Laboratory, Hanover, N. H.
KFQR—Walter LaFayette Ellis, Oklahoma, Okla.
WGBH—Fall River Herald Publishing Co., Portable Station, New England States.
KFVJ—First Baptist Church, San Jose, Cal.
KFOC—First Christian Church, Whittier, Cal.
KFPV—Heintz & Kohlmoos, Inc., San Francisco, Cal.
WBBV—Johnstown Radio Co., Johnstown, Pa.
WIAK—Journal Stockman Co., Omaha, Neb.
WPAZ—John R. Koch, Charlestown, West Va.
WHBS—Edward Wm. Locke, Mechanicsburg, O.
WWAO—Michigan College of Mines, Houghton, Mich.
WIBF—S. P. Miller Dance Activities, Wheatland, Wis.
WCAY—The Milwaukee Civic Broadcasting Assn., Inc., Milwaukee, Wis.
KFOJ—Moberly High School Radio Club, Moberly, Mo.
WQAS—Prince Walter Company, Lowell, Mass.
KFRH—The Radio Shop, Grafton, N. D.
WCAG—Clyde R. Randall, New Orleans, La.
WRAA—The Rice Institute, Houston, Texas.
WFBY—Signal Officer, 5th Corps Area, Ft. Benjamin Harrison.
WCM—Texas Markets & Warehouse Dept., Univ. of Texas, Austin, Tex.
WHBO—Y. M. C. A., Pawtucket, R. I.

WNYC INJUNCTION DENIED

Supreme Court Justice Churchill, in New York City, refused to order WNYC shut down or censored for sending out political propaganda boosting the administration of Mayor Hylan. He held that it was impractical for a court to keep constant watch on the matter broadcast. He said it was up to the city officials to exercise good taste. The suit for an injunction was brought on behalf of the Citizens Union.

ROXY WINS CONTEST AS THE MOST POPULAR

Roxy won the Popularity Contest conducted by RADIO WORLD, in which readers balloted for the most popular radio entertainer. He received 17,482 votes. Ben Bernie and Orchestra finished second with 13,312, or 4,170 votes behind. Karl Bonawitz occupied third place, with 12,148 while the Happiness Boys were fourth with 10,882.

The victory for Roxy was, therefore, overwhelming and left no doubt such as a close finish might produce. Roxy was in a favorable position from the very start. For a few weeks Ben Bernie and Orchestra led, but Roxy soon snatched first place and held it continuously until the end, meanwhile widening the breach of votes between himself and Bernie's outfit.

His victory gains Roxy, besides the coveted title, an inscribed gold medal attesting to his well-earned honor. As he is now in Europe this medal will be presented to him on his return. He was informed by radiogram of his victory.

Roxy was announcer of the Capitol Theatre programs, WEAF, during the contest, but has resigned since. He will manage the Roxy Theatre, now building, and be connected with a syndicate movie proposition. Bonawitz was with WIP during the contest, but since transferred his activities to Atlantic City.

THE FINAL TALLY

S. A. Rothafel (Roxy)...........	17,482
Ben Bernie and Orchestra, WEAF	13,312
Karl Bonawitz....................	12,148
Others scattering.	

O'Rourke's Audio-Amplifier

(Concluded from page 5)

to one side of the panel-mounted rheostat, and the other side of the rheostat to the A minus post of the amplifier unit, which in turn is connected to all the F minus posts on the amplifier sockets.

The construction is very simple and the net result is not only an amplifier neat in appearance but very delightful in operation. The use of the transformer in the first stage brings up the volume to the desired point beyond the amplification valve of the tube itself. This is the stage where the transformer should be placed, because it induces high amplification and the succeeding stages magnify this still more (to an extent equal to the Mu or amplifying function of the tubes themselves). The signal should be amplified greatest at the point where it is weakest, when there is a disparity in the amount of amplification as between respective methods, for then the overloading of the last stage is avoided.

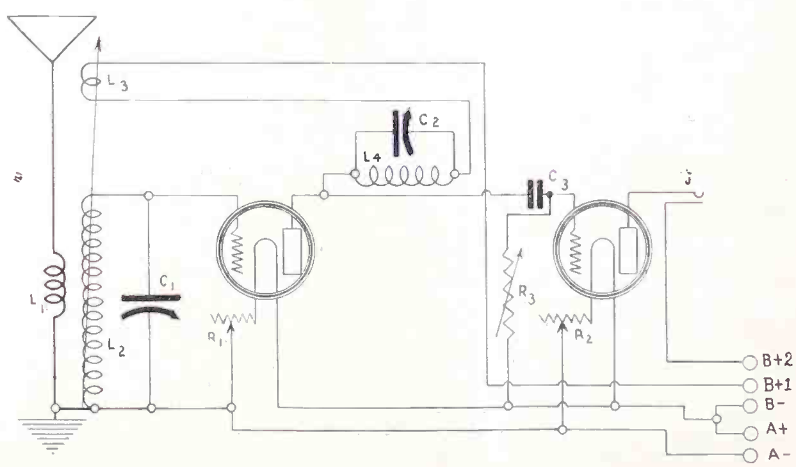
Do not use a transformer that is loud and noisy, for a transformer for the present purpose should afford volume without any intruding "gibberish." Succeeding stages of resistance amplification will not overcome noise originally introduced by a poor transformer in the first stage. A moderate ratio transformer, say 3-to-1, will do very nicely, but higher ratios are all right.

Speech will be more clearly audible than in most transformer hook-ups, so that not only quality is assured, but also distinctness. The muffled voice should be entirely absent.

One may have a set that uses a crystal as detector, instead of a tube. Ordinarily not enough volume will be obtained from two stages of transformer-coupled AF after a simple crystal detector. Of course not enough will be produced by the Fig. 1 hook-up, either. It is assumed that sets using a crystal detector have radio-frequency amplification ahead of the rectifier, even if only one stage. The crystal output is connected to the primary posts (input) of the AFT, the P and B posts.

The volume from the hookup shown in Fig. 1 is about equal to that from two transformer stages. The B battery voltage may have to be higher to accomplish this, but the net drain in milliamperes is no greater, hence the higher voltage need not necessarily entail any extra upkeep cost. You will decide that even greater cost would be justified, when measured in terms of the sweet results achieved.

Capacity for Interstage Coupling



CAPACITY COUPLING between RF and detector stage. C3 is the grid condenser, likewise the capacity coupler. L1L2L3 is a 3-circuit tuning coil, the secondary, L2, tuned by C1, usually a .0005 mfd. variable condenser. L4 has 35 turns of No. 22 SCC wire on a 3½" diameter tubing. C2 is .0005 mfd.

MR. DX HOUND

A Character Created by Radio World Artist

By HAL SINCLAIR

THE RADIO TRADE

SLF Dials For Round-Plate Condensers About to Appear

By Samuel Lager

Bruno Radio Corporation

THE competitive field in condenser manufacture is fiercely fought. The battle of 1926 probably will be waged about a focal point of straight-line frequency.

SAMUEL LAGER

The problem, as it appears at present, is:

(1) Will straight-line frequency condensers supplant straight-line capacity condensers?

(2) Will some other means than shaping the plates of condensers be applied, so that the advantages of the SLF condenser will be accessible to possessors of the other type?

Naturally, the set manufacturer, no less than the radio public and the condenser manufacturer, is watching events with keen interest. That something must be done to "uncrowd" the lower end of the dial is accepted as a fact by both the SLF condenser manufacturers and those who make SLC condensers, or the compromise between these two types, represented by the straight-line wavelength instrument.

