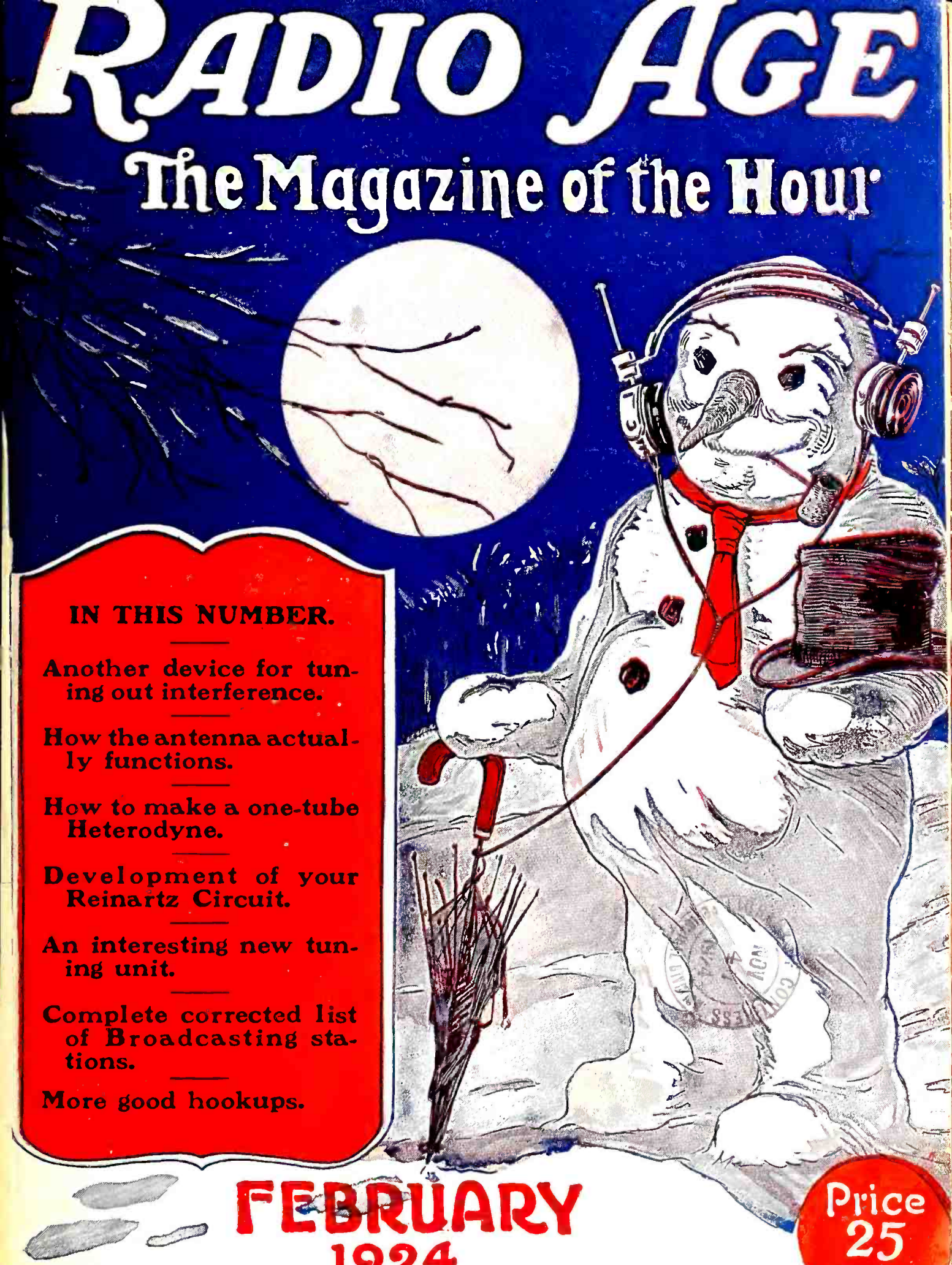
RADIO AGE

The Magazine of the Hour



IN THIS NUMBER.

Another device for tuning out interference.

How the antenna actually functions.

How to make a one-tube Heterodyne.

Development of your Reinartz Circuit.

An interesting new tuning unit.

Complete corrected list of Broadcasting stations.

More good hookups.

FEBRUARY

1924

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We have laid aside a limited number of back numbers of Radio Age for you. Below we are listing the hook-ups and circuit diagrams to be found in these magazines. Select the ones you want, enclose 30 cents in stamps for each one desired.

We advise immediate attention to this as the stock of back numbers is diminishing rapidly.

May, 1922

—How to make a simple Crystal Set for $6.

June, 1922

—How to make a Receiving Transformer.
—Aerials under ground and under water.
—Electric light wires as auxiliary to radio.

September, 1922

—How to construct the Reinarts Receiver.
—Federal Act regulating radio.

October, 1922

—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922

—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.

December, 1922

—Supply exhausted.

January, 1923

—How to make a sharp-tuning Crystal Detector.
—Fixed condensers in home-made receiving sets.
—Description of loading coil for simple sets.

April, 1923

—The Kopprasch circuit.
—How to make a one-tube loop aerial set.
—A two-circuit Crystal Set.

May, 1923

—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinarts set for summer use.

June, 1923

—How to build the new Kaufman receiver.
—What about your antenna?

July, 1923

—The Grimes inverse duplex system.
—How to read and follow symbols.
—Proper antenna for tuning.

August, 1923

—Construction of the Cockaday four-circuit tuner.
—An efficient two-stage amplifier.
—A simple buzzer transmitting set.

September, 1923

—How to load your set to receive new wave lengths.
—Simple Radio Frequency Receiver.

October, 1923

—The Four-Tube Neutrodyne.
—Your First Tube Set.

November, 1923

—The Super-Heterodyne.
—A Three-Circuit Tuner.
—How to Learn Code.

December, 1923

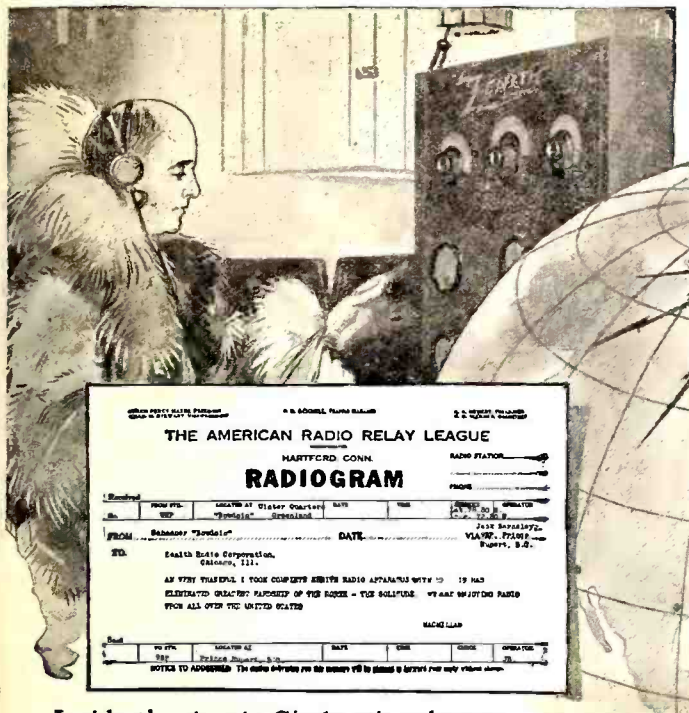
—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924

—Tuning Out Interference—Wave Traps—Eliminators—Filters.
The article which was favored with the grateful interest of the radio public after its announcement by Station WJAZ.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

RADIO AGE, Inc.

500-510 North Dearborn Street, - - - - - - - - - CHICAGO, ILL.



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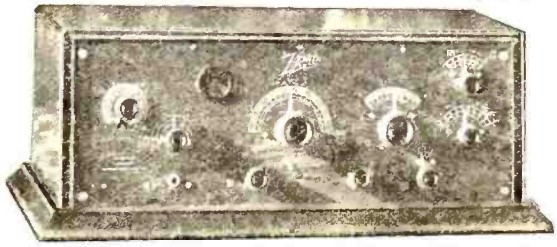

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RADIO AGE

The Magazine of the Hour

(Established March, 1922)

Volume 3 *FEBRUARY, 1924* *Number 2*

CONTENTS

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70,000!

AS THE forms for the February issue are about to close it looks as if 70,000 would be the *minimum* press run for this month. Dealers' orders are still coming in as this is written and most of them call for substantial increases over January. We are likely to need 75,000 copies.

One Chicago magazine shop sold out its RADIO AGE supply three times on January 7 and when our distributor reached the store with a fourth consignment of the January issue, thirty customers were waiting for their "Magazine of the Hour." That little loop store sold 900 copies in one day.

"Sold out clean" said a telegram from Montreal, almost immediately after receiving the January issue. Pawtucket, Rhode Island, next came in with a telegram asking that their original order be duplicated. Long distance telephone calls, telegrams, letters and personal visits from dealers steamed things up until the business manager had to telephone the printing house to put the forms all back on the presses for a second run.

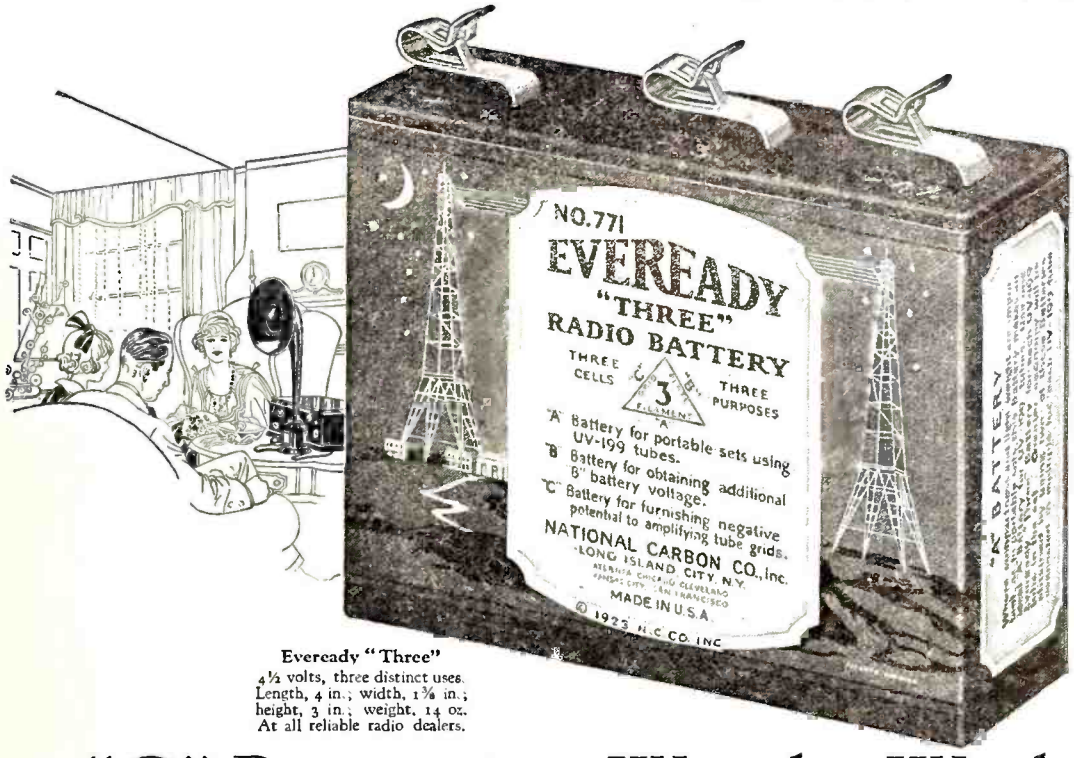
We told you on this page of the January issue that this was distinctively a reader's magazine and we explained how we had attained a prosperous success, practically on circulation alone. Now we are going to tell you what made that January issue sell like peanuts at a circus.

It was the article on "Tuning out Interference." It was the best and most comprehensive article on the subject thus far published. E. F. McDonald, Jr., president of the Zenith Radio Corporation, broadcast some kind words about the article from Zenith-Edgewater Station WJAZ and other stations followed his example. That announcement over the air introduced us to more than 20,000 new readers. Their letters have been coming in—and their subscriptions. We thank the broadcasters and the broadcast listeners. We promise to reciprocate by continuing to do our best to print a good radio magazine.

Frederick Smith

—Editor, RADIO AGE

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"



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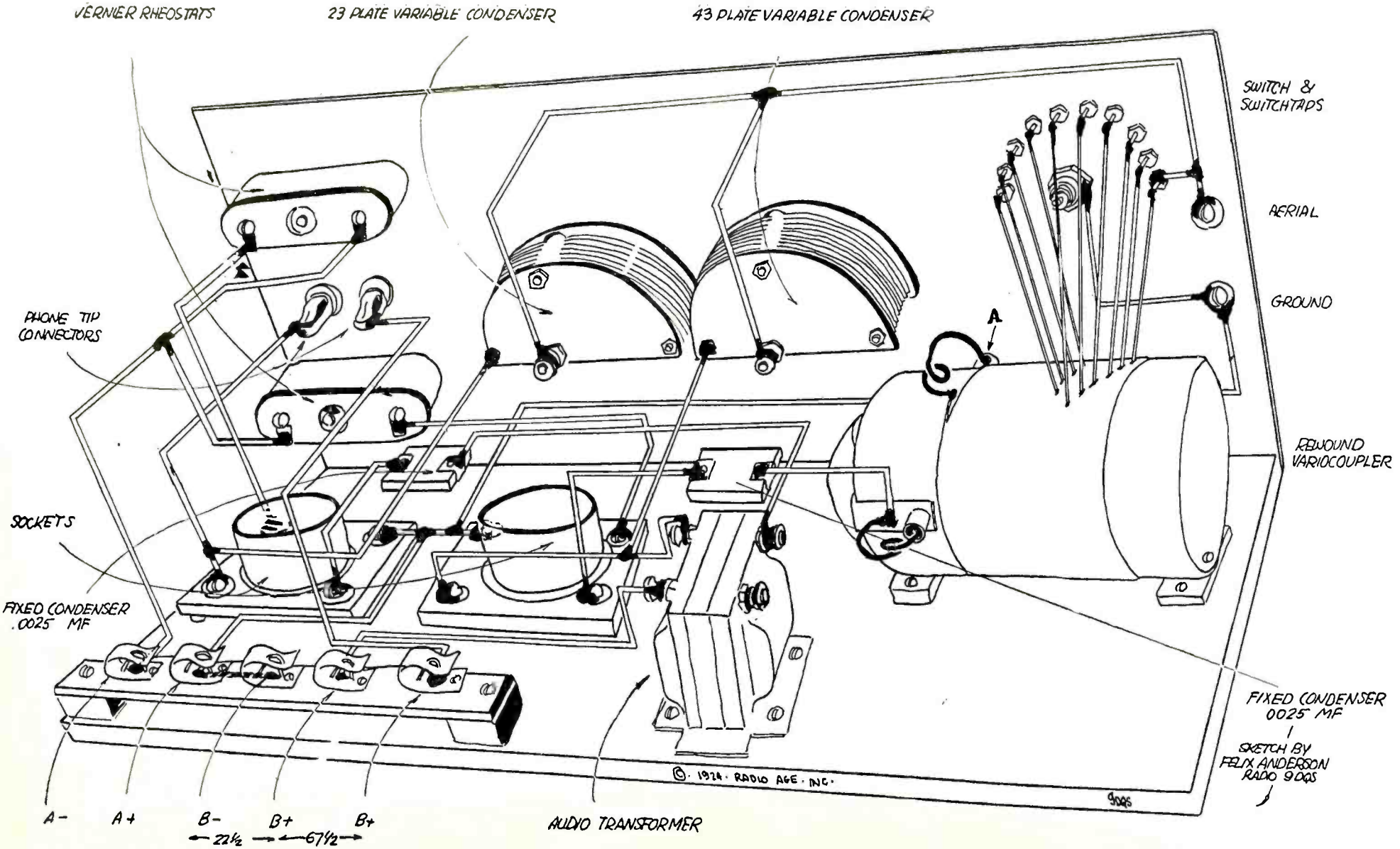


Figure 1. An isometric sketch of the Reinartz Audio Regenerator, described in detail in the accompanying article. The circuit uses a rewound variocoupler as a tuning inductance.

RADIO AGE

"THE MAGAZINE OF THE HOUR"

M. B. Smith
Publisher

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

The Reinartz Audio Regenerator

By FELIX ANDERSON

Technical Assistant, Radio Age

HEARKEN 'ye Reinartz followers! Drag out the tool kit, count over the radio budget, and learn how to make a set that will rattle the diaphragms of your telephone receivers.

To make improvements and adaptations on a good circuit is always in order. We are, therefore, presenting to our readers several new circuits and adaptations of the Reinartz circuit which have evolved since the original presentation of this system in June, 1922.

The original Reinartz circuit consists of a spider web coil wound in auto transformer fashion, with a capacity (condenser) shunted across its grid circuit inductance. It is a well known fact that an arrangement of this kind does not deliver as great a voltage variation to the grid of the tube as would an arrangement comprising a large variable inductance, making it unnecessary to use the capacity for tuning purposes.

Acting upon this principle, John Reinartz, originator of the Reinartz circuit, and owner and operator of radio station 1QP—evolved the circuit shown in Figure 2. Instead of tuning the grid circuit with a condenser as was outlined in the September, 1922, issue of RADIO AGE by Mr. Pearne, Mr. Reinartz substitutes a large variable inductance to accomplish this purpose.

The originator of this circuit claims it is so much better than the original spider web system, that he advises those using the first system to give this new permutation a trial.

Construction

To construct this set, it will be necessary to rewind a standard variocoupler. This is about the only drawback of the system, but it will be found that no difficulty will be experienced by the average fan who has by this time become familiar with winding coils of all descriptions and sizes in the course of his radio experiments. In purchasing the variocoupler get one in which the tube is not more than three and one-half inches in diameter, and which has a rotor large enough to accommodate fourteen turns of No. 18 SSC insulated wire, on each side of the shaft.

The primary is wound in the following manner. Punch two holes in the cardboard tubing, and start winding, using No. 18 SSC wire. The first ten turns are tapped every turn as shown in the sketch in Figure 1. This winding should start at the end opposite the rotor of the tuner. After the first ten turns are wound, complete the coil by winding 35 turns without taps, leaving an end sufficiently long for connecting purposes.

The rotor should then be rewound as mentioned above, with 28 turns of the same size wire, placing 14 turns on each half of the rotor.

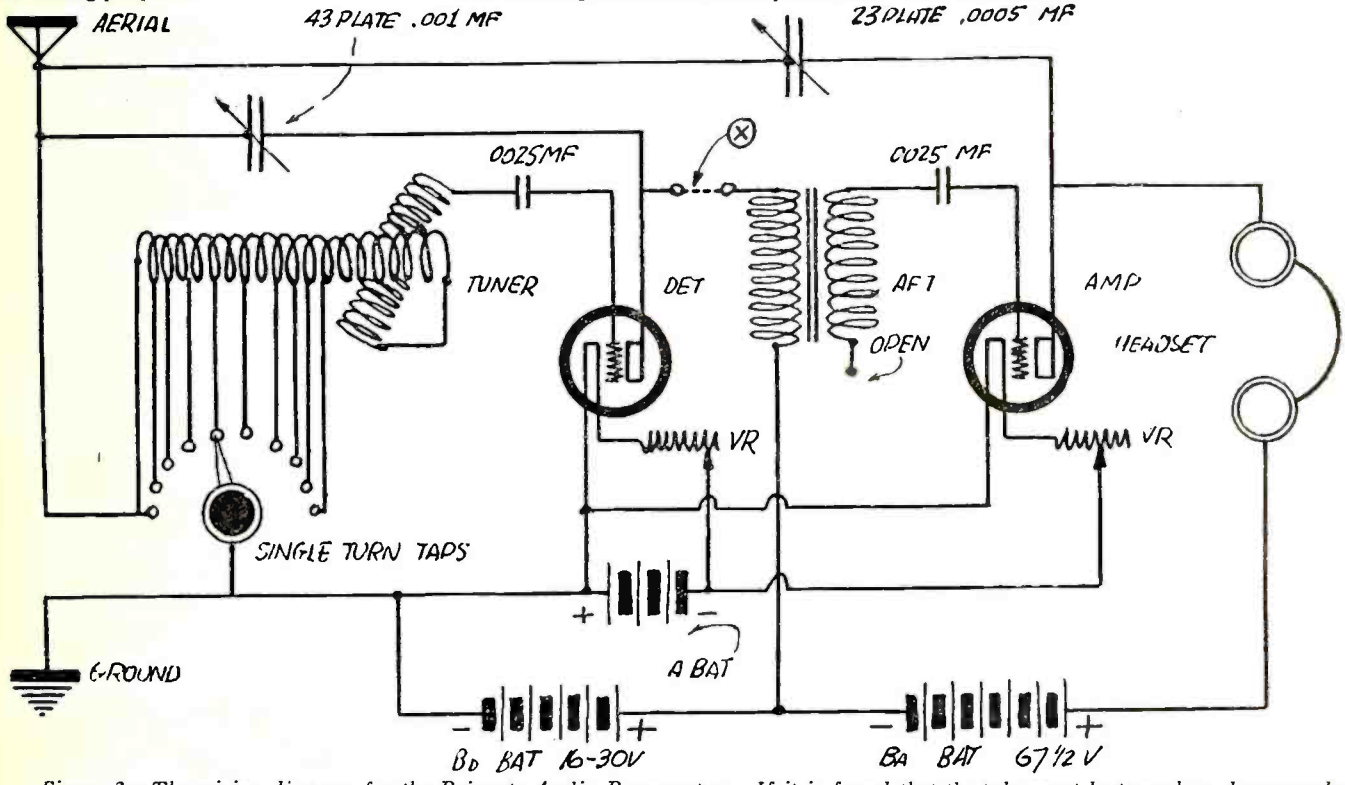


Figure 2—The wiring diagram for the Reinartz Audio Regenerator. If it is found that the tube must be turned on dangerously high to make the set oscillate properly, a choke coil consisting of about six turns of the same size wire as is used on the tuner on a 1-inch tube should be inserted at the point marked X.