The straight-line had a tantalizing curve in many SLF models, hence the instrument was not what it pretended to be. Some manufacturers have produced a condenser that, except at the extreme lower end of the readings, is decidedly straight-line. Good for them.

Manufacturers of other types of condensers may be worrying about their product. Shall they face about? This is very costly. Also it is risky. Some who undertake the risk may fare handsomely.

The SLF condensers represent one way of uncrowding the lower end of the dial. A straight-line frequency dial, however, is another method, this being used on the regular round plate condensers (straight-line capacity). The dial would have to introduce slow motion at the lower end and more rapid motion at the upper end. That this will be an early achievement in the radio field is a foregone conclusion, since the advisability is strong and the device introduces no insoluble mechanical problems. The shaping of condenser plates is a good solution for SLF, but why is not the shaping of mechanical plates in a dial just as good, since the end to be achieved is exactly the same, though one is electrical and the other mechanical?

RADIO MOVIES BY 1935, ATWATER KENT PREDICTS

Broadcasting of motion pictures will be the next outstanding advance in the field of wireless communication, said Atwater Kent, of Philadelphia, a member of Secretary Hoover's Committee on Broadcasting. He added:

"Recent success in radio vision experiments indicate that by 1935, and perhaps even sooner, we can sit at home and watch the playing of a championship baseball series, projected on a radio picture screen, besides hearing the umpire's voice and the crowd's cheers."

Coming Events

AUG. 18 to 21—3d National Convention, American Radio Relay League, Edgewater Beach Hotel, Chicago.

AUG. 22 to 29—3d Annual Pacific Radio Exposition, Civic Auditorium, San Francisco. Write P. R. E., 905 Mission St., San Francisco.

AUG. 23 to SEPT. 6—Canadian National Expos., Exposition Coliseum, Toronto, Can.

SEPT. 5 to 12—Third annual National Radio Exposition, Ambassador Auditorium, Los Angeles, Cal. Address Waldo K. Tupper.

SEPT. 9 to 20—International Wireless Exposition, Geneva, Switzerland.

SEPT. 12 to 19—Fourth Annual National Radio Exposition, Grand Central Palace, N. Y. C. Write American Radio Exp. Co., 522 Fifth Ave., N. Y. C.

SEPT. 14 to 19—Second Radio World's Fair, 258th Field Artillery Armory, Kingsbridge Road and Jerome Ave., N. Y. C. Write Radio World's Fair, Times Bldg., N. Y. C.

SEPT. 14 to 19—Pittsburgh Radio Show, Motor Square Garden. Write J. A. Simpson, 420 Bessemer Bldg., Pittsburgh, Pa.

SEPT. 14 to 19—Radio Show, Winnipeg, Can., Canadian Expos. Co.

SEPT. 21 to 26—First Annual Radio Expos., Broadcast Listeners' Association, Cadle Tabernacle, Indianapolis, Ind. Write Claude S. Wallin, Hotel Severin.

SEPT. 21 to 29—International Radio Exposition, Steel Pier, Atlantic City, N. J.

SEPT. 28 to OCT. 3—National Radio Exposition, American Exp. Palace, Chicago. Write N. R. E., 440 S. Dearborn St., Chicago, Ill.

SEPT. 28 to OCT. 3—Midwest Radio Week.

OCT. 3 to 10—Radio Exposition, Arena, 46th and Market Streets, Philadelphia, Pa., G. B. Bodenhof, manager, auspices Philadelphia Public Ledger.

OCT. 5 to 10—Second Annual Northwest Radio Exposition, Auditorium, St. Paul, Minn. Write 515 Tribune Annex.

OCT. 5 to 11—Second Annual Radio Show, Convention Hall, Washington, D. C. Write Radio Merchants' Association, 233 Woodward Bldg.

OCT. 10 to 16—National Radio Show, City Auditorium, Denver, Colo.

OCT. 12 to 17—Boston Radio Show, Mechanics' Hall. Write to B. R. S., 209 Massachusetts Ave., Boston, Mass.

OCT. 12 to 17—St. Louis Radio Show, Coliseum. Write Thos. P. Convey, manager, 737 Frisco Bldg., St. Louis, Mo.

OCT. 12 to 17—Radio Show, Montreal, Can., Canadian Expos. Co.

OCT. 17 to 24—Brooklyn Radio Show, 23d Regt. Armory. Write Jos. O'Malley, 1157 Atlantic Ave., Brooklyn, N. Y.

OCT. 19 to 25—Second Annual Cincinnati Radio Exposition, Music Hall. Write to G. B. Bodenhof, care Cincinnati Enquirer.

NOV. 2 to 7—Radio Show, Toronto, Can., Canadian Expos. Co.

NOV. 3 to 8—Radio Trade Association Exposition, Arena Gardens, Detroit. Write Robt. J. Kirschner, chairman.

NOV. 19 to 25—Milwaukee Radio Exp., Civic Auditorium. Write Sidney Neu, of J. Andrae & Sons, Milwaukee, Wis.

NOV. 17 to 22—4th Annual Chicago Radio Exp., Coliseum. Write Herrmann & Kerr, Cort Theatre Bldg., Chicago, Ill.

NEW CORPORATIONS

Carillion Radio Co., Essex, N. Y., $5,000; P. H. and E. D. Boyle, B. M. Dillion. (Atty., F. W. Dudley, Port Henry, N. Y.)

Francfort-Buer Corp., Yonkers, N. Y., radio cabinets, etc., $5,000; H. Francfort, J. A. Buer. (Atty., B. E. Reardon, Yonkers).

Q. R. V. Radio Service, N. Y. City, 200 common, no par; H. Kamke, J. F. B. Meachim, J. S. Dunham. (Atty., R. M. Field, 346 Broadway, N. Y. City).

CAPITAL INCREASES

Richardson Radio, N. Y. City, 2,000 to 5,000 shares, no par.

Marwol Radio Corp., N. Y. City, $10,000 to $1,000,000.

Radio Electric Clock Corp., New York, $1,000,000 to $10,000,000.

Daven Expands; Executives Appointed

W. H. Frasse, president of the Daven Radio Corp., announces the appointment of K. R. Moses as sales manager. Mr. Moses was previously sales promotion manager of Crosley Radio Corp. and sales manager of the Amberola Division of the Thomas A. Edison, Inc. Mr. Moses has had twelve years of phonograph and radio experience.

W. A. Balevre has been appointed advertising and sales promotion manager. Mr. Balevre has been connected with the Daven Radio Corp. for eighteen months and before that was with the Adams Morgan Co., manufacturers of the Paragon receivers. Mr. Balevre is thoroughly conversant with the needs of Daven distributors and dealers in the way of advertising and sales promotion. Many new plans are being inaugurated. C. B. L. Townley, formerly of the International General Electric Co., has been appointed purchasing agent. M. D. Runyon, formerly prominently identified with the electrical appliance business, has been appointed special representative and will represent the Daven Corp. among the manufacturers of complete sets. He will make his headquarters at the home office, 158 Summit street, Newark, N. J.

The Sales Department has established an office at 332 South Michigan avenue, Chicago, and G. D. Harris has been placed in charge.

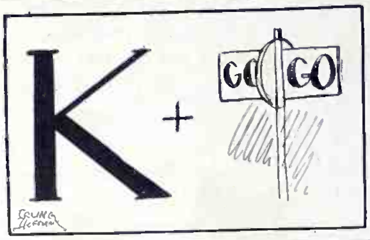
A sales office has also been established at 209 Baltimore Building, Kansas City, Mo. Fred Garner, A. M. I. R. E., will be in charge.

F. D. Rankins has been appointed New England sales representative with offices at 1018 New Chamber of Commerce Building, Boston, Mass. R. A. Sayres has been appointed sales representative to cover the metropolitan district of New York City. Mr. Sayres was formerly connected with the A. H. Grebe Co.

WOMAN WINS THE PRIZE IN RADIO PLAY CONTEST

A comedy, "Sue 'Em!," by Nancy Brosius of Cleveland, was selected by the judges of the WGBS Radio Drama Contest as the best play submitted for radio production. Miss Brosius receives $75 cash as advance royalties from WGBS, WGY and WIP, each of these stations planning to produce the winning play over the air soon. At WGBS it will be acted by the Providencetown Players. Brentano's will issue the comedy in ceive the regular author's royalties from the sale of the book. She will also receive royalties on each subsequent production of the piece, whether on the air or by dramatic organizations.

The Weekly Rebus



JOIN THE A. B. C.

A. B. C. stands for American Broadcast Club, an organization of fans banded together to promote the welfare of radio. There are no dues, no obligations. Address A. B. C. Editor, RADIO WORLD, 1493 Broadway, New York City.

William Welch, 6518 Greenwood St., Chicago, Ill.
S. H. Fox, Blackie, Alberta, Canada.
P. Lester Cressy, 503 N. 2nd St., Catauissa, Pa.
Emil H. Schulz, 3243 Wilton Ave., Chicago, Ill.
P. V. Williams, 242 Miramar Ave., San Francisco, Cal.
A. H. Thomas, 75 Park Ave., Glen Ridge, N. J.
John Scott, 497 Zanesville Ave., Logan, O.
Landon Dennison, 233 South Main St., Keyser, W. Va.
Chas. H. Malchom, Jr., East 16th St. and Cortelyou Road, Brooklyn, N. Y.
Howard Melson, P. O. Box 21, Wendling, Ore.
Paul Higinbotham, Red Lake Falls, Minn.
S. S. Richardson, 604 King St., London, Ontario, Canada.
Thomas Penyoun, 3840 Mayfield Road, Cleveland Heights, O.
Walter Wetzel, 1122 Versailles Ave., Alameda, Cal.
Max Tarlow, 23 South Virginia Ave., Cranford, N. J.

REFLEX NEEDS WORK

No reflex need be expected to work perfectly the moment of completion. Constructors should be prepared to put in a little extra work after that. Once the set is "right" it will give good satisfaction—your money's worth on the tubes, for a certainty!

Literature Wanted

THE names of readers of RADIO WORLD who desire literature from radio jobbers and dealers are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.
Trade Service Editor,
RADIO WORLD,
1493 Broadway, New York City.

I desire to receive radio literature.

Name ....
City or town ....
State ....
Are you a dealer? ....
If not who is your dealer?
His Name ....
His Address ....

E. J. Guerne, 2104 Cleveland Ave., New Orleans, La.
Herbert McDonald, 3900 3rd Ave., Des Moines, Ia.
W. I. Bartlett, Atlanta, Me. (Dealer).
A. Cooke, 1304 Pacific St., Brooklyn, N. Y.
F. Runquist, 4323 Manchester Ave., St. Louis, Mo. (Dealer).
Stanley Morse, Waterbury, Vt.
Chas. U. Boyle, 2712 Urquhart St., New Orleans, La.
A. R. Birchard, East Shoreham, Vt.
H. E. Ampacker, Lewistown, Pa.
E. Northdurft, Mt. Olive, Ill.
H. Leath, Paris, Ill.
R. K. Shopner, 2 Friend St. Place, Lynn, Mass.

A. B. C. Editor, RADIO WORLD,
1493 Broadway, New York City.
Please enroll me as a member of the American Broadcast Club.
Name ....
Address ....
City or Town ....
State ....

"THE SMOKESTACK PORTABLE," by Neal Fitzalan, in June 6, 1925 issue. Other features are: "A" and "B" Battery Eliminator, by P. E. Edelman; How to Make a Wavemeter, by Lewis Winner; Official List of Broadcasting Stations; Resistance AF in a RF Set That Gets DX on 2 Controls, by Capt. P. V. O'Rourke, etc., 15c a copy, or start your subscription with that number. RADIO WORLD, 1493 Broadway, New York.

THE OFFICIAL LIST OF STATIONS in the United States, Canada, Cuba, etc., with list of station slogans, was published in June 6 issue. Send 15c for copy to RADIO WORLD, 1493 Broadway, New York City.

WILLIAM JENNINGS BRYAN is remembered for his "Cross of Gold" speech and his Scopes trial activities, among the outstanding things of his life. On the verge of death his oratory rang out through the nation. He is seated behind the nearer microphone, in shirt sleeves, in the above photo taken at the Scopes trial. (Underwood & Underwood.)

THE KEY TO THE AIR

(*Continued from page 15*)

WEDNESDAY, AUGUST 19

WAAM, Newark, N. J., 263 (ESTDS)—11 AM to 12 M; 7 PM to 11.
WAHG, Richmond Hill, N. Y., 316 (ESTDS)—12 M to 1:05 PM; 8 to 12.
WAMB, Minneapolis, Minn., 243.8 (CST)—12 M to 1 PM; 10 to 12.
WBBM, Chicago, Ill., 226 (CST)—8 PM to 10.
WBZ, Springfield, Mass., 333.1 (ESTDS)—6 PM to 11.
WCAE, Pittsburgh, Pa., 461.3 (ESTDS)—12:30 PM to 1:30; 4:30 to 5:30; 6:30 to 11.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (CST)—9:30 AM to 12 M; 1:30 to 4; 5:30 to 11.
WDAF, Kansas City, Kansas, 365.6 (CST)—3:30 PM to 7; 8 to 9:15; 11:45 to 1 AM.