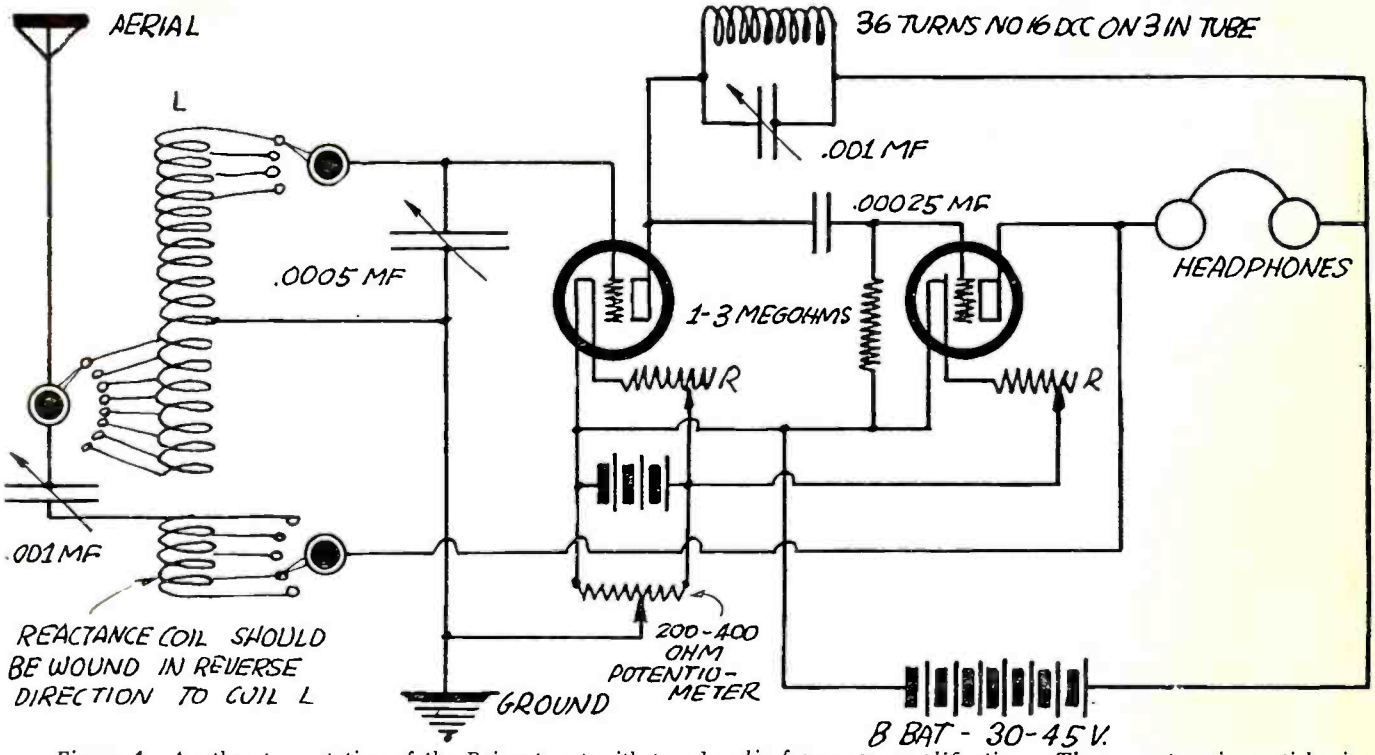


Figure 4—Another permutation of the Reinartz set with tuned radio frequency amplification. The accompanying article gives the necessary constants for building this set.

The 45th turn on the stationary coil is then connected to the first turn on the rotor as shown at "A" on the isometric sketch. This puts the two coils in series, very much like a variometer.

Additional Apparatus

For those who already have Reinartz sets, very few additional parts other than the variocoupler will be necessary, but for those constructing the first set of this type, we are printing a complete list of apparatus necessary. The parts are:

1 43 plate vernier variable condenser.
1 23 plate vernier variable condenser.
2 .0025 or .003 fixed condensers.
2 tube sockets.
2 rheostats, resistance depending on type of tube used.
1 set of phone tip jacks.
1 dozen switchpoints.
1 switch lever.
1 standard 4 or 6 to 1 audio frequency transformer.
5 Fahnstock binding posts.
2 standard binding posts.
1 7x15 inch bakelite or formula panel.
1 variocoupler fulfilling the specifications aforementioned.

Bus bar, mounting board, phones, tubes, batteries and other customary accessories.

After the parts have been acquired, the builder should arrange them on the panel and mounting board as shown in the isometric sketch.

If a single hole is drilled in the back of the cabinet, which should be of the hinged top type, all the battery wires may be run into the set through this hole and connected with ease to the spring type of binding posts as shown in the sketch. The antenna and ground posts are of more attractive design to preserve the general appearance of the set.

Operation

The set makes use of the audio regeneration principle, inasmuch as the condenser connected to the plate of the second tube feeds back capacitatively the audio currents of the second valve, very much in the same manner as the radio frequency is fed back to the antenna from the plate of the first tube. It will be noted that the grid condensers change their capacities from the usual .00025 to .0025 or .003 MF. This, with the open low voltage connection on the audio frequency transformer are practically the only departures from the usual circuits.

Mr. Reinartz claims that this permutation is easily equal to a two stage amplifier if properly constructed and intelligently operated.

The adjustments of the 23 plate condenser control the tone of the signal, and permits reception with unusual clarity. If, however, the condenser mentioned is advanced too far, the signal while terrifically amplified will contain an audible oscillation or tube howl. The condenser should be adjusted to a point where the circuit is so called "triggered off," an intermediate point where the circuit is quiet and clear. The signals are as produced by this triggering action clear, sharp and clean, and without "mush."

The set will function with practically any type of tube, but for the best results, a U V 200 should be used with about 16 or 18 volts on the plate and coupled to the second tube which should be either a WE VT 1 or other amplifying tube by an Acme transformer.

Other Improvements

Through the Technical Office of this magazine, the writer notices many requests for different permutations of the Reinartz circuit with radio frequency amplification of the tuned type. Figure 3 shows one type of circuit which is sometimes effective in this respect. The constants of the circuit are shown on the diagram, and need no comment.

(Continued on page 48)

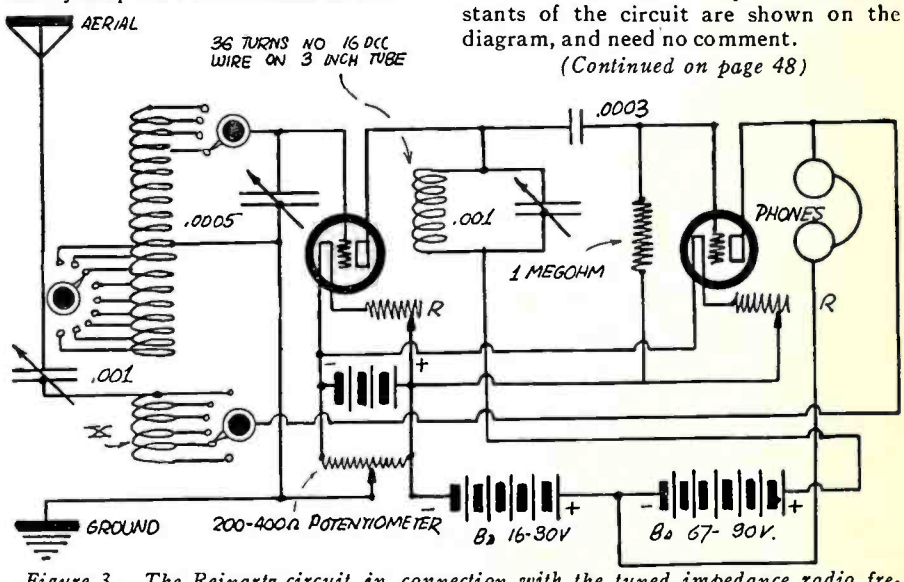


Figure 3. The Reinartz circuit in connection with the tuned impedance radio frequency method of low frequency amplification. This method is highly efficient in tuning over a broad band of waves.

Single Detector Tube Heterodyne

By JOHN B. RATHBUN

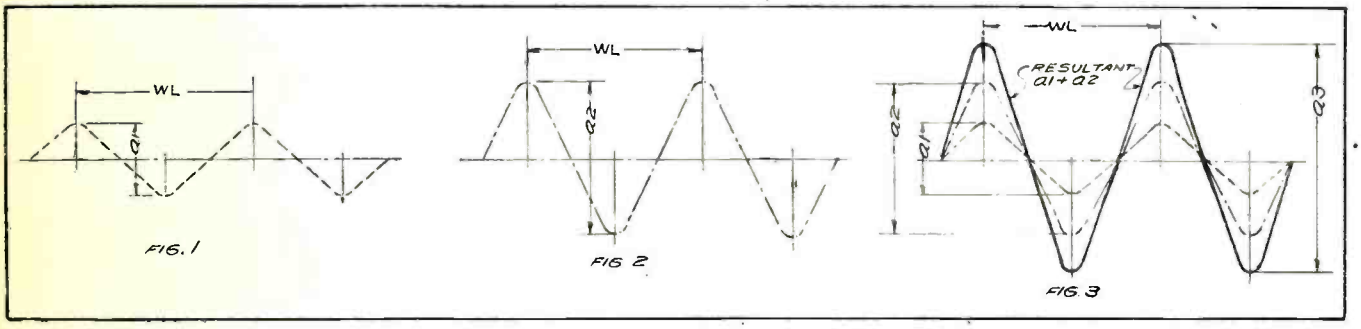
FOR the experimentally inclined this pocket edition heterodyne receiver will prove exceedingly interesting and instructive, and further still can be made the nucleus of a full fledged super-heterodyne set should the builder decide later to add the necessary stages of amplification. Properly constructed and handled, this baby of the heterodyne family is capable of very good results, particularly where there is much interference between local broadcasting stations. Its selectivity is one of its crowning features.

So much has been said of late on the working principles of the heterodyne and super-heterodyne that it seems almost unnecessary to enter into anything more than a brief outline of the heterodyne theory at this point. The purpose of the unit shown here is to adjust the tuning circuit to the frequency of the incoming radio impulses and then to augment these feeble waves by super-imposing other waves from a local oscillating tube upon the tuning circuit. The sum of the wave amplitude or wave intensity in the circuit is then made equal to the sum of the radio wave intensity and the oscillation wave intensity. This in a way is quite similar to the method used in feed back regenerative systems where the plate energy is fed back inductively into the secondary tuner coil except that a separate tube is used for this purpose. In fact, every regenerative circuit is to a certain extent a heterodyne in which the detector tube at once performs the functions of detector, oscillator and amplifier.

Using a separate tube as an oscillator is far more efficient, however, than using the detector tube for this purpose for there is no interference between the three functions when the separate oscillator tube is adjusted to the proper point for maximum oscillation. The proper filament adjustment for oscillations is seldom the best adjustment for detection or amplification, hence the single tube regenerative or "autodyne" cannot be expected to deliver the maximum output when working under all three principles.

Fig. 1 shows the normal oscillations in the detector-tuner circuit of a regenerative set, where (a1) is the "amplitude" or intensity of the radio waves. Fig. 2 shows the amplitude (a2) of the waves created by the local oscillator tube, and by a suitable supply of energy to this tube we can make the amplitude of the artificial oscillations several times greater than the value of the incoming radio waves shown in Fig. 1. The separate local oscillator tube can be adjusted to give any desired wave length so that these oscillations are very close to the frequency of the incoming oscillations.

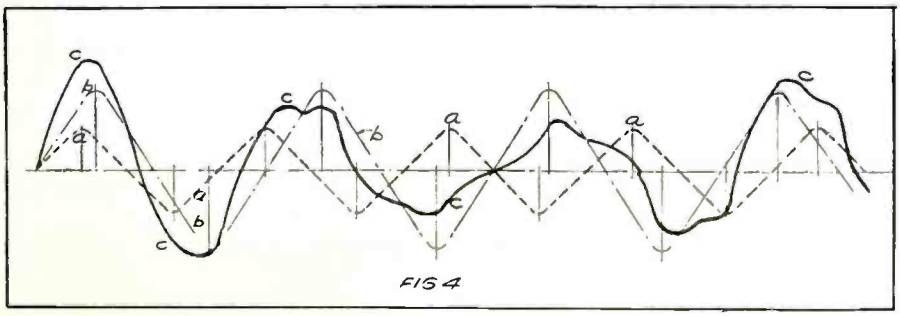
In Fig. 3 we have the oscillations from the oscillator tube impressed on the tuner circuit and so that the radio waves are in phase or in step with the waves of the oscillator tube. The total wave resulting from the two superimposed waves is shown by the heavy full curve and it will be seen that the amplitude of this wave (a3) is equal to the sum of the amplitudes (a1) and (a2) and that the amplification of the original incoming wave can be performed by adding another local wave to it. In the regenerative circuit or "autodyne," the detector tube supplies the wave (a2) and amplification is had to a lesser degree by the "feed-back method." In our present system with the separate heterodyne we can have the increase due to the detector tube plus the further increase due to the superimposed waves of the oscillator so that the total is much greater than before.



In all these figures we have assumed all of the waves were in step or in "phase," and that they were simple "sinusoidal" waves as delivered by the broadcasting station. This condition is best for the heterodyne having a single detector tube, but in the super-heterodyne where we are to reduce the effective wave length at the output of the detector for amplification in the following radio stages, we have another condition of wave summation. In the super-heterodyne the incoming radio waves from the aerial and the waves from the local oscillator are slightly "out of phase" or out of step in order to gain an interference which is commonly known as the "heterodyne note" or "beat note." It is by this method that we reduce the high frequency radio wave of the broadcasting station to a lower frequency wave.

Let us say that our radio amplifying transformers are adjusted for a maximum amplification at a frequency of 100,000 cycles per second, but that the incoming radio waves from the broadcasting station have a frequency of 800,000 cycles per second. This change of frequency from 800,000 to 100,000 cycles can be easily produced by the heterodyne method in which the independent local oscillator tube is made to impress a frequency of 700,000 cycles in the tuning circuit. The total or resultant frequency in this circuit is equal to the difference in the frequency of the radio waves and oscillator waves, or numerically: $800{,}000 - 700{,}000 = 100{,}000$ cycles per second in the circuit.

Since the waves must be out of step at the two frequencies of 800,000 and 700,000 cycles, the resultant wave is not exactly equal to the sums of the amplitudes but is somewhat less, and furthermore, the resultant wave of 100,000 cycles is no longer a pure sinusoidal curve but an irregularly shaped curve having several humps or peaks. In Fig. 4 we show the oscillator wave (b) out of phase with the radio wave (a) by just enough to produce the resultant wave (c) of 100,000 cycles. Since the amplitude of the wave (c) is equal to the sums of the other two amplitudes at every point in the length of the curve, we have a badly distorted "harmonic" which has a longer wave length than either of the other two waves.



When operating the single tube circuit we are operating more nearly under the conditions shown by Fig. 3 with all waves in phase or nearly so, but when we use the oscillator on a super-heterodyne having subsequent radio frequency amplifica-

tion at low frequencies then we control our oscillator tube so that the wave systems are out of phase as in Fig. 4. This is the only difference between our present single detector tube "baby" and the aristocratic super-heterodyne with two or three bushels of tubes. By use of the variable condenser which controls the oscillator tube, we can have the wave systems either in phase or out of phase at pleasure, hence we can use the circuit as a plain heterodyne or super-heterodyne at will.

SIMPLE SINGLE TUBE CIRCUIT

A simple single tube heterodyne can be made by introducing certain modifications into the common feed-back regenerative circuit so that the frequency of the plate circuit can be varied in respect to the frequency in the grid circuit. That is, the plate current is fed back inductively into the grid circuit in the usual way but additional means of frequency control are introduced into the plate circuit. A variable inductance such as a variometer may be used in series with the plate circuit or else a "tuned impedance" having an inductance coil and variable condenser can be inserted into the plate circuit. The latter is probably the more effective and will be used in the circuit described.

Fig. 5 contains the amplifier tube (T) with the grid condenser (K1) and grid leak (G). The tuning unit for wave length adjustment consists of a fixed coupler having the primary coil (P) and the secondary coil (S). The secondary coil is tuned by the variable condenser (C1) in the usual manner. The filament battery is at (A) with the rheostat (R). So far, the circuit is that of any simple tube circuit.

Plate current from the battery (B)

(*Continued on page 38.*)

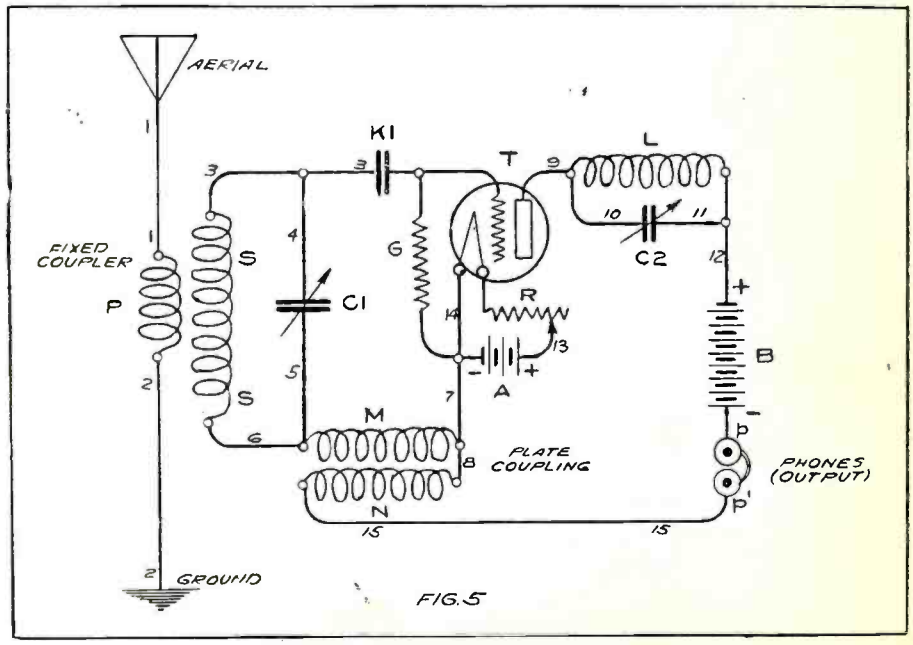


FIG. 5

Analogy of the Receiving Antenna

By FRANK D. PEARNE

JUST how the signals from a broadcasting station are received upon the aerial is somewhat of a mystery to the average radio enthusiast. He knows that the aerial is a very essential part of his receiving set and that almost any conductor strung across the roof, or between any high supports, will bring in the signals.

He will study carefully the different types of receiving sets to make sure that he understands which is the best for his particular needs and after it is constructed, he stretches a wire, or wires, across the roof with hardly any thought other than that of making it as high and as long as possible.

If he really understood just how the energy is received and just what action takes place in this very important part of his apparatus, he might be able to greatly increase the tone and quality of his reception. However, very little information on this subject is available and he can hardly be blamed for following along in the same rut as his fellow fans. It is true, much has been written in regard to long and short, high and low aerials, etc., but very little has been said in regard to how the aerial functions, excepting that it is a collector of electro magnetic waves.

Electrical Currents

The fact is that a current of electricity is set up in the aerial when electromagnetic waves cut through it, but as it is merely a conductor ending in the air, which is an insulator, the question often

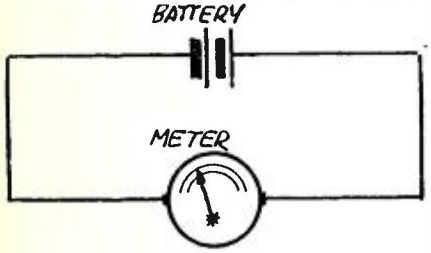


Fig. 1

arises as to how an electric current can flow in an open circuit. It is true (in the case of direct or continuous currents) a complete conducting circuit must be supplied before a current will flow and when such a curciut is established, the amount of current flowing will depend upon the electrical pressure applied and the electrical resistance of the circuit.

Such a circuit is shown in Figure 1. If this circuit is broken at any point, the current will cease to flow until it is again completed.

In Figure 2 we have an ordinary electric bell circuit, which forms a complete path over which the current can flow, with the exception of the button, at which point it is open. At any time the button is pressed, the circuit is completed, current flows and the bell rings. The air, being an insulator, will not let any current flow until an actual contact is made between the two springs in the button, by pressing on the knob.

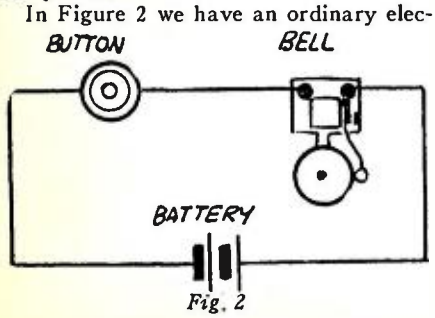


Fig. 2

Thus it is easily seen that an aerial circuit, with its open end extending into the air, does not supply a complete circuit and consequently a direct current cannot be produced in it.

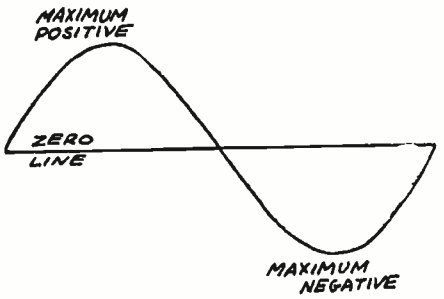


Fig. 3

A direct, or continuous, current can be compared to a stream of water flowing continuously through a pipe. The characteristics of an alternating, or oscillating, current are different. In this case instead of being continuous in one direction it starts at zero pressure, gradually rising to maximum, drops back to zero, reverses in direction, rises to maximum and comes back to zero, as shown in Figure 3. This illustration shows what is known as one cycle and the number of times it occurs in one second determines the frequency. While an alternating and an oscillating current are exactly the same, low frequency currents are usually referred to as alternating currents, while those of extremely high frequency are called oscillating currents.

In radio work, currents of very high frequency are used. For example, the ordinary 360 meter wave used by many broadcasting stations, is produced by a current having a frequency of 833,000 cycles and a 300 meter wave has a frequency of 1,000,000 cycles. Such high frequencies can not be obtained with ordinary alternating current generators and are usually supplied by vacuum tubes, which can be made to oscillate at the necessary high frequencies.

Resistance Governs Currents

Now in alternating current practice, the amount of current which will flow in a circuit is not only determined by the resistance of the circuit and the applied pressure, but two other factors enter into the consideration. These factors are called inductance and capacity. Inductance is caused by the rapid changes taking place in the circuit as the current rises, falls and reverses as shown in Figure 2. The effect of inductance is such as to set up a reactive current in the conductor, which opposes the applied current in direction. This reactive effect will depend upon the frequency of the current flowing through the conductor, being greater for high frequencies than for the lower frequencies. This inductive reaction tends to choke back the applied current, causing the current to lag behind the pressure. In other words it supplies another form of resistance which is not encountered in direct current work.

Capacity may be said to also be another form of resistance to alternating, or oscillating currents, although its effect is negative as compared with inductance and by the proper proportion of each, the effect of both inductance and capacity reactance can be neutralized, or made zero. As the effect of capacity is very essential not only in the aerial, but also in the receiver, the reader should have a very thorough understanding of its cause and nature. If two conductors having considerable surface are placed very close to each other, but not allowed to touch, and direct electrical pressure is applied to them, current will flow for a very small fraction of a second, after which it ceases to flow. This is due to the fact that the large surfaces of the conductors absorb some of the current, although the circuit is not complete. The current, however, will only flow long enough for the conductors to receive a charge equal to the applied pressure, after which no more current can flow, for the pressure in the

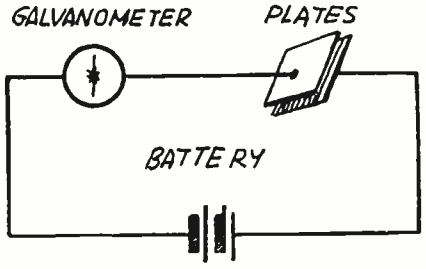


Fig. 4

conductors is then equal to the applied pressure and opposes it.

The size of the conductors, the distance of separation and the quality of the insulating material between them (in this case air) will determine the amount of current which will flow into them and the length of time required for them to receive a charge equal to the applied pressure.

Use of Galvanometer

Figure 4 shows such an arrangement with a battery supplying the pressure and a galvanometer connected in the circuit. At the instant the current is applied, a slight movement of the galvanometer will be noticed, showing that some current has moved in the circuit, although this circuit is open (between the con-

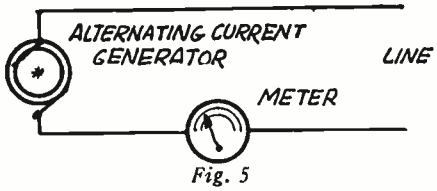


Fig. 5

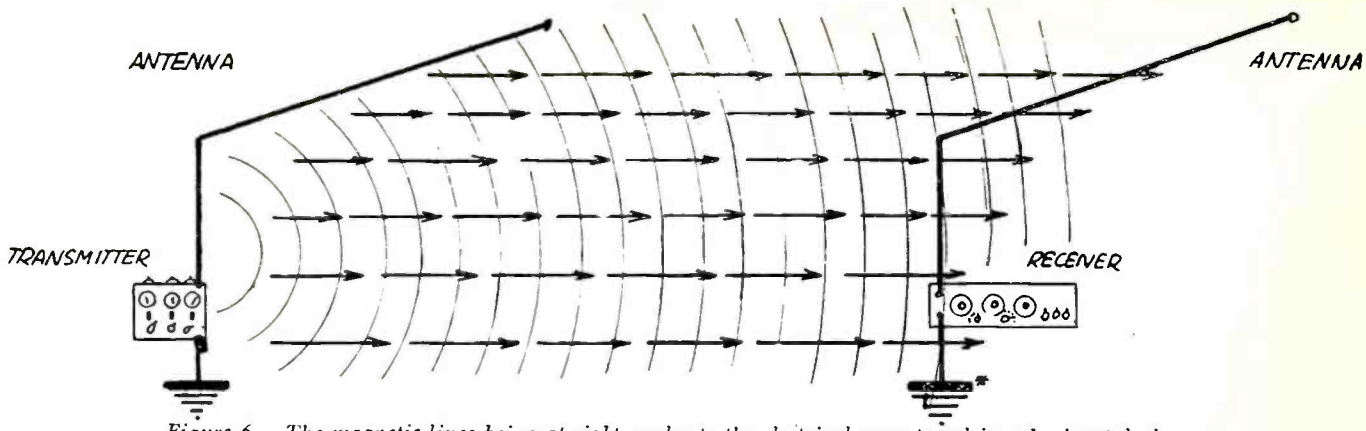


Figure 6. The magnetic lines being at right angles to the electrical wave travel in a horizontal plane.

ductors, or plates). Now if the current is quickly reversed, the pressure stored in the conductors will act with the current of the battery, or applied pressure adding its stored-up pressure to that of the battery and the combined pressure of both will flow through the galvanometer in the opposite direction, until the conductors become charged again. Each time the current is reversed the conductors will be discharged and charged up again in the opposite direction and it will be seen that if an alternating, or oscillating current is applied to the conductors, at each change in direction of current, a slight current will move, although the circuit is open. It is true that it moves for only a small fraction of a second, but it moved and that is the important thing. The galvanometer will show that a slight current flows first in one direction and then the other, as long as these reversals in current take place. This action of the conductors, or plates, is due to the capacity for absorbing a certain amount of current in receiving a charge. Now it will be apparent that the larger the conductors and the closer they are together the more capacity they will have, causing the current to flow longer before they become fully charged.

Figure 5 represents a condition which very often occurs on alternating current circuits. An ampere meter placed in the circuit near the generator will show some current flowing even though the circuit is open at the distant end. This is due to the capacity of the conductors absorbing and discharging current.

Action in Antenna

After this discussion on the subject of capacity, it becomes a simple matter to explain the action of the antenna. The energy supplied to the aerial of the transmitting station produces both electrical and magnetic effects. The electrical wave is in the form of a strain between the aerial and ground which is released at each pulsation carrying with it the tiny magnetic lines of force which eventually reach the receiving aerial and in cutting through it, produce a current of extremely low pressure in the aerial and the primary coil of the receiving set which is included in the circuit.

The principle involved in the production of this current is similar to that of the dynamo, in which the conductors are revolved in a magnetic field and made to cut through the magnetic lines of force. In the case of the aerial the lines of force are made to cut through the conductor. The electrical wave passes out into space in the form of lines from the aerial to the ground as shown in Figure 6. The magnetic lines being at right angles to the electrical wave travel in a horizontal plane, cutting through the receiving aerial as shown. As each cycle of the incoming wave reverses, the lines cut through the receiving aerial, first in one direction and then the other, producing in it, a current of the same frequency as that sent out from the broadcasting station. As each impulse is of extremely short duration, the capacity of the aerial should be enough to allow as great a charge as possible, or in other words, should be enough to allow it to charge completely with each impulse as previously explained, in order that entire antenna circuit may be made to oscillate in unison with it.

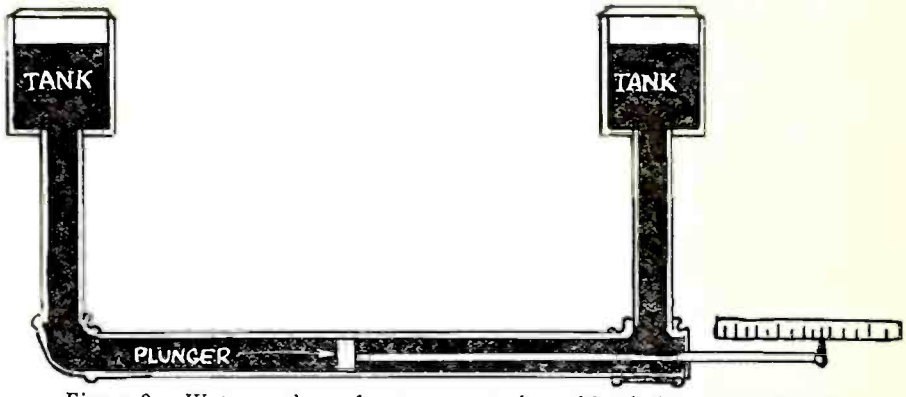


Figure 8. Water analogy of antenna capacity, with relation to wave length.

As the magnetic lines travel in a horizontal plane, most of the cutting takes place in the vertical part, or lead-in of the aerial, the horizontal part on the roof acting more as a capacity than as a receiver. In fact, if the flat part of the aerial is the same height on both ends, no cutting of the lines through it will take place, as the lines travel in the same plane with it, but if the end farthest from the lead-in is slightly elevated, then some cutting of the lines will take place, although the current produced in this part will be slightly out of phase (later, or ahead) with that produced in the vertical part, but it will be in the same direction.

Effect of Height

If, however, the distant end is considerably lower than the lead-in end as shown in Figure 7, then the current produced in this part will be in the opposite direction to that in the vertical part and the result obtained will be the difference

(Continued on page 44.)

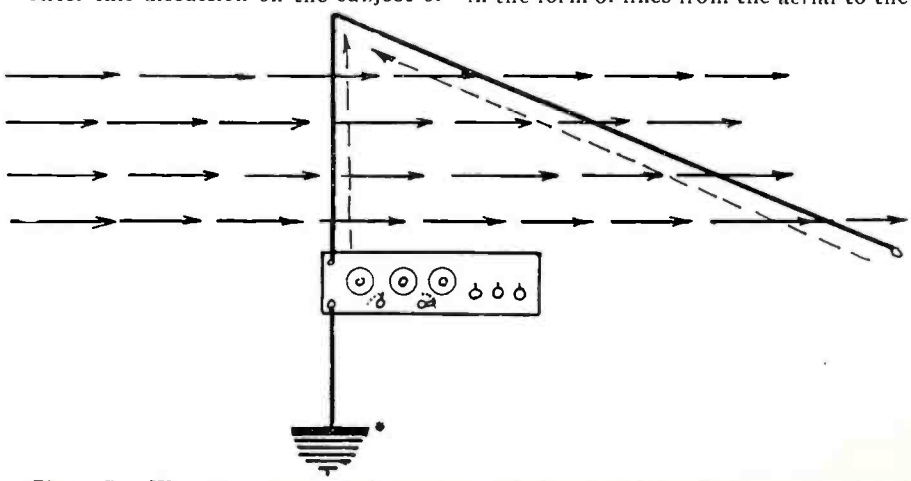


Figure 7. Wrong construction of antenna. The lines cut in such a manner as to set up opposing currents.

Interference Rejectors

By FELIX ANDERSON
Technical Assistant, Radio Age

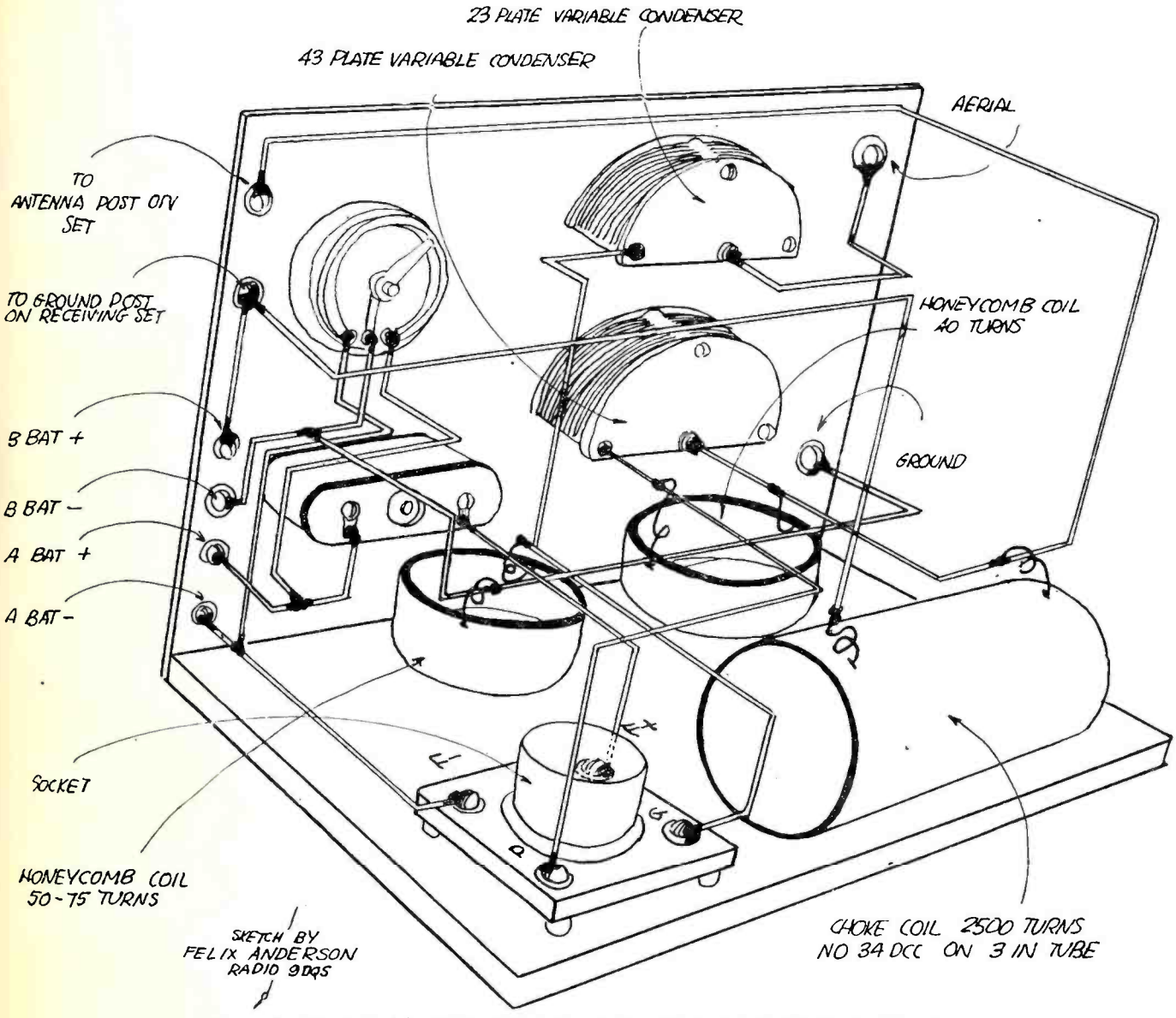


Figure 4—The isometric sketch of the tube rejector, illustrated electrically in figure 3.

IN THE January issue of RADIO AGE, the writer gave some practical hints on the construction of wave traps, and eliminators, useful in tuning out interference from stations and other sources, which met with the approval of many fans. The article, while describing in detail some of the more simple but nevertheless effective types of filters, did not comprise two types which are of great value in eliminating interference, and which are of great help in eliminating signals of disturbing nature.

The writer realizes fully that the average fan will not stop at expense or trouble when it comes to removing this obstacle from his path, and wishes therefore to give detail on the construction of two more elaborate types of so-called rejectors.

The first of these two rejectors is a system widely used by the British Marconi Company for tuning out interference from continuous wave stations. Broadcast stations using tube transmitters are included in the category of modulated continuous wave transmitters, and the rejector shown in Figure 1 is therefore of material assistance in eliminating signals from a station of that type.

The only disadvantage that this type of rejector has, is its cumbersome and clumsy construction, but the relative efficiency of a system of its kind greatly offsets any constructional or mechanical difficulties.

Procure about four feet of very heavy copper wire about the size used for street car trolley wire or larger, four switch levers, eight switch taps, about ten inches of copper strip one thirty-second of an inch thick or heavier, one dozen small nuts and bolts, a piece of brass eight inches long, one-sixteenth of an inch thick and about three-quarters of an inch wide, two binding posts, and four fixed condensers of the mica type of the following capacities: .001 MF, .002 MF, .003 MF, and .005 MF. You will need several feet of bus bar for wiring, a suitable mounting board or panel or other arrangement to fasten this accumulation of apparatus on.

Drill a hole large enough for a shaft to mount the slider in the panel or mounting board as shown in Figure 1. If you can acquire one of those porcelain gas stove handles such as is used on gas burner stop cocks, use it as a knob to vary the slider. Drill holes large enough to fit the small mounting screws to the panel (which by the way should be large enough to accommodate a fifteen inch circle of the heavy wire) at regular intervals along the circumference of a circle of fifteen inches diameter.