WEAF, New York City, 492 (ESTDS)—6:45 AM to 7:45; 11 to 12 M; 4 PM to 5; 6 to 12.
WEAO, Ohio State University, 293.9 (EST)—8 PM to 10.
WEAR, Cleveland, O., 390 (EST)—11:30 AM to 12:10 PM; 3:30 to 4:10; 6:45 to 7:45.
WEEI, Boston, Mass., 476 (ESTDS)—6:45 AM to 8; 3 PM to 4; 5:30 to 10.
WEMC, Berrien Spring, Mich., 266 (CST)—8:15 PM to 11.
WFAA, Dallas, Texas, 475.9 (CST)—10:30 AM to 11:30; 12:30 PM to 1.
WFBH, New York City, 270.6 (ESTDS)—2 PM to 7:30; 12 M to 1 AM.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:18; 8 to 10.
WGES, Chicago, Ill., 250 (CSTDS)—5 PM to 7; 10:30 to 1 AM.
WGBS, New York City, 316 (ESTDS)—10 AM to 11 PM; 1:30 to 4; 6 to 7.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 3:30 PM; 5:30 to 11:30.
WGR, Buffalo, N. Y., 319 (ESTDS)—12 M to 12:45 PM; 2:30 to 4:30; 6:30 to 11.
WGY, Schenectady, N. Y., 379.5 (CST)—5:30 PM to 7:30.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:15 PM; 4 to 5; 6 to 7:30; 8 to 10; 11:30 to 12:30 AM.
WHAS, Louisville, Ky., 399.8 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 368 (ESTDS)—2:15 PM to 5:30; 7:30 to 11; 11:30 to 12:30 AM.
WHO, Des Moines, Iowa, 526 (CST)—12:15 PM to 1:30; 6:30 to 12 M.
WHT, Chicago, Ill., 400 CSTDS)—11 AM to 2 PM; 7 to 8:30; 10:30 to 1 AM.
WIP, Philadelphia, Pa., 568 (ESTDS)—7 AM to 8; 10:20 to 11; 1 PM to 2; 3 to 4; 6 to 8.
WJZ, New York City, 455 (ESTDS)—10 AM to 11; 1 PM to 2; 4 to 6; 6 to 11:30.
WKRC, Cincinnati, Ohio, 326 (EST)—8 PM to 10.
WLIT, Philadelphia, Pa., 395 (EST)—12:02 PM to 12:30; 2 to 3; 4:30 to 6; 7:30 to 9.
WLW, Cincinnati, O., 422.3 (EST)—10:45 AM to 12:15 PM; 1:30 to 2:30; 3 to 5; 6 to 11.
WMCA, New York City, 341 (EST)—10:45 AM to 12 M; 6:30 PM to 12.
WNYC, New York City, 526 (ESTDS)—6:30 PM to 11.
WOC, Davenport, Iowa, 484 (CST)—12:57 PM to 2; 3 to 3:30; 4 to 7:05; 9 to 11.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 PM to 4; 6:15 to 12 M.
WPAK, Fargo, N. D., 283 (CST)—7:30 PM to 9.
WOJ, Chicago, Ill., 448 (CST)—11 AM to 12 M; 3 PM to 4; 7 to 8; 10 to 2 AM.
WRC, Washington, D. C., 469 (EST)—1 PM to 2; 4 to 6:30.
WREO, Lansing, Michigan, 285.5 (EST)—10 PM to 11.
WRNY, New York City, 258.5 (ESTDS)—11:59 AM to 2 PM; 7:59 to 9:55.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 2:30 to 3:30; 5 to 6; 10:45 to 12.
WSBF, St. Louis, Mo., 273 (CST)—12 M to 1 PM; 3 to 4; 7:30 to 9.
WWJ, Detroit, Mich., 352.7 (EST)—6 AM to 8:30; 9:30 to 10:30; 11:55 to 1:30 PM; 3 to 4; 6 to 7; 8 to 10.
KDKA, Pittsburgh, Pa., 309 (EST)—6 AM to 7; 9:45 to 12:15 PM; 2:30 to 3:20; 5:30 to 11.
KFAE, State College of Wash., 348.6 (PST)—7:30 PM to 9.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 11.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 5:15 to 6:15; 9:30 to 12:30 AM.
KFMQ, Fayettville, Ark., 299.8 (CST)—7:30 PM to 9.
KFNF, Shenandoah, Iowa, 266 (CST)—12:15 PM to 1:15; 3 to 4; 6:30 to 10.
KFOA, Seattle, Wash., 455 (PST)—12:30 PM to 1:30; 4 to 5:15; 6 to 10.
KGO, Oakland, Cal., 361.2 (PST)—11:30 AM to 1 PM; 1:30 to 2:30; 3 to 6:45.

"HOW TO MAKE—"

The following illustrated constructional articles have appeared in recent issues of RADIO WORLD:

Sept. 6, 1924—A simplified Neutrodyne with Grid-Biased Detector, by J. E. Anderson. A Low-Loss Wave Trap, by Brewster Lee.
Sept. 27—A 1-Tube No Crystal Reflex.
Nov. 15—A Sturdy Low-Loss Coil, by Lieut. P. V. O'Rourke. An Ultra 2-Tube Receiver, by Byrt C. Caldwell.
Dec. 13—The World's Simplest Tube Set, by Lieut. P. V. O'Rourke.
Dec. 20—A 1-Tube DX Wonder, Rich in Tone, by Herman Bernard. An Interchangeable Detector, by Chas. M. White.
Dec. 27—A 2-Tube Variometer Set, by Lieut. P. V. O'Rourke. Gelula's Super Flex.
Jan. 3, 1925—A 3-Tube Portable That Needs No Outdoor Aerial, by Abner J. Gelula.
Jan. 10—A Low-Loss DX Inductance, by Herbert E. Hayden.
Jan. 17—A $25 1-Tube DX Wonder, by Abner J. Gelula.
Jan. 24—A Selective $15 Crystal Set, by Brewster Lee. A Variometer-Tuned Reflex, by Abner J. Gelula. An $18 1-Tube DX Circuit for the Beginner, by Feodor Rofpatkin.
Jan. 31—A Regenerative Neutrodyne for More DX, by Abner J. Gelula. A Transcontinental 2-Tube Set, by H. E. Wright. An Experimental Reflex, by Lieut. P. V. O'Rourke.
Feb. 7—The Bluebird Reflex, by Lieut. P. V. O'Rourke. A $5 Home-Made Loudspeaker, by Herbert E. Hayden.
Feb. 14—A Super-Sensitive Receiver, by Chas. H. M. White. A Honeycomb RFT for DX, by Herbert E. Hayden.
Feb. 21—A 1-Tube Reflex for the Novice, by Feodor Rofpatkin. A Set for Professional Folk, by Lieut. P. V. O'Rourke. A Honeycomb Crystal Receiver, by Raymond B. Wailes.
Feb. 28—A Set That Does the Most Possible, With 6 Tubes, by Thomas W. Benson. Three Resistance Stages of AF on the 3-Circuit Tuner, by Albert Edwin Sonn.
March 7—Storage B Battery, by Herbert E. Hayden. Benson's Super-Heterodyne. Ideal Coils for Best Circuits, by J. E. Anderson.
March 14—The Reflexed 3-Circuit Tuner That You Can Log, by Herman Bernard. The Right Way to Put Coils and Condensers in a Set, By Byrt C. Caldwell.
March 21—A Variable Leak, by Herbert E. Hayden. A 4-Tube, 3-Control Set That Gets the Most DX, by Lieut. P. V. O'Rourke.
March 28—The Improved DX Dandy Set, by Herbert E. Hayden. A 3-Tube Reflex for the Novice, by Feodor Rofpatkin.
April 18—The Diamond of the Air (Part 3), by Herman Bernard. The 7-Tube Pressley Super-Heterodyne (Part 1), by Thomas W. Benson. An Easy D Coil, by Jack Norwood.
April 25—A 3-Tube, 2-Control DX Reflex, by Brewster Lee. Trouble Shooting Article on Diamond of the Air, by Herman Bernard. Wiring the Pressley Set (Part 2), by Thomas W. Benson.
May 2—The Twinplex, by J. E. Anderson.
May 9—A Set to Cut Static, by Feodor Rofpatkin. Toroid Circuit with Resistance AF, by E. I. Sidney. A Push-Pull AF Amplifier, by Lt. Peter V. O'Rourke.
May 16—A 3-Tube Reflexed Neutrodyne, by Percy Warren. The Baby Portable, by Herbert E. Hayden. One Tube More for Quality, by Brewster Lee.
May 23—Powerful 3-Tube Reflex Receiver, by H. E. Wright. The 2-Control Diamond (Part 1), by Herman Bernard.
May 30—Wiring the 2-Control Diamond (Part 2), by Herman Bernard. 1-Control Neutrodyne, by Sidney E. Finkelstein. Making Your Set Tune the Entire Wavelength Band, by J. E. Anderson.
June 6—The Smokestack Portable, by Neal Fitzalan. A and B Battery Eliminators, Using DC (Part 1), by P. E. Edelman. A Wavemeter, by Lewis Winner.
June 13—Simple Short-Wave Circuits, by Herbert E. Hayden. A Simple Push-Pull Rheostat, by A. C. G. Force. A and B Battery Eliminators, Using AC (Part 2), by P. E. Edelman. A Portable Super-Heterodyne, by Wainwright Astor.
June 20—The Diamond as a Reflex, by Herman Bernard. A 2-Tube Protable Reflex, by Herbert E. Hayden. A Reflex for 99 Type Tubes, by L. R. Barbley.
June 27—The Pocketbook Portable, by Burton Lindheim. The Power House Set, by John L. Munson. Lesson on Learning the Code.
July 4—The Handsome Portable, by Herbert E. Hayden. The Freedom Reflex, by Capt. P. V. O'Rourke. 8-Tube Super-Heterodyne, by Abner J. Gelula.
July 11—The Baby "Super," by J. E. Anderson. A 1-Dial Portable Receiver, by Capt. P. V. O'Rourke.
July 18—Anderson's 6-Tube Super-Heterodyne. The 3-Tube Marconi Receiver, by Percy Warren. A Good Battery Connector, by Herbert E. Hayden.
July 25—A Dynamic Radio Amplifier, by P. E. Edelman. An Anti-Radiation Toroid Set, by Capt. P. V. O'Rourke. Crystal Sets for Work Today, by Lewis Winner. Construction of the Diamond Described for the Novice, by Herman Bernard.
Aug. 1—Enormous Volume on DX Stations, by Sidney E. Finklestein. The Metropolitan Local Set, by J. E. Anderson. 4-Tube DX Divided Circuit, by Herbert E. Hayden. Series and Parallel Effects, by Herman Bernard.
Aug. 8—The Evolution Reflex, by Capt. P. V. O'Rourke. The Midget—A 3-Tube Set in Sewing Machine Cabinet, by Herbert E. Hayden. How to Build Your First Set, by Herman Bernard. 2-Year-Old Wins DX Stake, by Lewis Winner. Interference by Induction, by Prof. C. M. Jansky, Jr.

Any copy, 15c. Any 7 copies, $1.00. All these 36 copies for $5.00, or start subscription with any issue. Radio World, 1493 Broadway, N. Y. City.

KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30 PM; 5 to 10.
KHJ, Los Angeles, Cal., 405.2 (PST)—7 AM to 7:15; 12 M to 1:30 PM; 5:30 to 12.
KJR, Seattle, Wash., 484.4 (PST)—9 AM to 1 AM.
KNX, Hollywood, Cal., 337 (PST)—1 PM to 2; 7 to 12.
KOB, State College of New Mexico, 348.6 (MST)—11:55 AM to 12:30 PM; 7:30 to 8:30; 9:55 to 10:10.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 9.
KPO, San Francisco, Cal., 429 (PST)—7 AM to 8; 10:30 to 12 M; 1 PM to 2; 4:30 to 11.
KSD, St. Louis, Mo., 545.1 (CST)—7 PM to 10.
KTHS, Hot Springs, Ark., 374.8 (CST)—8:30 PM to 10.

KYW, Chicago, Ill., 536 (CSTDS)—6:30 AM to 7:30; 10:55 to 1 PM; 2:15 to 4; 6:02 to 11:30.
PWX, Havana, Cuba, 400 (EST)—8:30 PM to 11:30.
CNRM, Montreal, Quebec, Canada, 411 (ESTDS)—9 PM to 11.
CNRO, Ottawa, Ontario, Canada, 435 (EST)—7 PM to 11.

THURSDAY, AUGUST 20

WAAM, Newark, N. J., 263 (ESTDS)—11 AM to 12 M; 7 PM to 11.
WAHG, Richmond Hill, N. Y., 316 (EST)—12 PM to 1:05.
WAMB, Minneapolis, Minn., 243.8 (CST)—12 M to 1 PM; 10 to 12 M.
WBBM, Chicago, Ill., 226 (CST)—8 PM to 10.
WBOQ, Richmond Hill, N. Y., 236 (ESTDS)—3:30 PM to 6:30.
WBZ, Springfield, Mass., 333.1 (ESTDS)—6 PM to 11:45.
WCAE, Pittsburgh, Pa., 461.3 (CSTDS)—12:30 PM to 1:30; 4:30 to 5:30; 6:30 to 11.
WCBD, Zion, Ill., 344.6 (CST)—8 PM to 10.
WCCO, St. Paul and Minneapolis, Minn., 416.4 (CST)—9:30 AM to 12 M; 1:30 PM to 4; 5:50 to 10.
WEAF, New York City, 492 (ESTDS)—6:45 AM to 7:45; 11 to 12 M; 4 PM to 5; 6 to 12.
WEAR, Cleveland, O., 390 (EST)—10:30 AM to 12:10 PM; 3:30 to 4:15; 7 to 11.
WEEI, Boston, Mass., 467 (ESTDS)—6:45 AM to 7:45; 1 PM to 2; 2:30 to 10.
WFAA, Dallas, Texas, 475.9 (CST)—10:30 AM to 11:30; 12:30 PM to 1; 2:30 to 6; 6:45 to 7; 8:30 to 9:30; 11 to 1 AM.
WFBH, New York City, 272.6 (ESTDS)—2 PM to 7:30.
WGBS, New York City, 316 (ESTDS)—10 AM to 11; 1:30 PM to 4; 6 to 7:30.
WGCP, New York City, 252 (ESTDS)—2:30 PM to 5:15.
WGES, Chicago, Ill., 250 (CSTDS)—5 PM to 8; 10:30 to 1 AM.
WGN, Chicago, Ill., 370 (CST)—9:31 AM to 3:30 PM; 5:30 to 11:30.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 11:30; 6 PM to 7:15; 8:30 to 11.
WGR, Buffalo, N. Y., 319 (ESTDS)—12 M to 12:45 PM; 2 to 4; 7:30 to 11.
WHAD, Milwaukee, Wis., 275 (CST)—11 AM to 12:15 PM; 4 to 5; 6 to 7:30; 8 to 10.
WHAS, Louisville, Ky., 399.6 (CST)—4 PM to 5; 7:30 to 9.
WHN, New York City, 360 (ESTDS)—2:15 PM to 5; 7:30 to 11; 11:30 to 12:30 AM.
WHO, Des Moines, Iowa, 526 (CST)—7:30 PM to 9; 11 to 12.
WHT, Chicago, Ill., 400 (CSTDS)—11 AM to 2 PM; 7 to 8:30; 10:30 to 1 AM.
WJY, New York City, 405 (ESTDS)—7:30 PM to 11:30.
WJZ, New York City, 455 (ESTDS)—10 AM to 11; 1 PM to 2; 4 to 6; 7 to 12 M.
WLIT, Philadelphia, Pa., 395 (EST)—12:02 PM to 12:30; 2 to 3; 4:30 to 6; 8:30 to 9.
WLW, Cincinnati, O., 422.3 (EST)—10:40 AM to 12:15 PM; 1:30 to 5; 6 to 8; 10 to 11.
WMAK, Lockport, N. Y., 265.5 (EST)—11 PM to 1 AM.
WMCA, New York City, 341 (ESTDS)—11 AM to 12 M; 6:30 PM to 12.
WNYC, New York City, 526 (ESTDS)—3:15 PM to 4:15; 6:50 to 11.
WOAW, Omaha, Neb., 526 (CST)—12:30 PM to 1:30; 5:45 to 11.
WOC, Davenport, Iowa, 484 (CST)—12:57 AM to 2 PM; 3 to 3:30; 4 to 7:10; 8 to 9.
WOR, Newark, N. J., 405 (ESTDS)—6:45 AM to 7:45; 2:30 PM to 4; 6:15 to 7.
WPG, Atlantic City, N. J., 299.8 (ESTDS)—7 PM to 11.
WQJ, Chicago, Ill., 448 (CST)—11 AM to 12 M; 3 PM to 4; 7 to 8; 10 to 2 AM.
WRC, Washington, D. C., 469 (EST)—1 PM to 2; 4 to 6:30.
WREO, Lansing, Michigan, 285.5 (EST)—8:15 PM to 9:45; 10 to 11.
WRNY, New York City, 258.5 (ESTDS)—11:59 AM to 2 PM; 7:39 to 10.
WSB, Atlanta, Ga., 428.3 (CST)—12 M to 1 PM; 2:30 to 3:30; 5 to 6; 8 to 9; 10:45 to 12.
WSBF, St. Louis, Mo., 273 (CST)—12 M to 1 PM; 3 to 4; 8 to 9.
WWJ, Detroit, Mich., 352.7 (EST)—8 AM to 8:30; 9:30 to 10:30; 11:55 to 1:30; 3 to 4; 6 to 7; 8 to 9.
KDKA, Pittsburgh, Pa., 309 (EST)—9:45 AM to 12:15 PM; 2:30 to 3:30; 5:30 to 10:15.
KFAE, State College of Washington, 348.6 (PST)—7:30 PM to 9.
KFI, Los Angeles, Cal., 467 (PST)—5 PM to 11.
KFKX, Hastings, Neb., 288.3 (CST)—12:30 PM to 1:30; 5:15 to 6:15; 9:30 to 12:30.
KFNF, Shenandoah, Iowa, 266 (CST)—12:15 to 1:15 PM; 3 to 4; 6:30 to 10.
KFOA, Seattle, Wash., 455 (PST)—12:30 PM to 1:30; 4 to 5:15; 6 to 7.
KGO, Oakland, Cal., 361.2 (PST)—11:30 AM to 1 PM; 1:30 to 3; 4 to 6:45; 7:15 to 10
KGW, Portland, Oregon, 491.5 (PST)—11:30 AM to 1:30 PM; 5 to 11.