The next step is a feat of strength. The heavy wire must be bent into a well rounded circle of 15 inches diameter. After this has been done, it is carefully

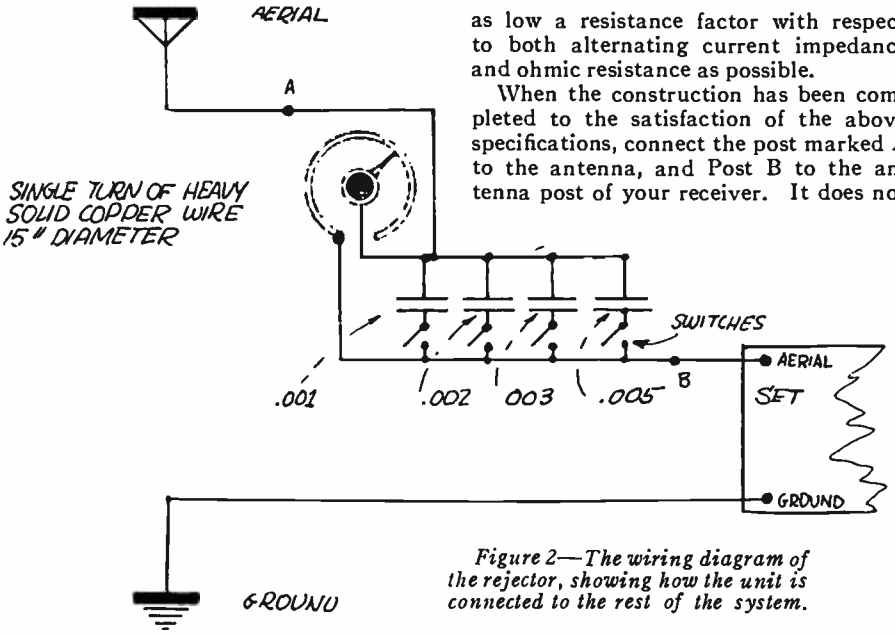


Figure 2—The wiring diagram of the rejector, showing how the unit is connected to the rest of the system.

sandpapered, and soldered rigidly to the copper strips which are cut from the ten inch piece of copper. The illustration shows how this is accomplished. The slider, constructed from the brass strip, should next be drilled and mounted so as to run smoothly over the entire arc. Drill for the mounting of the switch levers, and switch points and make allowance for the two binding posts. Two switchpoints must be used, one to throw the condenser into the circuit and the other out.

When all the apparatus has been mounted either according to the above instructions or to the taste of the builder, the instrument should be wired according to the diagram shown in Figure 2. The isometric sketch of the rejector also portrays clearly the method of wiring up such a unit.

Solder all the connections, and make sure that not a poor connection exists in the set. The secret of the entire rejector lies in the construction to make it possess as low a resistance factor with respect to both alternating current impedance and ohmic resistance as possible.

When the construction has been completed to the satisfaction of the above specifications, connect the post marked A to the antenna, and Post B to the antenna post of your receiver. It does not make a particle of difference what type of circuit you are using so long as it uses an antenna of the open end type. This circuit can be used with loop aerials, but the writer hardly deems it necessary to use an arrangement of this type with a properly constructed loop.

The rejector is tuned very much in the same way as the ordinary wave trap is operated. Different settings of the switches controlling the condensers, and varying of the slider on the inductance will reveal a certain well defined point where the signal of the interfering station is obliterated.

The receiver is then tuned to any wave except that to which the rejector is tuned.

The action of the rejector is the same as that of a wave trap, inasmuch as it consists of a highly selective parallel tuned circuit which is connected in series with the antenna lead. The rejector when properly tuned to the interfering wave by the manipulation of the condenser switches and slider offers a very high impedance to the frequency of that signal, while to other signals on other frequencies, the impedance is negligible. The signal not wanted is dissipated in the wave trap or rejector, while other signals which are not coming in on the same wavelength pass through the rejector without resistance.

The rejector may be connected into the antenna in the manner shown in Figure 5, page 6, of the January, 1924, issue of RADIO AGE, where it performs the same duties as outlined for the wave trap connections of that article.

It may not be amiss to again mention that if results are to be obtained with this type of filter, the condensers must be of low loss construction, the connections should be rigid, and it is even a good plan to wire the rejector up with wire of as great a thickness as mechanical reasonableness will permit. A number 10 or 12 wire is not any too large, and a strip of sheet copper cut into a ribbon about 1–2 inch wide is vastly superior for connecting purposes.

If you can convince yourself that a clumsy affair of the dimensions given is efficient enough to offset the appearance and convictions that radio apparatus should be as small as possible without regard to electrical specifications, we certainly recommend your constructing one of these rejectors.

Vacuum Tube Rejector

The most elaborate of all the interference preventors, selectors and systems to prevent interference as yet outlined in RADIO AGE is the radio frequency amplifier-rejector, which requires more apparatus than the ordinary detector circuits now in use.

A glance at Figure 3 will reveal that the circuit is really nothing more than a simple radio frequency amplifier which can be connected to the antenna and ground posts of any of the conventional receiving sets now in use. The circuit is, however, really more than that, due to the fact that it contains in its plate circuit a highly selective wave trap, which in con-

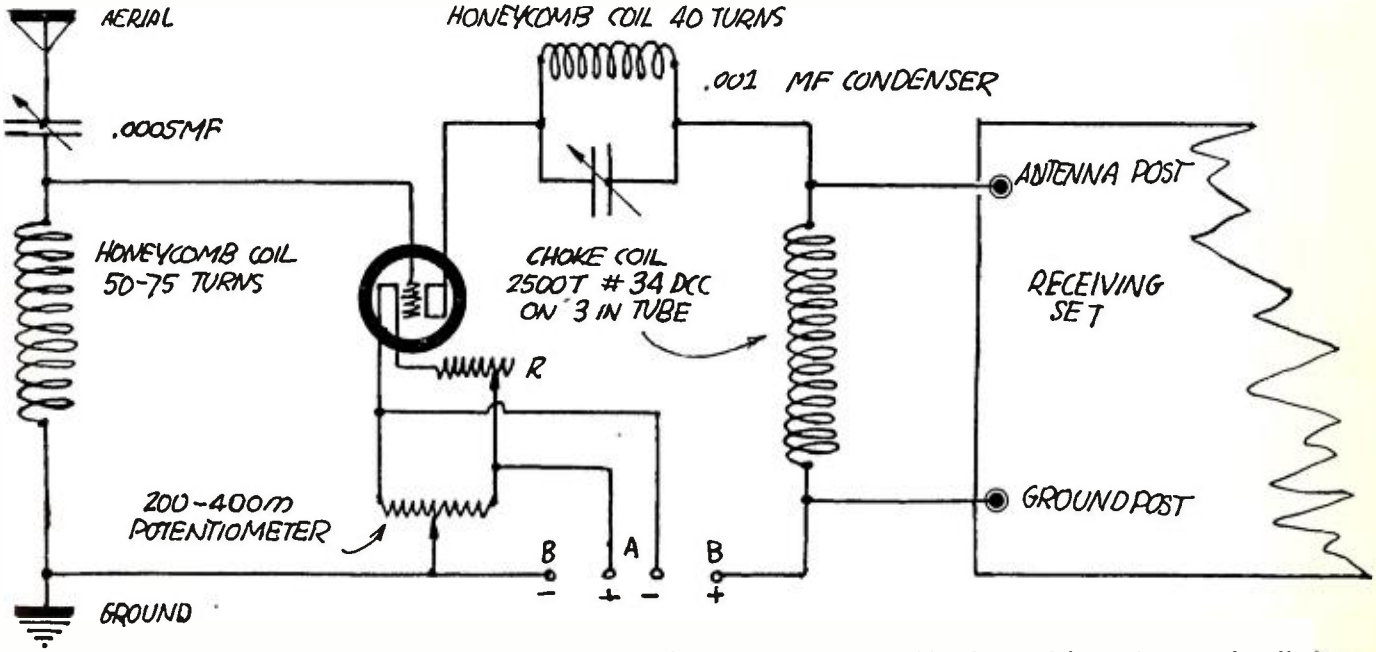
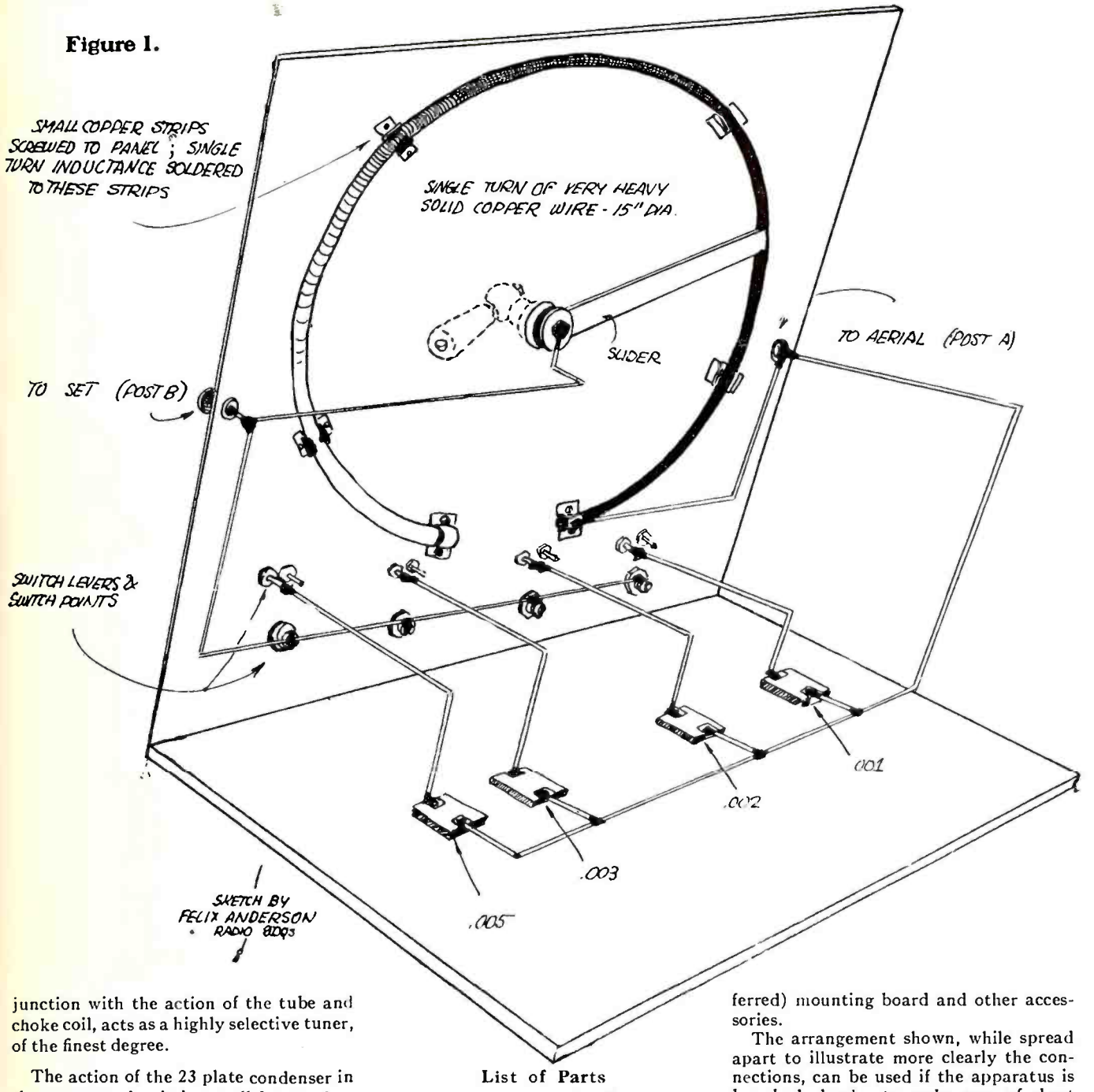


Figure 3—The tube type of rejector is one of unusual merit, and fans who are looking for an elaborate but sure-fire eliminator should try the one described herewith.

Figure 1.



junction with the action of the tube and choke coil, acts as a highly selective tuner, of the finest degree.

The action of the 23 plate condenser in the antenna circuit is a well known factor, inasmuch as many fans are already aware of its value in tuning. This condenser in connection with the honeycomb coil used as an inductance, form a preliminary tuning circuit much similar to the one described under the title of simple series eliminator in the January issue. Together with the action of the tube, which further increases the sharpness of tuning, it is in itself a circuit from which average selectivity may be expected.

The insertion of the forty turn honeycomb coil and 43 plate condenser in the plate circuit further removes the obnoxious interference, which we are trying to eliminate, and this, together with the tuning qualities of an efficient receiver, forms probably the most surefire method to rid one's self of what the amateurs term "QRM."

List of Parts

The necessary parts for the construction of a unit of this type are rather many when one considers that it is merely to be used as an interference preventer, but one should remember that in addition to its being a boon as far as selectivity is concerned, it is a simple radio frequency amplifier of efficient design. The parts necessary are:

1 7x10 inch panel.
1 23 plate condenser vernier type preferred.
1 43 plate condenser vernier type preferred.
1 50-75 turn honeycomb coil.
1 40 turn honeycomb coil.
1 rheostat.
1 200-400 ohm potentiometer.
1 tube socket.
1 radio frequency choke coil wound to specifications.
8 binding posts.
Bus bar, tube (Western-Electric preferred) mounting board and other accessories.

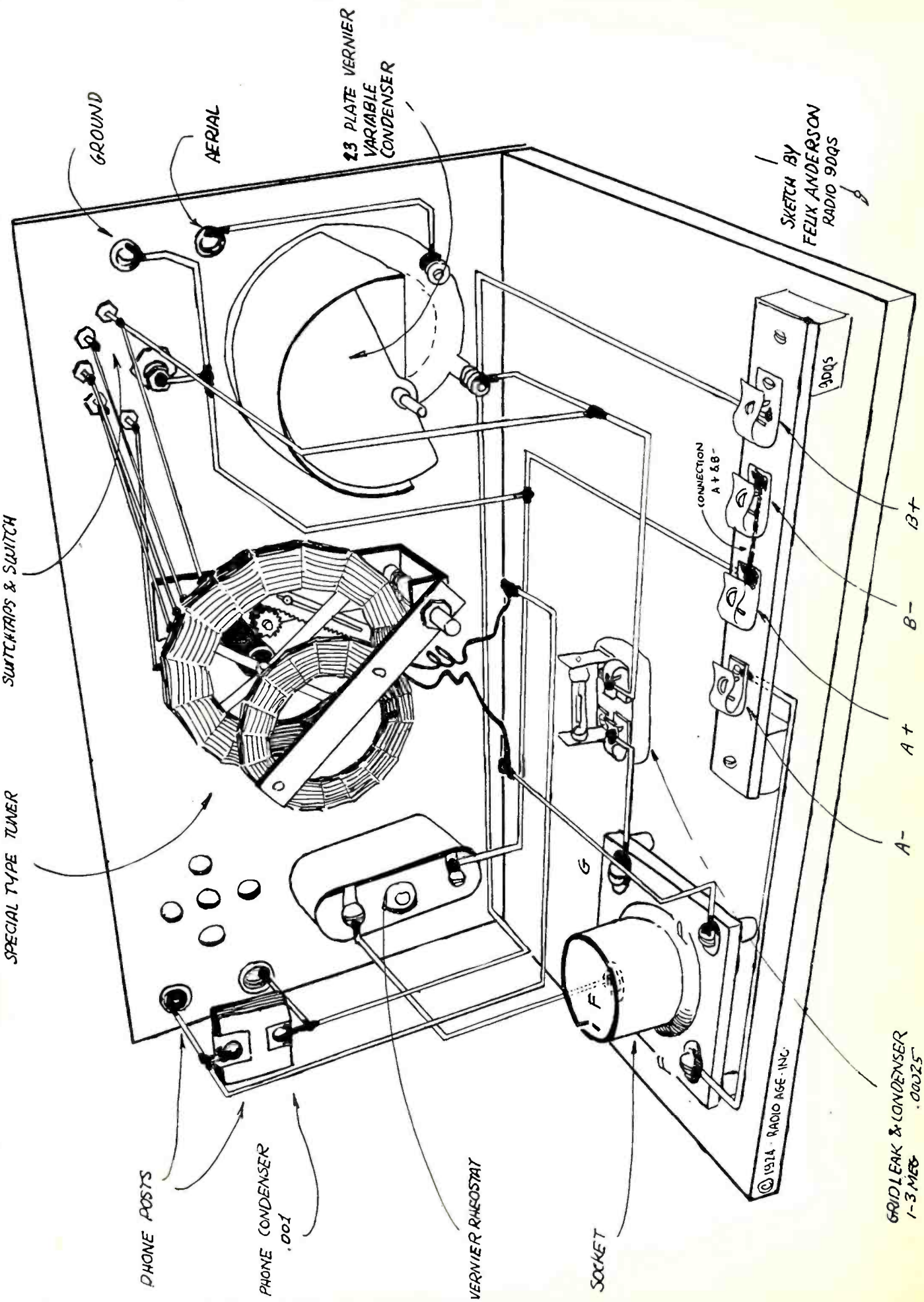
The arrangement shown, while spread apart to illustrate more clearly the connections, can be used if the apparatus is bunched closely, to make sure of short leads, so necessary in the construction of radio frequency apparatus. If the builder desires he may use his own judgment as far as arrangement is concerned so long as he observes carefully the rules regarding the construction of radio frequency units.

The construction is largely a matter of personal choice of apparatus, and knowing that amateurs rarely work to given dimensions, we refrain from printing template instructions or definite measurements.

The size of the honeycomb coil in the antenna circuit is largely dependent upon the size of antenna, and a little experimenting with coils of different sizes will soon determine which is the proper size to use.

The choke coil is probably the only difficult thing to make (here is where the

(Continued on page 38.)



An isometric sketch showing the simple, cleancut and effective arrangement of the set described by Mr. Pearne in the accompanying article. This set makes an ideal beginner's receiver.

The Old Reliable Circuit With New Tuning Unit

By FRANK D. PEARNE

MANY of the old time circuits, the ones which we used to build in the old days when broadcasting was hardly known, have proved their value over and over again and if the truth were known many of the supposedly new and intricate circuits of the last year or two are merely additions, or rearrangements of these old-timers. Some of these changes are for the better and some for the worse, but the original basic principles are still there and may be easily recognized if the circuit is carefully analyzed.

One of the most popular improvements was the substitution of the spider web coil instead of the large variable inductances previously used. The principal advantage of such a coil is the reduction of the distributed capacity which is present in straight layer windings. Distributed capacity acts like an extra load connected across the terminals of the coils, using up much of the feeble energy received upon the aerial and anything which tends to reduce it, is sure to improve reception, especially in the reception of signals from distant stations.

However, until recently no very convenient method of adjustment has ever been applied to such coils and the mounting and adjusting arrangement was usually left to the discretion of the builder and as might be expected, most of them were marvelous feats of engineering. Nearly all the adjustments were obtained by swinging one coil away from the other at right angles, the movable coil being mounted on some sort of a hinge which unless very carefully made, would not give the same adjustment two times in succession.

In the circuit shown in the accompanying drawing, the movable coil is made to move in the same plane as the stationary coil. making a coupling between the two with a flat magnetic field and by this method, the lines of force are concentrated, instead of being spread out. Because of this concentration, the lines do not penetrate to the other parts of the set and cause such disturbances as howling, nor will they waste their own energy.

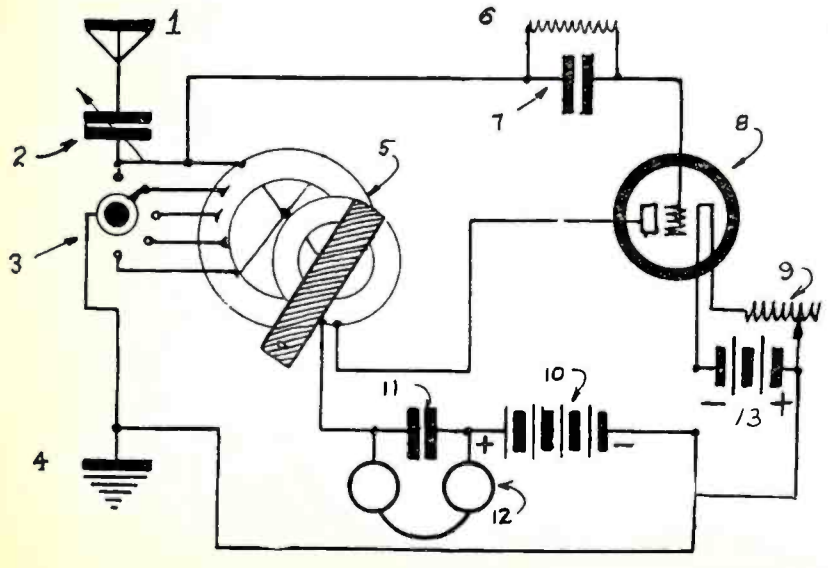
The tuning arrangement shown in the drawing was originally invented by Mr. Carl Pfanstiehl, president and engineer of the Pfanstiehl Radio Service Company, back in the early part of 1923, and as it has proven such a success in thousands of sets produced by him, he has consented to show his method to our readers. This sliding method of adjustment can be adapted to any of the popular circuits where the space is limited and will be found to give very close and sharp tuning.