KHJ, Los Angeles, Cal., 405.2 (PST)—7 AM to 7:15; 12 M to 3:20; 5:30 to 11:30.
KJR, Seattle, Wash., 484.4 (PST)—9 AM to 1 AM.
KNX, Hollywood, Cal., 337 (PST)—11 AM to 12:05 PM; 4 to 5; 6 to 12.
KOIL, Council Bluffs, Iowa, 278 (CST)—7:30 PM to 9.
KPO, San Francisco, Cal., 429 (PST)—7 AM to 8; 10:30 to 12 M; 1 PM to 2; 3:30 to 11.
KSD, St. Louis, Mo., 595.1 (CST)—7:30 PM to 9.
CNRA, Calgary, Alberta, Canada, 435.8 (MST)—9 PM to 11.

DX, VOLUME, SELECTIVITY

All Three Marvelously Combined in

"A Gem, a Jewel and a Joy"

Described by Herman Bernard in the July 25 issue. That is the 3-control set.

The Diamond as a 2-control set, using a double-condenser, was described in the May 23 issue. But if you are going to build the 2-control set, be sure to get the July 25 number also, for full information.

Either set works fine on loop or outdoor aerial.

Get your full measure of enjoyment from radio reception by building this set. Just the thing for fine summer reception.

Send 30c for the May 23 and July 25 issues, or start your subscription with the July 25 issue. Send $6.00 for yearly subscription and the May 23 and July 25 issues will be sent free. Address Circulation Manager, RADIO WORLD, 1493 Broadway, New York City.

LISTEN IN every Friday at 7 P. M. and hear Herman Bernard, managing editor of RADIO WORLD, discuss "Your Radio Problem," from WGBS, Gimbel Bros., New York City, 315.6 meters.

THE RADIO UNIVERSITY

(*Concluded from page 19*)

which I would like to put to some use into a 2-tube radio receiver. This set should have a step of tuned RF and a regenerative detector. The RF tube should be neutralized.—F. T. Lonsong, Beachville, Ia.

See Fig. 182.

* * *

PLEASE publish view of a 2-control crystal set, with diagram.—James Bunn, Buffalo, N. Y.

The rear view is shown on this page. For wiring diagram, see pages 16 and 17.

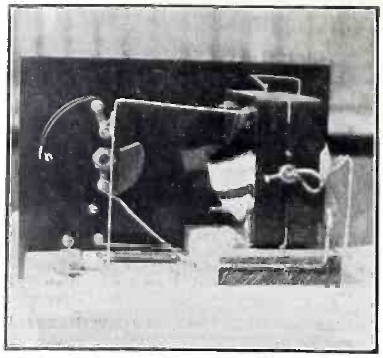
* * *

WOULD YOU kindly tell me what I should do so that my 6-tube loop set can be used on an outdoor aerial?—Chas. J. Lavereatt, 213 Bidwell Ave., Jersey City, N. J.

Take a form 3½" in diameter, 4" high. Wind 10 turns. (Use No. 22 DCC wire.) This is the primary. The beginning goes to the antenna and the end to the ground. Leave ¼" space. Wind 42 turns. This is the secondary. The beginning goes to the grid and the end to the F plus of first tube. See loop jack article in this issue.

* * *

I WOULD like to know if the 2-Control DX reflex discussed by Brewster Lee in April 25 issue of RADIO WORLD, could be installed in a small space as a portable? (2) How much B battery is required? (3) Could I use "Hedgehog" AF transformers?—Clair J. Chamberlain, 241 Furman St., Syracuse, N. Y.



THE CRYSTAL SET, using two controls, as constructed by George Hammel.

(1) Yes. (2) About 67½ volts on the plate is O. K. (3) Yes.

* * *

I WISH to build The Diamond for dry cell operation. (1) Can I build it according to picture diagram in July 25 issue? (2) Which are the best dry cell tubes to use, WD12 or UV199? (3) What is the best plate voltage to use on these tubes? (4) Can I use any of the straight-line frequency condensers for better results?—A. J. Olk, Phoenix Hotel, Winston Salem, North Carolina.

(1) Yes. (2) UV199. (3) As a detector, 45 volts; as an amplifier, 67 to 90 volts. (4) Yes.

* * *

WILL YOU kindly give me the instructions necessary to wind the coils for the B-T Nameless Circuit Radio. I desire to use the 3" basket-weave form and to tune these coils with an .0005 condenser instead of a 13-plate.—Wm. Pictattet, 326 N. 12th St., New Castle, Ind.

Put 12 turns on the primary, 42 turns on the secondary. Wind on a 3½" tubing, 4" high, with No. 22 DCC wire. The tickler was 43 turns, same wire, but around on a 2½" tubing, 2" high.

* * *

WILL YOU please tell me what ratio the iron core radio-transformer is in the 2-tube low loss reflex set in the Oct. 11, 1924, issue of RADIO WORLD?—John F. Hartnett, 861 Saratoga St., East Boston, Mass.

A high ratio transformer is best suited here (6 to 1).

DOCTOR DIAGNOSES CASE OF SIN AND SHAME CRITIC

DIAMOND EDITOR:

I built Feodor Rofpatkin's 1-tube Reflex and it worked great. I think if Mr. Hancock will rip his set down and start over again, he will be greatly surprised at the results.

I had just completed The Diamond of the Air and it certainly is great.—DR. H. A. REYNOLDS, 105 Lillian Avenue, Syracuse, N. Y.

"BEST 4-TUBE SET," NEW YORKER THINKS

DIAMOND EDITOR:

I have built The Diamond and it works splendidly. Anybody who says that RADIO WORLD does not publish good diagrams is greatly mistaken. The Diamond is the best 4-tube set made.—HAROLD NAFZ, 2342 Ryer Avenue, New York City.

WINNER'S SET

(Concluded from page 7)

bottom terminal of the filament control jack. The other terminal goes to the B plus 100 volts. From the F minus post of the socket bring a wire to one terminal of the Amperite. Bring the end to the A minus post of the terminal strip. From the F minus post of the last tube bring a wire to one terminal of the Amperite, the other terminal going to the same place that the end of Amperite for the 3rd tube went to, i.e., A minus. Bring the two F pluses from the sockets together. Connect these to the third terminal (after the insulation) of the last jack. The end terminal goes to the A plus. Connect A minus to B minus.

Getting the Results

The set is now completely wired up. All that has to be done is to wire the A and B batteries up, put the antenna and ground on and you are all set to listen in. This receiver is bound to give trouble. It was designed to give trouble so that the novice will learn by making mistakes. But the set will work and the tubes will not blow out. But getting the results that this set is capable of giving is a job, even though the hookup is standard.

Put the plug in the filament jack. Turn the rheostats up. Do you hear a click, when you pull the plug in and out? If you do, this shows that there is a complete plate circuit being made. Turn C1 and C3 to about 50 on the dials or perhaps to about the place where the condenser plates are one-quarter out of mesh. Now turn the variometer back and forth. A loud click should be heard, accompanied by some squeals, if a station happens to be on the air at that time. Now turn all the dials back and forth, keeping the center dial about 20 degrees ahead of the other two dial readings. The station will come in with a loud squawk. Turn the variometer to the left until the regeneration has ceased. This is all nice, but the station will not come rolling in so easily, especially if this is your first set. You will find that either the set squeals too much or too little. If there is too much squealing, take out C2 and put in a condenser with a value of .0005 mfd. Pull L5 away from L6. Decrease the resistance in R2. This will let less current pass through the grid circuit, or in other words, the condenser will discharge the current through the leak more slowly. A choking effect is obtained. If you don't get enough regeneration put more resistance in R2. Reverse the winding of L6. Reverse the A battery and put more plate voltage on the detector tube. No doubt, when you take out the radio-frequency tube, you will still hear signals. This will only happen on local stations. On distance the radio tube comes into use. In other words the RF tube may be taken out when listening to local reception. Sometimes the reception is louder with it in, but this is very seldom. This information is given for fans who complain that they still hear signals when they take the RF tube out. Still others complain that they cannot hear a thing when they take the tube out. This is due to the characteristics of the tube as well as the wiring of the circuit. It is very difficult completely to neutralize a set which employs regeneration in the detector tube. As a matter of fact neutralization doesn't help much, if at all.

Those building this set and making it work properly can build any set that was or will be designed, as all the intricacies of fundamental radio are here employed.

The antenna wire should be 100 feet in length, the leadin 20 feet (if possible), and the ground 10 feet from the set. Don't forget to use a lightning arrestor. Use the cold water pipe for a ground.

Note Fig. 2, the picture diagram a detector and 2-step amplifier, which prevents any radio-frequency current feedback. This is extensively used by the Radio Corporation of America in sets aboard ship.

Readers Praise Diamond; Disagree With Hancock

(*Concluded from page 11*)

of your circuits make errors when they are wiring the set. I have made the following sets and have had wonderful results:

The 2-Tube Tone Beauty, by Brewster Lee, May 9 issue.

The 2-Tube Spare Parts Reflex, by Herbert E. Hayden, June 20 issue. The latter set is my pet. It is very clear and loud. I get Chicago on a Thorola loud speaker, all the way up here in the woods of Maine.

If any person expects results from a receiver he must use the best of parts and pay particular attention to the soldering of all the connections. I never had trouble in making any receiver work. I always take time and pains when wiring a set. I'll tell you why the radio fans who build sets do not get good results. For instance, they will take The Diamond of the Air and wire it up with a bunch of cheap parts in any old manner. They do not use any solder. They then blame the man who described the set, if it doesn't function as he said it would. That is a poor way to try out a circuit. I have made many mistakes, but one learns by mistakes, so cheer up Mr. Hancock. The circuits are O. K. You are at fault.

F. L. HUTCHINS,
Tumbledown Mt., Skinner, Me.

* * *

HANCOCK TOO HASTY, SAYS RADIO EXPERT

DIAMOND EDITOR:

I have been reading your wonderful magazine since last Fall and have every copy since the August issues here on file. I have hooked up lots of your circuits. Some I got good results from and some I did not, but the only reason a man fails to get results is when he doesn't use good apparatus or doesn't follow instructions.

I have been using the Diamond of the Air, even before you printed it. I used it last Winter with good success, having heard California regularly. The Diamond of the Air, if properly built, is the best radio set in the field today. It is designed on sound engineering principles and is theoretically correct.

I am using it with three stages of resistance - coupled audio amplification, which makes it by far the best radio set.

I do a whole lot of reading but not much writing. When I saw Mr. Hancock's letter I decided to do a little writing. I just want to say that Mr. Hancock is a little bit too hasty in his decision and altogether too free with his English. I would be glad to help him out with this particular hook-up.

As to the mustache being a fake, am afraid I cannot be of any assistance in that case.

I have been in the radio game for five years and have tried everything.

Well, here's hoping you much success and good luck in the future.

You may use this letter if you wish to.

W. F. BURGISS,
4AAJ, Elkin, N. C.

P. S.—Give Lewis Winner my regards and many "Tnx" for the Meissner transmitter dope.

* * *

WONDERFUL, SAYS FAN, CITING LIST OF STATIONS

DIAMOND EDITOR:

I built The Diamond and the following is a list of the stations that I have received: WEAF, WGBS, WIP, WLS, WCCO, WOC, WWJ, WJAR, WEAR, WSAI, WTAS, CNRO, WOS, WPS, WGN, WHAS, WLIT, WMCA, KYW, KDKA, KFKX, 6KW, KFI, PWX. I want to thank Herman Bernard for his wonderful contribution.—JOSEPH REBELLO, JR., 94 Armour Street, New Bedford, Mass.

Why One Should Install A Good Lightning Arrestor

In summer there is one thing some radio fans, especially beginners, are afraid of, and that is lightning. They fear that the antenna will be struck by a bolt. According to recent Bureau of Standards tests any metal object on the roof is as much an attractor of lightning as the antenna. However, fire insurance companies demand that all radio receivers be protected with some device, which, if the antenna of that radio receiver is struck by lightning, will cause the lightning to travel to the ground through a specially improvised gap, thereby doing away with any possible chance of fire.

A lightning arrestor is a small article, costs little and is simple to put up. No one should even ask if such an instrument is required. They save a lot of trouble as well as worry. Once installed, you can rest back and forget about a fire to be caused by lightning, during an electrical storm. The arrestor protects the house as well as the receiver.