In the circuit described, the movable coil is included in the plate circuit, and acts as a feedback, making the set regenerative, and as by this method its position can be changed so minutely that the amplification by regeneration can be controlled to a very fine point, which is so necessary in getting long distance reception. The 23 plate condenser in the aerial circuit will also help to a marked degree in bringing in the distance.

While a carbon rheostat is shown on the panel, merely for convenience, any standard rheostat will answer the purpose very nicely. The phone condenser is used to by-pass the radio frequency current, which cannot get through the highly re-active windings on the phones. Any standard detector tube may be used and the filament battery selected will be determined by the type of tube used.

Figure 1 is an isometric drawing showing the panel arrangement and layout of the parts. This can be any convenient size of panel and baseboard to suit the cabinet which the builder can obtain. Figure 2 is a schematic arrangement of the circuit showing a list of the necessary parts and their different values.

This circuit in use in Chicago has been picking up California and all distant points in America. The circuit is not unusual and has been thoroughly tried out and can be depended upon and the total absence of any dielectric material in the magnetic field, eliminates loss of energy through dielectric absorption, and in the reception of distant signals. This point is of the most vital importance.



LEGEND

1 AERIAL
2 23 PLATE VERNIER CONDENSER
3 SWITCH & SWITCH TAPS
4 GROUND
5 TUNING UNIT
6 GRID LEAK—1-3 MEGOHMS
7 GRID CONDENSER .00025 MF.
8 ANY TYPE TUBE
9 VERNIER RHEOSTAT
10 B BATTERY 16-30 V.
11 PHONE CONDENSER .001 MF
12 HEADSET
13 FILAMENT BATTERY

MacMillan's Messages

An absurd newspaper dispatch was published recently to the effect that the Aerial League of America was urging radio operators to check up and try to determine why Dr. Donald B. MacMillan's radio messages "had not been heard in Canada and the United States." One Chicago daily gave the "story" quite a play and other papers in various parts of the country gave it space.

It apparently had escaped the notice of all these editors that practically every newspaper in the country for several months has been publishing items about reception of messages from Dr. MacMillan. Interesting accounts of how Jack Barnsley had received and relayed many messages from Canada to the United States have frequently been printed.

Denial of the Relay League's astonishing suggestion was slow in overtaking the original misstatement. On December 17 Kenneth B. Warner, president of the A. R. R. L. effectually spiked the yarn. President E. F. McDonald, Jr., of the National Association of Broadcasters also sent a statement broadcast, showing that communications had been received regularly in both the United States and Canada.

"NERK!"

WASHINGTON, D. C.—With the materialization of the plans for the polar trip of the naval air cruiser, "Shenandoah," or the ZR-1, it has been decided that her original 300-mile radio equipment first described in these columns last July, is inadequate and a brand new transmitting unit good for a thousand miles has been developed by naval radio engineers.

If, late in July or August, fans pick up the call, NERK, they may shout with glee, for it will be the "Shenandoah" communicating with one of the far-northern radio shore or ship stations.

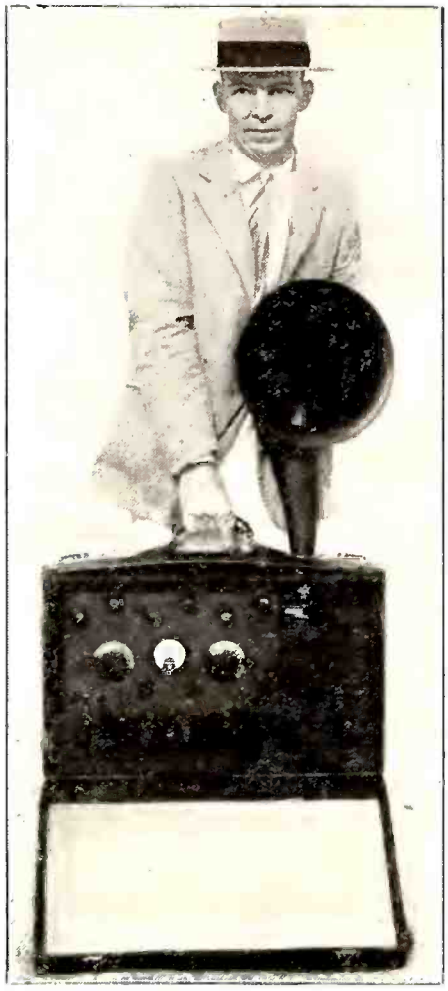
Radio equipment plans for the "Shenandoah" include two transmitting sets, two receiving outfits and a radio compass. The high-powered set which replaces the six fifty-watt tubes, includes two 2-kw tubes, with an input of 4 kw, and an output of 2 kw. With this transmitting set it is believed several northern radio stations such as exist in Iceland, Greenland, Spitzbergen and Russia, or our own Alaskan stations, can be reached. With the powerful receiving sets Annapolis, Cordova, Lafayette, Nauen and other high-powered stations can be copied, or used as points to establish the position of the great airship by means of the radio compass. This instrument is now believed indispensable on this exploration trip from a base at Point Barrow, Alaska, 1,117 miles south of the Pole.

Besides the high-powered transmitting set, an auxiliary medium-range telegraph and telephone set is to be installed aboard the aerial cruiser. The telephone feature will be utilized for communicating with ground stations when landings are being made for the immediate transmission of orders to the ground crew or operators at the mooring masts.

All the radio equipment weighs is 1,023 pounds, which in itself is believed by engineers to be a great accomplishment, giving a transmitting radius of approximately a mile a pound. This is very light in comparison to the radio apparatus carried by surface vessels of the navy. The after-section of the control car will be used as the radio shack. Some difficulty in locating the radio compass where it will be operative and yet not hinder the progress of the airship and interfere with landings is being encountered, but this problem will be solved soon, radio experts declare.

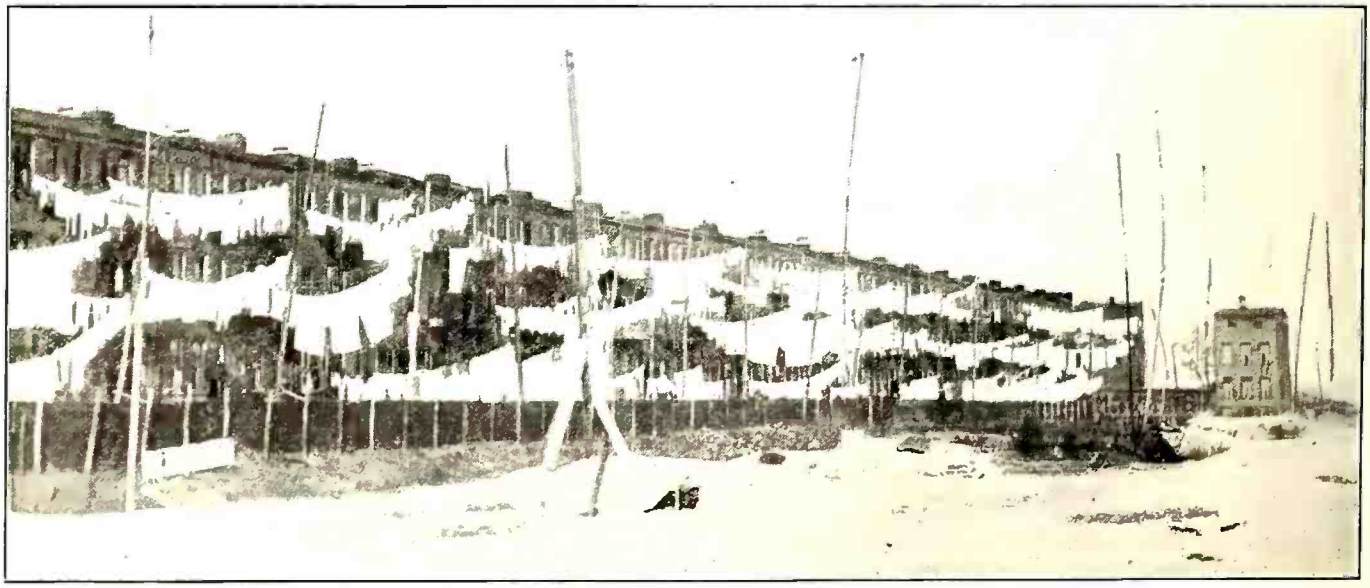
The plans call for the use of two-base ships in the far north, each of which will be outfitted with a mooring mast and carry radio apparatus for communicating with the "Shenandoah" when she is on voyages. One of these remodelled tankers will be sent to Point Barrow, 70° north, and the other will in all probability be dispatched to Spitzbergen, where it is hoped a temporary radio-compass station can be established. Two other portable radio-compass stations will also be erected as far north as they can be pushed. With the two ships, this will give the "Shenandoah" five radio compass stations of her own from which to check her position and progress toward the top of the world, even if she fails to pick up existing radio stations.

As has been pointed out previously, radio will enable the navy to check the position of the airship and if the pole is reached to prove it conclusively by cross bearings made aboard. Her positions could be rechecked later by northern stations having radio compasses. This eliminates faking of a position not attained and is a new feature in polar exploration made possible by radio. Since the Arctic summer is barely two months in length, and daylight is believed a necessary requisite in this venture to the Pole by air, speed in establishing the temporary radio stations in the north is necessary, so that the airship need never be out of touch with main and auxiliary bases.



"Radio Dare-devil"

Major Edward H. Armstrong, of New York, is here shown with a six-bulb suitcase receiver. The major is seen in summer attire because he was snapped at Palm Beach, Fla., where he went for a honeymoon. Mrs. Armstrong was Miss Marian MacInnis, of Merrimac, Mass. It was Major Armstrong who applied the regenerative principle to radio circuits.



AERIALS AND CLOTHESLINES

Picturing the back of a row of tenements near Jackson Avenue, Long Island City, where the tenants are not permitted to string aerials on the roofs. To overcome this objection, a young forest of backyard poles in competition with wash poles serve as aerials for the radio enthusiasts.

Crystal, to Tube, to Loud Speaker

A Two Stage Audio Frequency Amplifier to Use With Selective Receiver Described in January Radio Age

By J. A. CALLAHAN

IN LAST month's description of a selective tube receiver, evolved from our original crystal detector circuit of the December issue, we have considered merely what may be regarded as the essential processes of reception.

The response of all methods of reception can be further improved by straightforward amplification.

We conceive the most simple to be that method which deals with amplification of low frequency currents which is called, for obvious reasons, as previously discussed, audio frequency amplification. Radio frequency currents are by no means as simple of control and the perfection of the type of amplification under discussion is advisable before any attempt at the other is assayed.

The method consists essentially of a series of audion amplifiers arranged electrically so that the amplified output of each tube is passed on successively to the next to be again amplified. Each tube with its passing-on coupling is referred to as a stage, or step in the amplifier.

As magnification of tube and battery noises, and other disturbances of this nature, is proportional to the magnification of the signal received the number of audio frequency stages which are advisable are two, possibly three.

Several methods of linking tubes are possible; resistance, inductance or transformer coupling. We are offering herein the latter method as affording the greatest degree of increased volume.

Transformers

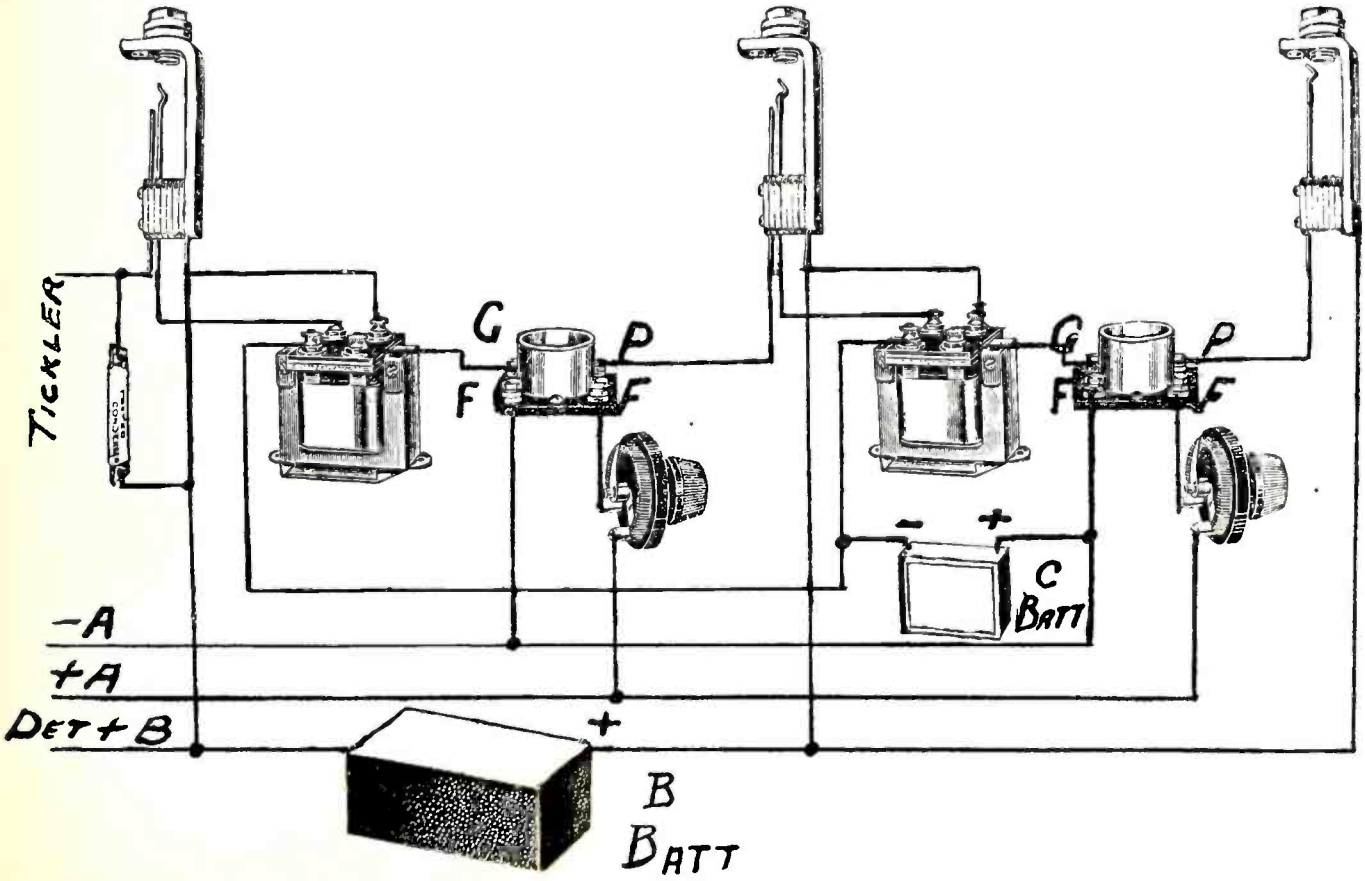
In selection of transformers preference should be given to those types which are shielded. In view of the low cost of these units a discussion for their construction does not seem necessary. The proper ratio is a six to one on first and second stages respectively. It is advantageous to connect the second stage of amplification as a push-pull type. This method was described at length in the January issue of RADIO AGE with a presentation of its virtues.

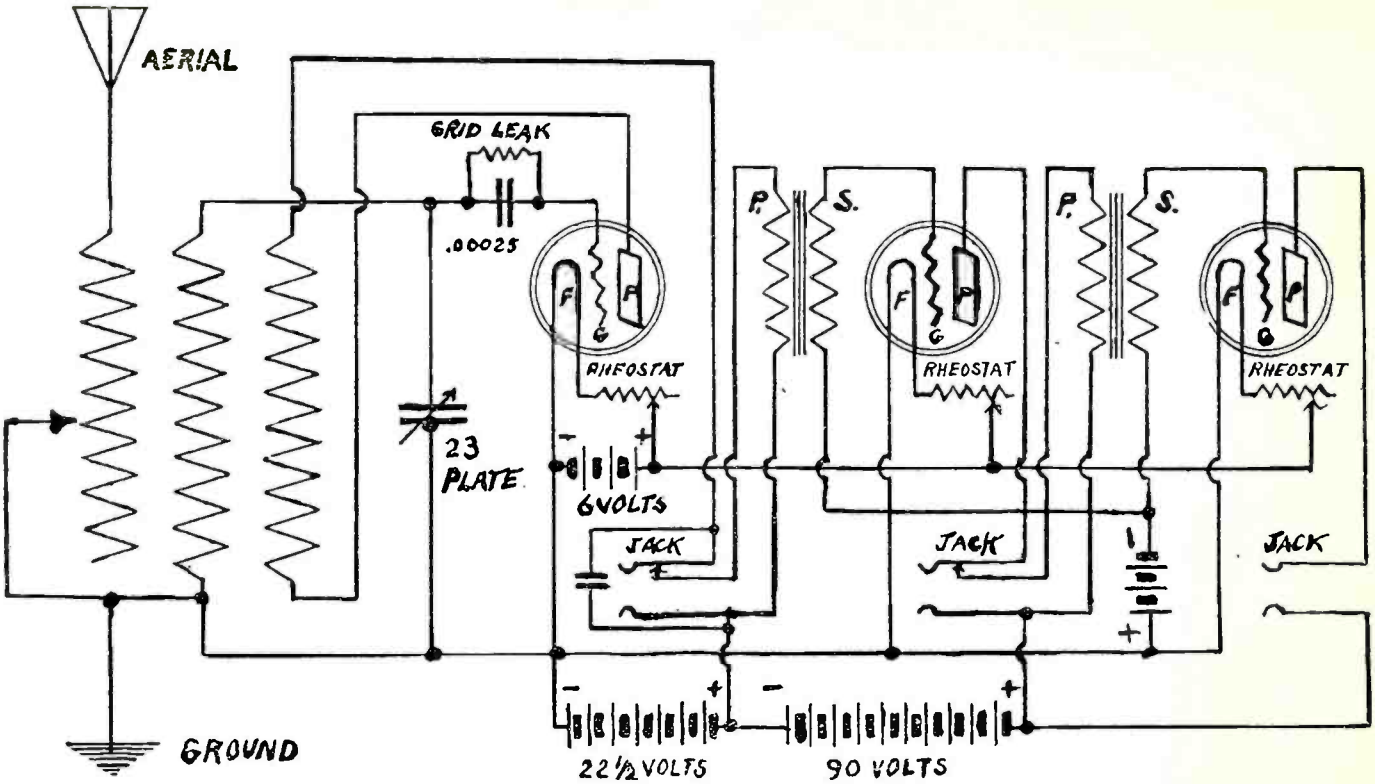
Switches or jacks are usually provided for connecting the telephones either in the plate circuit of the second tube for full amplification or in the plate circuit of the first tube for the use of a single stage. In the diagram pictured, jacks are shown and are of the three-prong type which are preferred by the writer because they are more simple to connect, having one less contact as a source of disorder. This method of jack connection allows one side of primary to remain connected to circuit; however, with audio frequency current there will be no disadvantage of dead end or capacity losses.

If the four-prong jacks are preferred, they can, of course, be employed.

Filament control jacks can be employed and do not differ in construction from other standard types of jacks, with the exception of two additional prongs for filament which act in the nature of a switch contact to connect A battery to filament of tube to be employed. This method relieves the necessity for filament current switches for detector and amplifier tubes. It eliminates switches between amplifiers and between amplifier and detector. It is a saving of filament current which under customary operation is wasted by leaving tubes burning while not in service. It simplifies the operation of the receiver. Pushing in the phone plug connects the receivers to circuit of detector or desired stage of amplification and lights the tube or tubes all in one operation. An added convenience is found in that once the proper adjustment of rheostat is obtained it will remain constant. A diagram showing connection of this type of jacks is offered for your convenience, should they be preferred.

As advised for our detector, or tuning unit, in the January issue we are still adhering to the preference for six-volt tubes in this unit, those known as am-





plifier tubes, which differ somewhat from the detector tube.

Dry Cells

The smaller tubes can be used, with dry cells, without necessitating any change in the circuit, with the possible exception of rheostat resistance.

The U V 201a or C 301a are recommended.

The resistance of rheostat depends upon the tube employed and is rated as given in the accompanying table.

W D 11-12 tube.....6 ohm rheostat
U V 199 and C 299..20 to 30 ohm rheostat
UV 201a and C301A.....
.....15 to 20 ohm rheostat
UV 201, C301 and 216A.....
.....4 to 6 ohm rheostat

A "C" battery is advisable because of the resulting economy of B battery current and is particularly advantageous in increasing volume if the peanut tubes are used. This should be four and one-half volts, regardless of type of tubes in circuit. B battery connection is indicated in diagram and plate potential can be from sixty to 100 volts.