What Is It?

What is the arrestor composed of? There are two heavy copper leads (No. 8 wire usually used), the ends of which are brought to within 1/64" of each other. This is hermetically sealed and the opposite leads brought out to a pair of binding posts. When the lightning strikes your antenna it jumps the small gap and goes to the ground. If there were no gap the strength of the bolt would burn the wire.

In all arrestors the antenna end of the gap is larger in diameter than the ground. By that I mean that due to the fact that a higher potential is generated in the antenna, a large wire is required to carry this current, because after it jumps this gap, half the power is lost.

BATTLESHIP HEARS NKF

The naval experimental station at Bellevue, near Washington (call letter NKF), held good two-way radio communication with the Seattle, then somewhere between Honolulu and Samoa. It was the only time since the departure of the Seattle from Honolulu that she has been communicated with directly by high frequency, but it is believed that the reason is principally her need of clearing traffic to nearer stations. She has been heard communicating with other stations on several occasions.

S. C. Pleass, a member of the American Radio Relay League, at Johannesburg, South Africa, has reported to Captain McLean the consistent and reliable reception of 40-meter signals from the United States fleet at Honolulu during both May and June. This is about half way around the earth, one station being at the antipodes of the other, and is about the maximum distance at which it is possible to try to effect radio communication.

"The results in this case," said Captain McLean, "are unquestionably among the most remarkable ever recorded.

How to Test the Crystal In the 2-Tube Reflex

(*Continued from page 4*)

There can be no doubt of success, if directions are followed and useful parts employed.

Test the Crystal

Be very sure that your crystal is a good one. Try it out in an experimental srystal hookup, just to be certain that it does work. Use the secondary L5 for testing, connecting aerial to one end of that coil, ground to the other, with a vairable condenser, lying on a table, if need be, connected to the two ends of the coil. Join one side of the crytsal to the aerial, the other side of the crystal to one of the phone tips, the other phone top to ground With this hookup you will hear local stations, in fact, will probably hear two, maybe three, at once, but you are testing your crystal, not building a set.

Wiring Kinks Explained

An understanding of the electrical features of the circuit will aid you in wiring. The aerial and ground system is joined to the aperiodic primary L1, the signals are passed to the secondary L2 and are tuned by the condenser C1. The plate of the RF tube is connected to one side of the tickler, the other side of the tickler to one terminal of the aperiodic primary L4 of the interstage coupler. The end of that winding must go to B plus, to feed the high positive potential (voltage) to the plate of the tube. But instead of going directly to B plus the lead is attached to the P post of the second audio transformer, whose other terminal, B, must go to B plus, too. Hence the B current is fed backwards, so to speak, first through the primary of AFT2, next through the primary of the intersage coupler, and finally through the tickler, whence it reaches the plate of the first tube. The only other point novel to those who have not built reflex sets is the actual reflexing.

Looking at Fig. 2, imagine the radio signals passing through L1 to L2, by induction, is tuned and travels from plate back to grid, again by induction (tickler action), and simultaneously to L4 and over to L5. Here, in L5, the crystal is connected in series. The coil L5 is tuned, thus aiding the exclusion of undesired signal and other forms of interference, and contributing toward stability. The crystal chops up the waves (which to this point have been at radio frequencies), and alows only a direct pulsating current to pass. Some little RF current will pass across the crystal, too, but this is more or less wasted. The open end of the crystal, and the end of L5 other than the one that is attached to crystal, are connected to the primary of AFT1. The pul-

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Circulation Manager, RADIO WORLD, 1493 Broadway, New York City.

A DYNAMIC SET, Enormous Power on 3 Tubes, by P. E. Edelman. An Anti-Radiation Toroid Set, by Capt. P. V. O'Rourke. Four Crystal Hookups by Lewis Winner. Other features in RADIO WORLD dated July 25, 1925. 15c a copy, or start your subscription with that number. RADIO WORLD, 1493 Broadway, New York.

sating direct current is alternating current, to be sure, but is known preferably by the other name, to distinguish it more readily from the much more rapid alternations in radio frequencies. Hence the current is at audible frequencies, but you cannot hear anything, because phones, which respond to such fluctuations, would have to be inserted at this point. We do not care to use this as a listening post, hence the current is stepped up by AFT1 and delivered to the first tube. This is the first visit this kind of current has paid to this tube, since it has been handling radio frequencies. The secondary of AFT1 is connected with G post to the end of L2 that would normally go direct to A minus. But instead the F post of AFT1 is connected to A minus, hence this grid return is accomplished anyway, and at the same time the audio currents are fed to the tube at the grid. What we take out of the tube now (having gotten all the radio frequencies we need) are currents that have passed through one stage of audio amplification. The rest is simple addition of a straight stage of AF. The audio current travels through the tickler, through L4, through the primary of AFT2 and is induced in the secondary of AFT2, whence it is delivered into the second tube at grid and taken out, greatly amplified, at the point represented by the jack J.

Anyway, it works.

High-Powered Stations Discussed by Dellinger

(Concluded from page 12)

taneous broadcasting of national events by 20 to 30 stations. This interconnection is in general accomplished through through the use of long-distance wire telephone lines. In one group of stations it is accomplished through the use of high-frequency radio rebroadcasting.

The effort to make a single program simultaneously available to larger audiences is also being furthered by the use of higher and higher power. About 30 stations have increased their power within the past year from approximately ½ to 5 kilowatts. A beginning has been made in the use of stations of approximately 50 kilowatts. This extension of the scope of radio broadcasting is beginning in the possibility of world-wide as well as nationwide broadcasting.

The Pay Question Solved

One of the serious problems of the early days of broadcasting has solved itself. This is the question as to who should pay for broadcasting. A great diversity of interests is shown among the owners of broadcasting stations. Of the 500 or so stations, approximately one-half are owned and operated by manufacturers of or dealers in radio apparatus and other commercial interests profiting from the sale of radio apparatus. The other half are owned by educational and religious institutions, local governments, and various commercial and semi-commercial organizations. The broadcasting carried on by this class is for some form or aspect of advertising.

Selective Crystal Sets

By Herman Bernard—Next Week's Radio World, Issue Dated August 22

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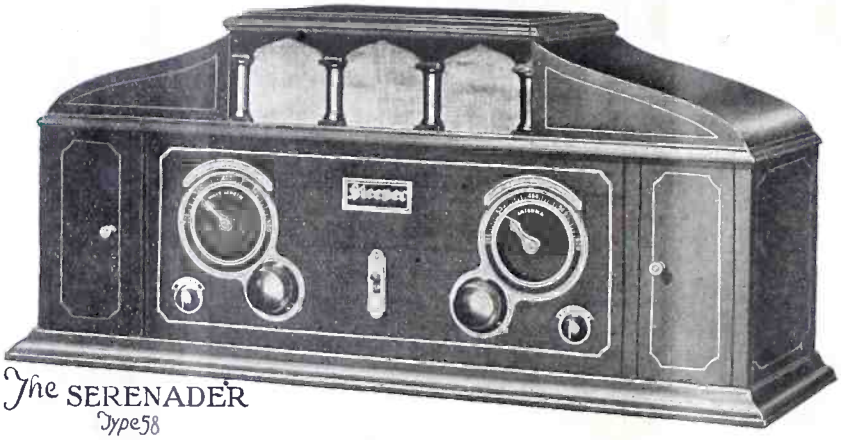

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