Difficulties may be encountered in perfecting operation of the amplifier. Sometimes transformers are defective, often through being damaged in shipment. A simple test by which condition can be determined is employed by connecting the primary of transformer in series with a 22½ volt B battery and a voltmeter which has a reading of from 25 to 50 volts. Depending upon the make of transformer, the reading of voltmeter should be between ten and eighteen volts. If the meter registers over twenty volts the transformer is shorted. If it does not register at all some connection is broken and in either case the transformer is not serviceable and must be replaced.

The secondary of transformer is tested in the same manner. The volt meter in this testing should read from five to ten volts if effective and if over fifteen volts is registered it is shorted.

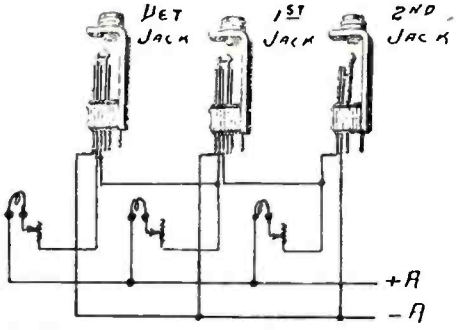
Locating Troubles

If signals are without amplification look for a dead B battery or defective transformer.

If no signal is received look for lack of contact of jack or for disconnected B battery.

Distorted signals result from inoperative C battery or defective transformer.

Now that we have offered you a selective tuner and an efficient amplifier you are going to experience the added joy of general participation in the high quality of entertainment being broadcast, rather than that which is limited to the phone method of reproduction, and there need be no scramble and argument in your generally peaceable family as to "whose turn it is to listen-in" because you are justified in adding a loud speaker to your equipment, knowing that it will afford a highly satisfactory performance.



Tiny Receiver

Harold Lane, one of the Washington correspondents has what is believed to be the simplest complete radio receiver yet assembled. He carries it in his vest pocket, phone and all. When he is near anything which will serve as an antenna, he makes a contact, sometimes only with his hand, often neglecting to make a ground connection, and listens in.

To be sure, he takes what he gets—the nearest and strongest station on the air. The vest-pocket set comprises a single head phone, without leads, and a fixed crystal detector, connected in parallel with the phone by two short copper wires from the telephone terminal. Placing the phone to one ear and making contact with as good an aerial as he can find conveniently by means of his fingers, which of course must touch one of the two terminals, is all he has to do. By this means he has heard NAA time signals and set his watch, and also whiled away odd minutes by listening to WRC or WCAP when they were on the air. One day he picked up KDKA. When convenient he also makes a ground connection at the other phone terminal, but he says it isn't always necessary. The particular crystal he uses is a compact unit about the size of a short thick lead pencil with binding posts at each end convenient for connection with the phone terminals. He used to use a tuner but as this bulky apparatus didn't improve incoming signals he discarded it as he also did his phone leads and wires for connecting with aerial and ground. The result is believed to be the neatest cheapest and smallest portable set in use.

Interesting Combination Receivers

By R. H. LANGLEY
Radio Engineering Dept. General Electric Company

ONE of the most fascinating things about Radio is that it provides such a fruitful field for experiment. The art is young, and there are many questions yet to be answered. The apparatus for the study of these problems is already planted in millions of American homes, and this paper is addressed to those who find pleasure in trying new circuit combinations.

With a small selection of the standard apparatus, it is possible to arrange many interesting new combinations that are not given in the instructions. I shall give now a list of the apparatus needed for the combinations to be described later, and it might be well to make mental note of the items which you do not have.

2—Single circuit regenerative tuners
1—Vacuum tube detector and 2 stage amplifier
1—Three stage radio amplifier
1—Variable air condenser
1—6 Volt storage battery or
6—No. 6 dry cells
4—Blocks of plate battery, 22 1-2 volts each
1—3 cell Flashlight battery for bias, 4 1-2 V
1—Homemade loop antenna
6—Radiotrons, UV 201, UV 201-A or UV-199
—Outdoor antenna and ground connection.

The loop will consist of 8 to 10 turns of almost any kind of copper wire, wound at 3-8 or 1-2 inch spacing on a wood frame 3 or 4 feet square, and arranged so that it may be rotated on a vertical axis.

In all the circuits to be described, a UV 200 soft detector tube may be used, if suitable arrangements are made for obtaining the correct plate voltage.

Eighteen Circuits

With the apparatus just enumerated, there are at least 18 different receiver circuits possible. Some will be very sensitive, some highly selective and some both selective and sensitive. Some will be suitable for use in congested districts, some will function best for nearby stations and some for distant stations. It is not possible of course to give diagrams of these circuits, but we can classify and describe them so that the possibilities of the various combinations may be seen.

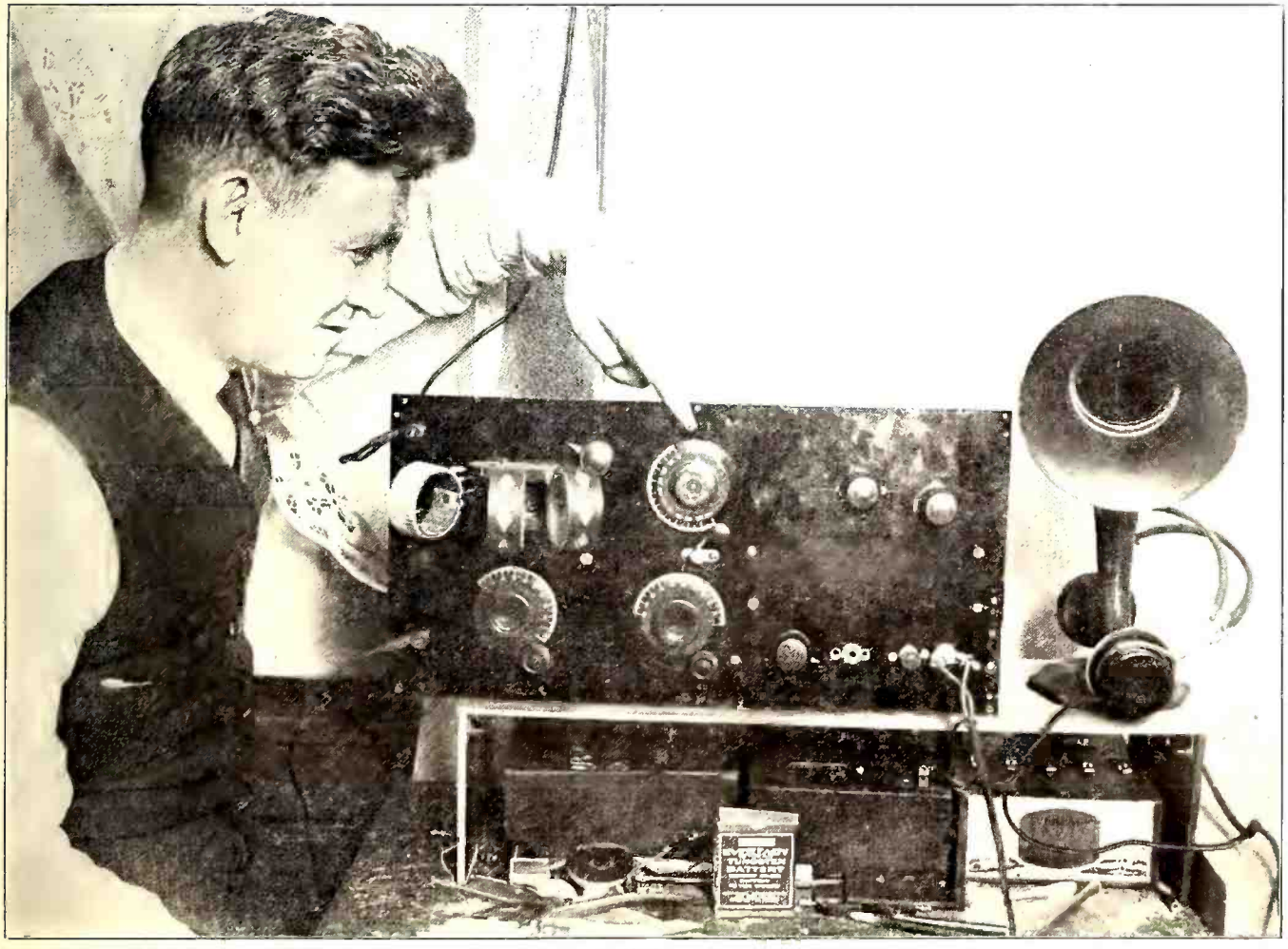
Let us divide the 18 circuits into five classes.

First, on the outdoor antenna without radio amplification.
Second, on the outdoor antenna with radio amplification.
Third, on the loop antenna.
Fourth, using both the outdoor antenna and the loop, and
Fifth, some special arrangements.

In the first class, that is, on the outdoor antenna without radio amplification we can list seven different combinations. Two of these regenerative; the other five circuits are not regenerative. This, of course, means a great deal in signal strength, particularly on the more distant stations, but for the sake of making the list clear and easy to remember we will take them all together.

The seven circuit arrangements possible on the outdoor antenna without radio amplification are as follows:

First, single circuit tuner, using crystal detector.



LONDON AND LOS ANGELES

Mr. Kennedy is here shown pointing out the vernier rheostat on his simple three tube honeycomb regenerative set. He does all his tuning on this rheostat and on the secondary condenser. He gets Los Angeles and London. See photograph on next page. (Kadel & Herbert.)

Second, single circuit tuner with vacuum tube detector amplifier.
Third, single circuit tuner, with detector amplifier and the regenerative connection.
Fourth, using the outside condenser to make a two circuit tuner.
Fifth, using two tuners to make a two circuit tuner.
Sixth, using two tuners to make a three circuit tuner and
Seventh, using two tuners and the external condenser to make a three circuit tuner, with all three circuit tuned.

There are two ways of using the external variable air condenser to make a two circuit tuner. We may connect the variable condenser across the tickler coil to make a secondary circuit or we may connect the condenser in series with the tickler coil to make a primary circuit.

In using two tuners to make a two circuit tuner the tickler coil of the first tuner is used as a coupling coil and connected to the input terminals of the second tuner.

In using two tuners to make a three circuit tuner, the two tickler coils are connected together to form the third or link circuit. If we connect the variable air condenser in series with the two tickler coils, we can then tune this intermediate circuit.

The second class of circuits were those on the outdoor antenna with radio amplification. For these we use our three stage radio amplifier and insert it between the tuning system and the detector amplifier. This may be done on any of the seven combinations which we have just noted except possibly with the crystal detector.

Loop Antennae

In the third class we use the loop antenna. There are several combinations here; let us notice only two. The first is the straight loop circuit where the variable air condenser is connected across the loop and then connected to the three stage radio frequency amplifier and from this to the detector audio amplifier. The second combination, which by the way is a very interesting one, provides a method for using the loop in a regenerative circuit. This uses the loop and one of the single circuit tuners, then the radio frequency amplifier and the detector amplifier.

The fourth class uses the antenna and the loop in combination. There are also several possibilities here. The best one, perhaps, consists in connecting the antenna and ground to one of the single circuit tuners. The loop and variable air condenser are connected to the three stage radio amplifier and the detector amplifier in the usual way. These are two independent circuits, the only connection between them being that the tickler coil in the tuner is connected to the tickler terminal on the detector amplifier. This combination is quite remarkable in performance. The antenna circuit is brought into resonance with the signal by means of the tuner and the loop circuit picks up energy from this tuner antenna circuit. The reactions obtained by the tickler coil connection make it possible to successfully eliminate very loud nearby stations.

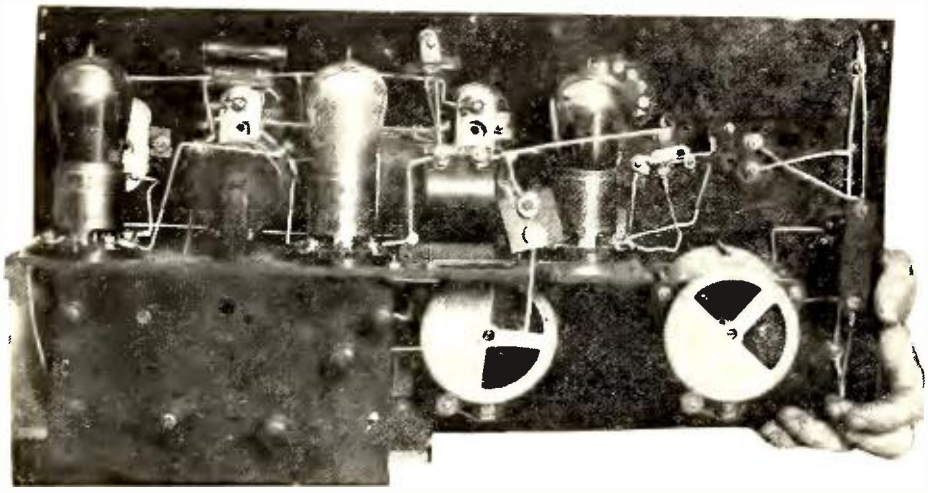
In the fifth class, let us notice two stunts. The first one consists in amplifying the signal obtained from the crystal detector, by connecting in such a way that the output of the crystal detector goes thru the primary of the first audio frequency transformer. No batteries are needed in the crystal detector circuit. This is a very fine way of obtaining excellent loud speaker signals from nearby stations. The second stunt, is the use of a grid bias and a higher plate voltage on the amplifier tubes. Open the grid circuit and insert a small Flashlight battery of say 4 1-2 volts between the grid and the filament bus. The negative end of biasing battery should be connected to the grid and the positive end to the filament bus. It is then possible to use very much higher plate voltage on the amplifier tubes, with the result that considerably greater amplification is obtained with the same or even better quality of reproduction. With the UV-201, UV-201-A or UV-199 radiotrons, the plate voltage may be increased to 90 or 110 volts.

Aerials and Tuning

There are many people who imagine that the loop antenna is a substitute for the big outdoor aerial and that the same results can be obtained from either. This of course is very far from the truth. There is a very fundamental difference. The aerial is a condenser. It is a very large condenser to be sure, so far as its physical dimensions are concerned, but it does not have a very large capacity.

The loop, on the other hand, is an inductance. This means that the method of tuning the aerial is quite different from the method for the loop. The same receiving sets will not work interchangeably on either. The single circuit tuners are suitable for tuning the antenna, but when we used the loop, we used a separate variable air condenser to tune it.

In these experimental combination receivers, it makes very little difference which tube we use. The main difference between the various tubes is in energy consumption in the filament, rather than in performance as detectors or amplifiers. Some are slightly better than others in this respect, but the main purpose of the newer types is to simplify the A battery problem. The UV-200 and the UV-201 require 1 ampere filament current necessitating a storage battery. This is expensive and troublesome and requires frequent charging. The UV-201-A takes only 1-4 of an ampere and can be operated four times as long on one charge of the battery. It may also be operated from dry batteries. The UV-199 tube takes only 6-100 of an ampere and can be operated from dry batteries with great success.



A DISTANCE GETTER

Thomas J. Kennedy, 470 West 159th Street, N. Y., regularly receives 2-LO, of London, Eng., and KHJ, Los Angeles, with this simple three-circuit honeycomb regenerative set. He tunes with the secondary condenser and the rheostat of the detector tube, without moving the honeycomb coils or the ground condenser. Note how he uses condensers and grid leaks across the transformer secondaries to clear up signals. (Kadel & Herbert.)

Radio "Help Wanted"

The Government is advertising by radio! But, although direct radio advertising is banned, there are few who will object, since the results achieved seem to indicate that the public is benefited. Every Wednesday night, Mr. Morgan of the Civil Service Commission, broadcasts from NAA, Arlington, openings in government positions and announces examinations to be held for every kind of a job from that of an unskilled laborer to those requiring highly trained scientists, statisticians and executives. Some replies indicate direct results, but as not all applicants state how they learned of the openings, an exact check is impossible.

The recent call for apprentices for the Washington Navy Yard, however, brought several phone calls and mail inquiries from fathers and mothers interested in securing first class training for mechanically inclined sons.

The openings annually announced over the radio phone cover as many as 1,000 different positions, Mr. Morgan states, and he is anxious for those seeking Government work to listen in Wednesday evenings at 7:25 and learn what is available.

CRUSADERS

These radio fans are sure that they can induce others not to interfere with the enjoyment of neighbors by making their regenerative receivers squeal. Miss Helen Dickinson, (seated on table) is getting the signatures of New York neighbors to an anti-squeal pledge. (Kadel & Herbert.)

How to Avoid Interference

By JOHN V. L. HOGAN

The seventh and eighth of this series of radio talks, which have attracted wide attention, were presented through Station WEAF, New York, by Mr. Hogan, consulting engineer and past president of the Institute of Radio Engineers and author of "The Outline of Radio."

IT IS possible to classify the six things that give the most trouble, as follows:

1. Nearby broadcasting stations using wave frequencies close to that which it is desired to receive.
2. Radio telegraph transmitters of the spark type.
3. Oscillating receivers that produce whistling noises.
4. Distant broadcasting transmitters that radiate waves having frequencies within a few kilocycles of the frequency being received.
5. Atmospheric discharges, known as "strays" or "static."
6. Induction from lighting, trolley or power systems.

Of these six kinds of interference, the first, second and third are the most bothersome. Perhaps this interference from nearby broadcasting stations is not so great a difficulty as is interference from spark transmitters, but where it does exist it is practically continuous whereas spark interference at worst is only intermittent. I suppose that accounts for the fact that most of the letters I have received ask, in one way or another, for remedies that will prevent hearing speech or music from one broadcasting transmitter while listening to another. In any event, this kind of interference is wholly or partly spoiling the broadcast reception in many homes today and it is doubtless the first that we should study in detail.

There is one very good thing about this "crosstalk," as we may call it, and that is that it can be very nearly if not entirely eliminated by rearrangement of your own receiving apparatus. Of course, you must be reasonable in what you expect from any radio receiver; it would hardly be fair for a man who lived only a few blocks from WCAE in Pittsburgh to expect his receiver to pick up signals from KDZE in Seattle without interference. That is because WCAE sends out a wave of 650 kilocycles and would be heard very loudly, whereas KDZE sends at 660 kilocycles (only 10 kilocycles higher) and would produce very weak signals at Pittsburgh. On the other hand, this Pittsburgh man might very fairly expect a good receiver to cut out WCAE at 650 kilocycles (even though very near to him) while he listened to WOR in Newark at 740 kilocycles, to WEAF in New York at 610 kilocycles.

In the same way, anyone living anywhere in or around New York may reasonably expect to be able to listen to any one of the four local stations WEAF (610 kc), WJZ (660 kc), WOR (740 kc) or WHN (833 kc) without any interference from any of the other three at any time. Many people living in the middle West Side district of New York have apparatus with which they are unable to hear any stations other than WJY or WJZ when those transmitters are working; but this trouble is not hard to cure, for there is no insuperable difficulty in getting a receiver that will bring in long distance stations such as KDKA in Pittsburgh and WJAZ in Chicago even when installed within only a few blocks of WJY and WJZ.

Depends on Receiver

The whole matter of eliminating interference from one broadcasting station while listening to another comes down to the choice of your receiver. There are two rules to guide this choice, as follows:

1: The nearer your receiver is to any broadcasting station, the more highly selective it must be to prevent interference from that station.

2: The greater the distance you desire to receive, and consequently the more sensitive your receiving apparatus is, the higher its selectiveness must be to prevent interference.

Thus you will see that a receiving set which is perfectly satisfactory in one location or for one service may fail utterly when used in another place for another

purpose. Radio receiving is very emphatically a matter in which one man's meat may be another's poison. It may be helpful, though to consider a list of twelve types of useful radio receivers arranged in the approximate order of their selectiveness, and I will give you such a list tonight. If your receiver is at the bottom of the list, don't let that fact disturb you, for if it is sufficiently selective for your purposes, well and good. But even a receiving set that is rated half-way up the list might not be good enough for some locations, and in such cases the only two remedies are either to pass the set along to someone else who can use it and to get a new outfit of better selectiveness, or else to improve the original receiver. Here, then, are twelve types arranged in the order that I believe puts the most selective outfits at the top and the least selective at the bottom:

1: Superheterodyne with closely tuned intermediate amplifier.
2: Multiple-stage tuned radio frequency amplifier with regeneration and with double-tuned aerial input circuit.
3: Multiple-stage tuned radio frequency amplifier with regeneration and single-tuned aerial-input circuit.
4: Multiple-stage tuned radio frequency amplifier without regeneration but with double-tuned aerial-input circuit.
5: Simple regenerator with double-tuned aerial-input circuit.
6: Multiple-stage tuned radio frequency amplifier without regeneration, with single-tuned aerial-input circuit.
7: Simple regenerator with single-tuned aerial-input circuit.
8: Multiple-stage untuned radio frequency amplifier with regeneration.
9: Non-regenerative audion detector with double-tuned aerial-input circuit.
10: Crystal detector with double-tuned aerial-input circuit.
11: Non-regenerative audion detector with single-tuned aerial-input circuit.
12: Crystal detector with single-tuned aerial-input circuit.

Remember that this list is arranged in the order of *selectiveness*, as it appeals to me. A different list would be required to show the relative sensitiveness and a still different list to indicate the relative ease of adjustment. Still further, bear in mind that to warrant its rating on this list any particular receiver must be well designed and well built; a poorly made superheterodyne may be less selective than a good single-tuned simple regenerator.

Cross-Talk

Cross-talk between broadcasting stations is without doubt breaking up more reception than any other single kind of interference. People who can at one time hear music from some one station, and hear it easily and clearly, find a little later than some other station begins to dominate their receivers and that they cannot "tune it out" sufficiently well to listen to the first. Perhaps they can adjust their receivers so that the interference is no louder than the speech or music that they desire to hear, but it is still there and is intense enough to give all the discomfort of "getting the wires crossed."

If you are experiencing this sort of difficulty—and I know that thousands of you are—make careful note of these two points:

First: The trouble necessarily lies in your receiver, for the wave frequencies of the broadcasting stations are far enough apart to permit reasonable freedom from interference in any location. Such interference is not the fault of any broadcasting station nor of the assignment of wave frequencies.

Second: Either your receiver is of a type which cannot possibly have adequate selectiveness for elimination of the interference in your locality, or it is so designed that its selective power is less than your particular type should have.

60 CENTS

John P. Buckley, scientist with the U. S. Bureau of Standards, completed this crystal detector and he claims they could be made and sold in quantities at sixty cents each. (Fotograms.)

These two points state facts that cannot be controverted, and it is just because of that that we can all afford to be optimistic about cutting out this cross-talk interference. If this trouble did not lie in your receiving sets it might be a hopeless job to get rid of it; since it is necessarily the fault of your receiver, it can be cured right in your own home.

Some of you may be inclined to doubt the possibility of cutting out interferring stations which send on waves close in frequency to the one you want to hear. People have said to me: "I paid $250 for my radio set, and if it won't pick up WCAF while WEAF is sending I don't believe that anything will." The answer to this is that character is what makes a radio receiver good. Dollars have little more to do with it than with the making of a man. People in your own neighborhood, using relatively inexpensive outfits of good design, are cutting right through interference that is troubling other folks whose sets, in spite of their higher cost, are poorly laid out.

Last week I listed twelve general types of radio receivers, in the order of their selective ability. Nearly every set now in use falls into one of these twelve classifications. If your set is low on the list, and if you suffer from cross-talk interference, perhaps you will have to get a more selective type before you can cut it out. The probabilities are, though, that your set is not as good as it should be even in its own type. Therefore your first step should be to make certain that your outfit is of good design.

Spark Transmitters

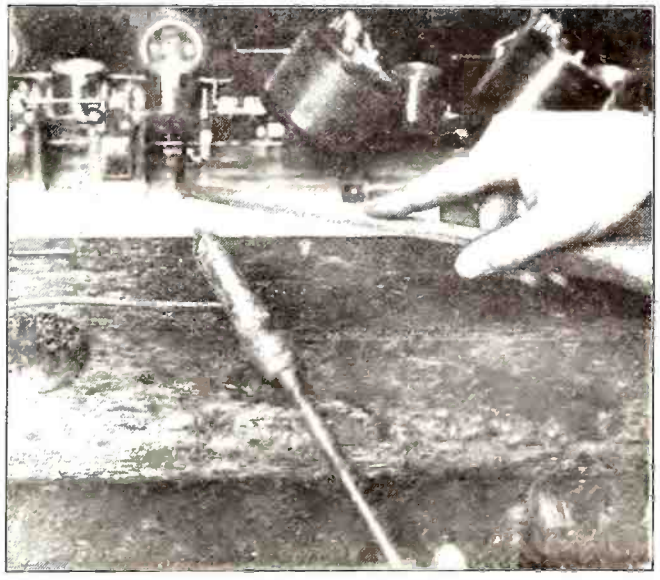
Before we go into the practical things that can be done to improve receiver selectiveness let us give a moment to the second worst kind of program-smasher, which is the spark radio-telegraph transmitter used in ship-and-shore wireless. Those of you who have good receivers may disagree with my rating this spark transmitter as the second worst source of interference, for to you it is by far the most aggravating. But that is because you have already overcome trouble number one (cross-talk); our unfortunate friends whose receivers are so poorly selective that they cannot listen comfortably to any but the nearest or loudest broadcasting station are very numerous, and we must give them first aid.

The fact is, however, that by improving the selectiveness of your receivers you will greatly decrease the Morsecode dot-and-dash spark station interference that you now hear. You will never eliminate it completely, however, for spark transmitters will break through and produce disturbances in the most highly selective broadcast receivers that can be built. The only real cure for spark station interference is to eliminate the spark transmitters themselves. That very thing is going on from day to day, so you should all be able to note a continued improvement as progress is made.

Since any increase in receiver selectiveness will aid in reducing both cross-talk and spark interference, let us see what can be done in this direction. First we should consider the last or least selective receiver on the list I gave last week, No. 12, the crystal detector with single tuned aerial circuit. Lots of people are using these outfits, and in some locations they work very well if they are properly put together. If you have one, and if it is not performing to your taste, you can probably improve it by putting a variable condenser in series with your aerial circuit, i. e., between the lead-in of your aerial and the binding post on the set to which the aerial was connected. Then use as much of the tuning coil as you can and do the tuning on the variable condenser. A still greater improvement can usually be made by connecting the crystal detector and telephone side-circuit across

(Continued on page 41.)

Little Things That Help



SOLDERING HINTS

Poor soldering will ruin the best of sets. Picture at the left shows how to make sure your iron is hot enough. Hold it five inches from your face and if you can feel the heat, you are ready. Be sure your iron is clean. It may be cleaned easily with a file, as shown in the picture at the right. (Kadel & Herbert.)

Receiver Essentials

Many radio fans are constructing their own receivers, some of which work well, and some which are tolerated merely because the builder has not the necessary funds to make a new one, says Beverly Dudley, member of the American Radio Relay League. For the construction of a receiver which is to work entirely satisfactorily, a thorough knowledge of radio principles is essential, but one may get on well with a few pointers and his own common sense.

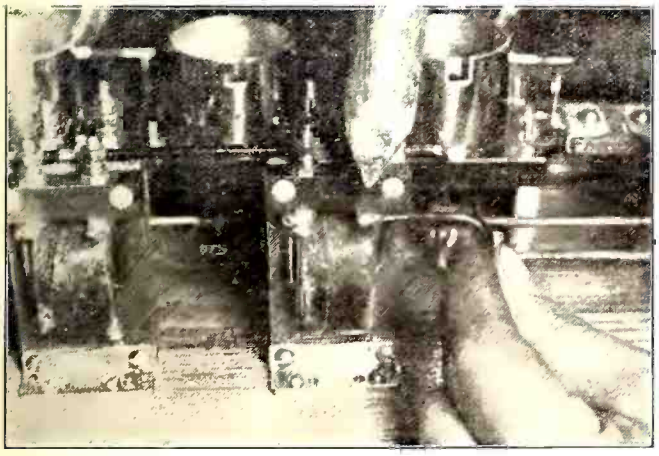
The essentials of a good receiver are: (1) Sensitivity, (2) Selectivity, (3) Ease of control, and (4) Moderate cost. To combine all of these features is not as simple a matter as it may seem.

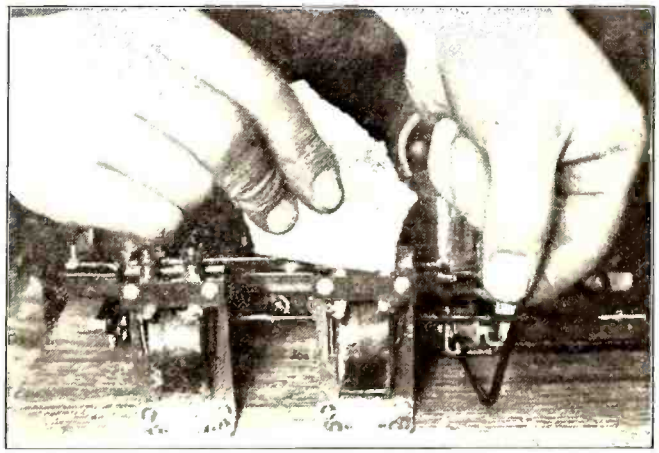
First of all, a receiver must be sensitive. This means the use of vacuum tubes, and radio frequency amplification or regeneration. For a single tube set, regeneration is quite a desirable, almost necessary application. There are numerous regenerative circuits to choose from, but for short wave reception a circuit in which regeneration takes place by use of a tickler is most satisfactory. Regeneration is secured by means of the absorption method, which offers some advantages.

Two Circuit Tuner

For selectivity, a two circuit tuner seems to be the only one worthy of consideration. Tests made last winter showed a single circuit tuner to bring in the stations a trifle louder, but the tuning was so broad that local and loud broadcasts could not be eliminated. Even a few amateurs who work on 200 meters were heard on this tuner, when tuned for the broadcasts. It is of no use to get loud signals, if you cannot pick out the desired stations to the exclusion of the rest. The main objection a radio fan has to a two circuit tuner is the additional control.

Tuners may be made in such a way as to afford the simplicity of the single circuit tuner with the selectivity of the loose coupled tuner, by making the primary of the circuit aperiodic. That is to say that the primary is not tuned at all. This untuned primary consists of from one to five turns of wire wound over the secondary coil, or coupled to it. These turns may be tapped or not.





SOLDERING THAT HOLDS

The picture on the right shows how the point to which the connection is to be made should be cleaned with a piece of sandpaper. On the left picture shows how the iron is used after a little soldering flux has been applied to the contact point. The iron should not have too much solder on it and after the connection is soldered and cooled the connection should be wiped off with a little alcohol and a tooth brush. (Kadel & Herbert.)

The Reinartz tuner uses a tapped but untuned primary. This is a very satisfactory method of coupling the primary and secondary circuits.

Ease of control is very essential, especially to the radio amateur in his traffic work. One cannot tune a receiver all evening merely to hear the bed-time stories from Radioville, two miles away. Don't have seventeen tuning controls on your receiver; three is plenty. A receiver may be—though they usually are not—selective with but one tuning control. Don't however, sacrifice efficiency for ease of control.

As to the cost: buy inexpensive parts if necessary; not cheap parts; there's a difference. The cost of many receivers could be kept down by taking off a lot of the trimmings; a receiver doesn't need voltmeters or bezels mounted on its panel.

Be sure to purchase a good variable condenser. The one with the least parts is all right. One cannot upon merely examining a condenser tell its electrical efficiency. A variable condenser should be mechanically good. Hard rubber is much better for insulation on a condenser than porous, absorbent fiber. Get good mica insulated fixed condensers if you value the quality of the signals you desire from your set. See that the fixed condensers are well made and firmly pressed tight. A fixed condenser the capacity of which varies is worse than nothing.

Amateur Records

Hartford, Conn.—By virtue of recent two-way amateur radio contacts established by Kenneth B. Warner, secretary of the American Radio Relay League, England comes to the forefront among nations of the world that can now communicate across the Atlantic through radio stations operated by citizen amateur radio men. Nine complete messages have been sent across the ocean on a wave length of 100 meters between Mr. Warner operating station 1MO here and J. A. Partridge owner of the English amateur station 2KF situated in London.

There is no question but what amateur two-way transoceanic traffic has opened up a new field of no less importance than the early successes, showing the possibilities of amateur radio, and not a few of the old time hams, whose calls were famous in the old spark days, are bounding back "on the air" to partake in international thrills. The tests are spoken of as the dawn of a world amateur relay.

Kenneth B. Warner, secretary of the League, estimated today that a total of sixty messages had been transmitted across the Atlantic since the first two-way contact was made between amateur stations 1MO in Hartford and 8AB in France the night of Nov. 27. The signals of 8AB have been loud and scores of amateurs are hurriedly bringing their receiver down to the 100 meter wave length.

A radiogram received at League Headquarters stated that amateur station, 9ZT, operated by Donald Wallace, assistant manager of the Dakota division, had been in two-way contact with the French amateur and messages had been exchanged reliably. Deloy is believed to have transmitted a total of thirty-three messages.

9,563 Miles!

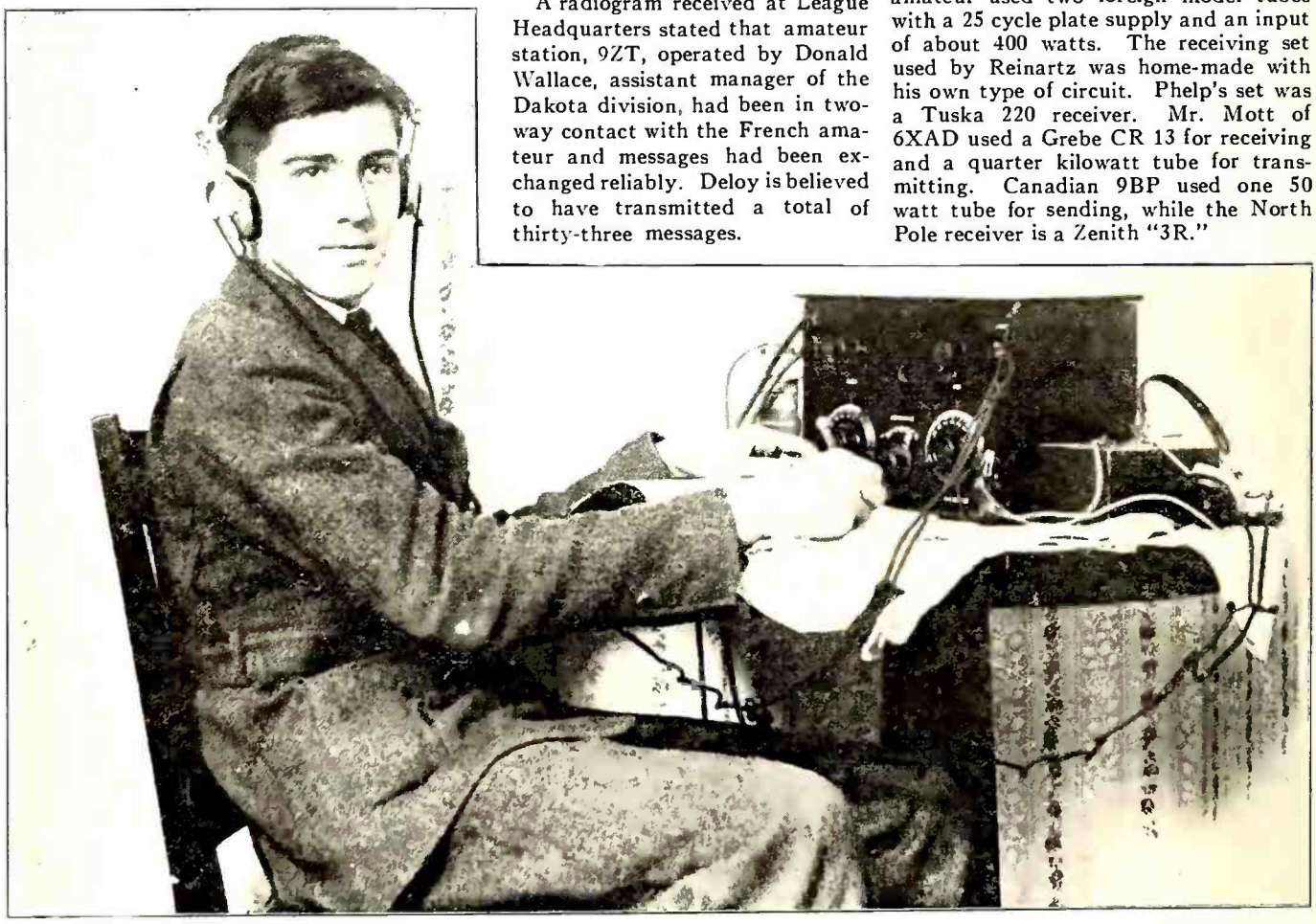
Hartford, Conn.—An amateur radio message from France to the North Pole has covered the farthest distance ever traversed by an amateur relay, arriving safely in the ice-bound cabin of Captain Donald B. MacMillan's schooner "Bowdoin" after a 9,565 miles journey.

The same night after Monsieur Leon Deloy at Nice, France, transmitted a message to the Arctic explorer, a repetition of the dots and dashes came in on the headphones of Donald Mix, radio operator for MacMillan, 11 degrees from the pole and inside the aurora.

In order to reach Refuge Harbor, Greenland, the message took a round about course across the Atlantic to South Manchester, Connecticut, where it was received by John L. Reinartz, operating amateur station IXAM. Reinartz gave the message by telephone to Boyd Phelps of Hartford, who relayed it to 6XAD at Avalon, Catalina Island, off the coast of California. Thence it was sent to Jack Barnsley of 9BP, Prince Rupert, British Columbia, who finished the relay.

The distance covered by each relay was about as follows: Nice to Hartford, 3,500 miles; Hartford to Catalina Island, 2,500 miles; Catalina to Prince Rupert, 1,305 miles, and Prince Rupert to Refuge Harbor, 2,260 miles, making the greatest amateur relay mileage.

In this remarkable record the French amateur used two foreign model tubes with a 25 cycle plate supply and an input of about 400 watts. The receiving set used by Reinartz was home-made with his own type of circuit. Phelp's set was a Tuska 220 receiver. Mr. Mott of 6XAD used a Grebe CR 13 for receiving and a quarter kilowatt tube for transmitting. Canadian 9BP used one 50 watt tube for sending, while the North Pole receiver is a Zenith "3R."



HEARD ENGLAND

Everett L. Battey's friends did not take his little one-tube set very seriously until recently, when he picked up three English stations. Everett's home is at Wollaston, Mass. He logged Bournemouth, Cardiff and London in one day. He uses a dry cell.

The Superdyne Receiver

IN a recent talk, before the American Radio Relay League in Chicago, Mr. C. D. Tuska, President of the C. D. Tuska Company, gave interesting details about the superdyne receiver—a new circuit developed by Robert S. Miner of the Tuska laboratories.

Mr. Miner, known to radio amateurs as IRU, almost a year ago started to work on a receiver that would give results which would surpass the regenerative receiver and the many radio frequency outfits he had tested.

In seeking for this new super circuit, he and his associates investigated all of the latest circuits and every modification of regenerative, radio frequency and other circuits about which they had information. In Mr. Miner's opinion, the only trouble with radio frequency is that it is not possible to get sufficient amplification per stage, and he decided to locate the difficulties and then to overcome them.

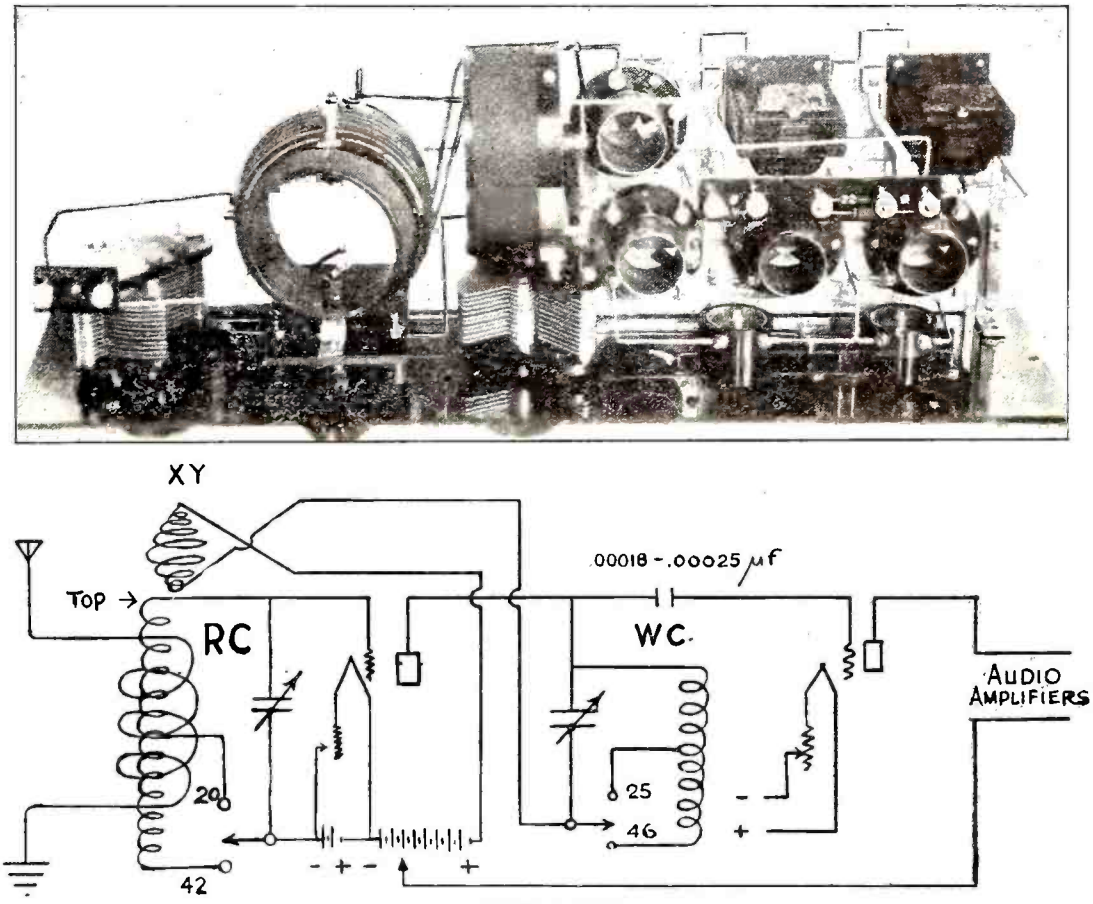
When the superdyne circuit was being perfected it became evident that resonant circuits must be used, but as soon as this was done the tubes started to oscillate and spoiled everything so that the investigators were in what might be called a "vicious circle." The method used to overcome this difficulty was put in the conventional Armstrong feedback *but feed the energy back in the reverse direction or negatively.* The circuit was given just enough feedback to offset the positive capacity feedback of the tube. This stopped oscillation and made it possible to secure absolute resonance between the grid and the plate circuits. Not only was resonance secured, but the maximum impedance in the plate circuit was used which means the biggest voltage impulse which it can be hoped to build up.

The superdyne circuit is shown in the accompanying illustration. "RC" is the resonant circuit of the grid. "WC" is the resonant circuit of the plate while "XY" is the reverse feedback which stops oscillation. The detector is connected as shown. After it was found what the possibilities were with this circuit, experiments were made to see if it could be improved by changing the constants. All of the stages of increasing capacity and decreasing inductance as well as the reverse, were gone through. Every sort of coupling and every conceivable manner of turns ratio was tried. Hundreds of separate experiments indicated that the successful operation of the circuit depended to an extremely high degree on following dimensions carefully.

Not only does this apply to instructions about sizes of wire and dimensions but in addition care must be taken not to parallel the grid and the plate wires of the radio frequency stage. These wires must be kept at right angles and as far apart as possible. If the reverse feedback coil is coupled too closely to the grid coil the capacity between the grid and plate windings exceeds the negative magnetic feedback and the set will not work. It is extremely important to avoid this trouble so care must be taken to copy exactly the specifications outlined.

The dimensions and constants of the various coils and condensers are shown in the accompanying table. Reception on the detector has not been particularly successful probably due in part to the capacity of the phones on the ungrounded circuit. When operating with a small indoor antenna, the filaments should be grounded and the antenna connected to the grid of the first tube leaving out the antenna coupling turn. With this method, phones on the detector will probably be entirely satisfactory.

The maximum results can be obtained after the operator has learned how to carefully adjust the circuits but it is not possible to get these results until one has had some experience in tuning faint signals.



SUPERDYNE

Photograph of the assembled superdyne and diagram of wiring arrangement of this interesting receiver. As stated in the accompanying article the manufacturers are ready to assist fans in making this set if they desire instructions.

COIL DATA

	Coil Form O. D.	Winding	TURNS	WIRE	TAPS	Micro-henries
Secondary	4" Over Sec.	1¼" Turns Spaced	42	No. 22 D.S.C.	0.20.42	273
Antenna		¼" Ball	4	No. 22 D.S.C.	0.4	
Tickler	3-⅝"	Motor	18x2—36	No. 22 D.S.C.	0.36	
Plate Reactance	4"	1¼"	46	No. 22 D.S.C.	0.25.46	264

Condenser (Grid) Tuska Type 271 23 Plates Maximum Capacity .000482
Condenser Plate Tuska Type 271 23 Plates Maximum Capacity .000482
Wave Length Range (Approx.) 176-358: 310-660.

The astonishing part about this outfit is that it operates without an antenna and gives signals of sufficient intensity to be heard through the use of a loudspeaker. In Hartford, Connecticut, without the use of an antenna or loop or capacity of any sort, other than the usual ground connection, broadcast has been heard on a loud speaker from Chicago, Davenport, Kansas City, and nearer stations. Havana, Cuba, has been obtained without an outside aerial.

Desiring to compare this set with some of the sensitive sets on the market it was recently taken to Washington and a series of tests made. First, a constant artificial source of power was set up. This was tuned on a regenerative receiver and the audibility measured around 50. With the same power, the same tubes, batteries, etc., the superdyne receiver showed an audibility of over 200. The same two outfits were tried under similar conditions with a broadcasting station as the source of power. Here the regenerative receiver showed audibility of about 60, while corresponding conditions showed the superdyne receiver to have an audibility of 10,000, which was the end of the meter.

The next test was of a more practical nature. Here the superdyne receiver under actual receiving conditions was compared with the naval six-tube universal radio frequency amplifier. The signals with the four-tube superdyne were probably three to four times louder than with the six tubes of the navy amplifier.

The last experiment was the most astonishing of all. In this test the four-tube superdyne was compared with the eight tubes on a super-heterodyne receiver. Some of the signals on the super-heterodyne surpassed this new circuit while in other cases the superdyne exceeded the super-heterodyne. Taken all in all, and being very conservative, Mr. Tuska believed that the best that could be said for the super-heterodyne was that the signals may have been slightly louder using the eight tubes than they were on the superdyne with four tubes.

In operating this circuit it has been found that it is highly desirable to adjust the plate circuit for the wave length to be received, then operate the reverse feedback coil, which has been called a "stabilizer", and the grid circuit in exactly the same manner as a regenerative receiver is operated. By carefully adjusting the reverse feedback against the positive capacity feedback astounding degrees of amplification can be gotten. It has been figured that the voltage amplification per stage probably runs in the neighborhood of 100 times. One tube of radio frequency regeneration of the old style rarely exceeds a voltage amplification of eight or nine times.

In order to simplify the operation the makers have omitted any tuned antenna circuit and simply used four turns of wire which are closely coupled to the grid circuit. This impulse excitation method of tuning seems to be sufficiently selective, probably due to the selectivity of the two resonant circuits.

Numerous attempts have been made to simplify the adjustments of the receiver, such as using fixed reverse feedback and gearing the two tuning condensers together, but this method decreases the sensitiveness of the receiver. The closed circuits do not affect each other's wave lengths, but the feedback varies with the wave length received. The reverse feedback has an appreciable effect on the grid circuit tuning. Fortunately, however, the plate circuit remains absolutely constant and may be calibrated in terms of wave lengths.

While the Tuska company expects to market complete superdyne sets, it is willing to assist amateurs building their own sets and will be glad to hear of successful efforts.

The Proposed Radio Legislation

Washington D. C.—There will be no general radio conference in Washington in the near future Secretary Hoover has announced. The Commerce Department is rapidly completing the details of a tentative regulatory radio bill based on the old White Bill he explained. He believes that this can best be done by government officials without further conference. Practically all the suggestions offered by representatives in the several lines of radio work presented at last year's conference will be incorporated the Secretary indicated pointing out that conditions have not changed materially since last year except that the number of transmitting stations has increased.

When it is attempted to draw up legislative recommendations or bills with a large body of diversified interests it usually takes several months. Early action on the new radio bill is necessary.

HIGH LIFE

This experimental radio station was built in a treetop by two Oakland, Calif. boys. They say reception conditions are so good up there that a fellow can almost see the ether waves coming. (Keystone)

A few days ago a delegation of radio interests representing the press clubs, engineers, broadcasters, and amateurs called upon President Coolidge and the Secretary of Commerce urging that a general conference be called in an effort to reduce interference from ships affecting commercial amateur and general broadcasting. The Secretary explained that interference was decreasing due to the voluntary adoption of regulations laid down last year and that the Department was striving to remedy present difficulties through revising the White Bill which was passed by the House last session. Any recommendations which the committee desired to make in writing the Secretary said would be considered by the Department Officials now working out the revisions to the existing radio laws established in 1912.

Officials of the Government point out that many difficult questions arise when regulatory legislation is attempted. Such questions as monopolistic control it is believed should be handled by courts under existing laws and not incorporated in radio legislation.

The prohibition of operation by aliens if injected into radio legislation would tend to handicap American radio development commercially in foreign countries and could be regulated without being covered in a radio bill.

The question of whether or not radio is a public utility is not essentially necessary in a law which should be regulatory it is believed.

Some definite standards of operation and equipment especially in the commercial fields must be included however, it is asserted so that Secretaries of Commerce will have some basis for their decisions as to whether an existing station may continue operation in the event a new company desires to enter the field or whether it must cease operating to permit the opening of another station. The amount of traffic might or might not demand more than one station and efficiency would be questioned.

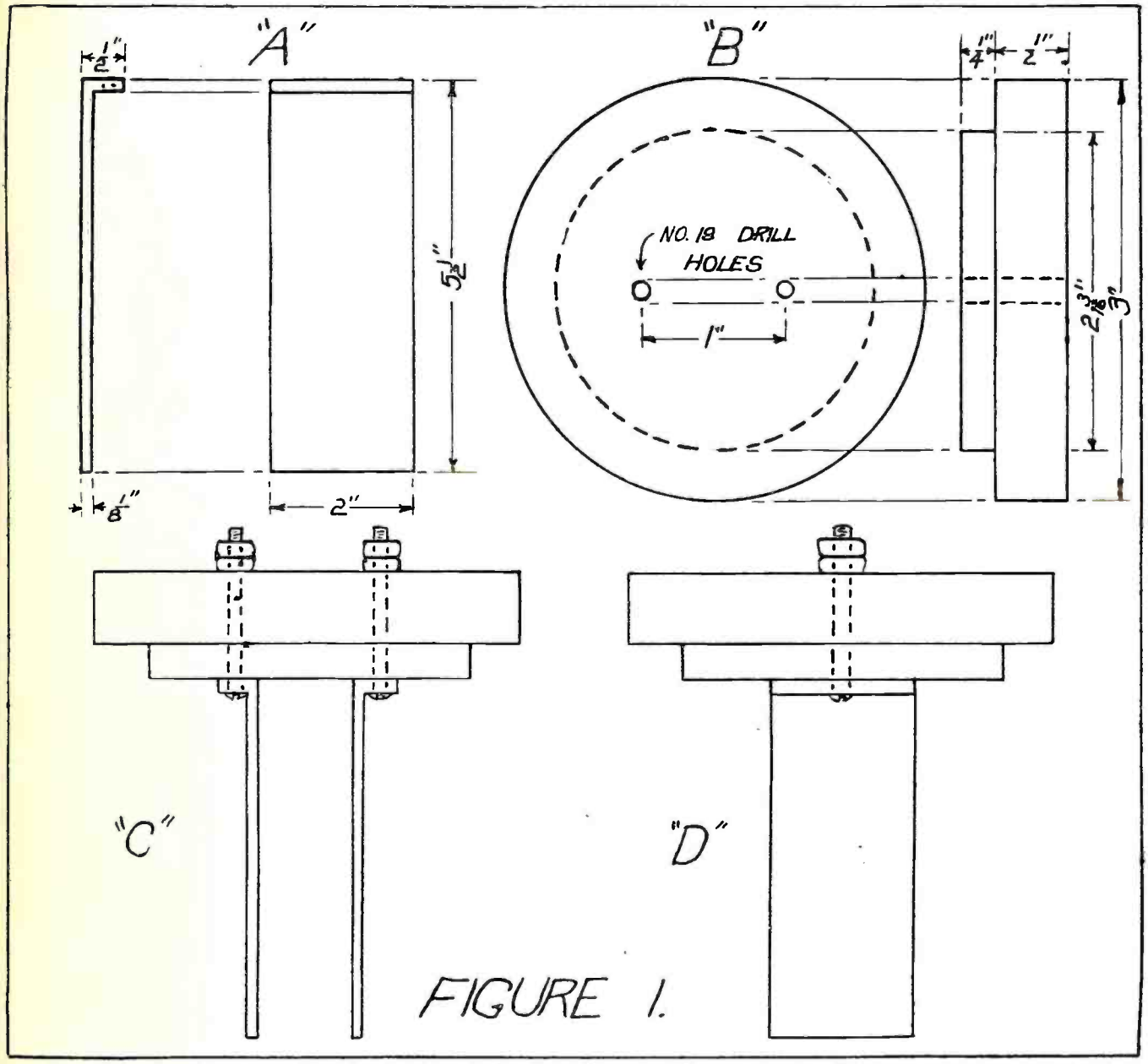
Many phases of development indicate that broad latitude must be granted to the Commerce Department but standards of requirements and service in the public interest should be made clear for the future expansion it is believed.

Recently new interference problems have arisen over which the Department has no control under existing laws. Complaints received report interference from regenerative or re-radiating receiving sets, violet ray machines, electrical precipitating plants, bell-ringing magnetos on telephone lines, and leaking insulation on power transmission lines. Government regulations should it is believed give the Department power to prevent such interference.

After the presentation of the tentative bill in the House and its assignment to the Merchant Marine and Fisheries Committee it is understood that public hearings will be held at which time all interests may appear to present their suggestions and recommendations.

An Inexpensive Homemade Battery Charger

By F. D. PEARNE



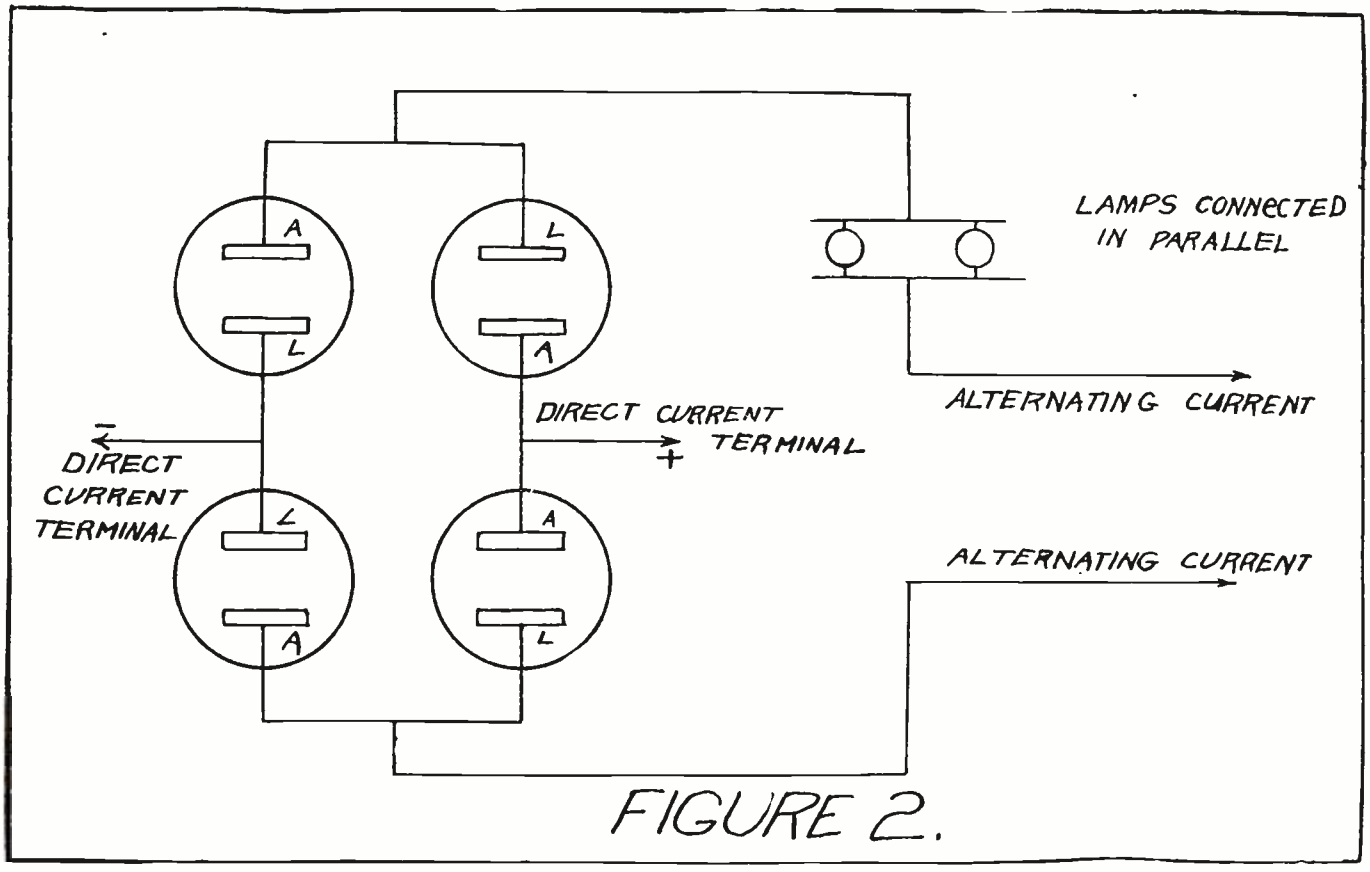
The constructional and assembling details of the Noden Valve Electrolytic Battery charger. This type of rectifier is designed for use in homes where the 110 volt house lighting current of the alternating type is available.

ONE of the most essential requirements of a radio set is some kind of a charging apparatus which will keep the storage battery charged at all times. This is comparatively easy where the electric lighting circuit is of the direct current type, but unfortunately for the radio fan, most lighting circuits use the alternating current and before a battery can be charged with this current, some method of rectification must be used. Various devices for this purpose are now on the market, some of which are sold at reasonable prices, while others are really expensive, and as the average radio fan usually has plenty of outlets for his spare change, I am going to describe a rectifier which any amateur can build at an expense of less than $3.

This outfit is known as the "Noden valve" and will answer the purpose very well and in fact is really better than some of the rectifiers one may buy, for the reason that it rectifies both sides of the alternating current wave, which some of the standard outfits do not do. The materials required consist of four ordinary quart size mason jars, such as are used for putting up preserves; four pieces of sheet aluminum one-eighth of an inch thick; four pieces of sheet lead of the same size and thickness, four wooden tops to cover the jars, a few brass machine screws and nuts, and about two and one-half pounds of phosphate of ammonium.

First cut out four plates of good soft sheet aluminum, six inches long, two inches wide and one-eighth of an inch thick. Bend one end over, one-half inch as shown at "A", Figure 1. Drill a hole through the center of the part which is turned over. This should be drilled with a No. 18 drill which is large enough to allow an 8-32 brass machine screw to pass through it. These plates should be made of soft aluminum for the reason that hard aluminum will crack and break, if bent at a sharp angle. Next cut out four pieces of sheet lead of the same size and shape as the aluminum pieces, and drill holes of the same size in the same place.

The wooden tops for the jars should be turned out of hard wood. The flange should be three inches in diameter and one-half inch thick and the smaller part is two and three-sixteenths inches in diameter and one-quarter inch thick.



The wiring diagram of the jars and the method of connecting the lamps into the circuit to control the charging rate of the rectifier. Full details for the construction and operation of this unit appear herewith.

This small projection is to extend down into the jar and will just fit into the neck of the quart-sized fruit jar. If any other kind of a jar is used, this size should be changed to suit the case. If it is not convenient to turn these tops out in a lathe they can be made of two pieces cut out with a jig saw and fastened together with screws, but these screws must be so located that they do not interfere with the holes which are to be drilled, as shown at "B," Figure 1. Now mount one aluminum plate and one lead plate on each of the tops as shown at "C," Figure 1. These plates are held in place by 8-32 brass machine screws, one and one-half inches long and fastened with a nut on the other side. The nut should be turned up very tight so that the plate is held rigidly in place. Another nut on top of the first one serves as a binding post to which the wires will be connected later.

After all four units are complete the part of the plates which was turned over, as well as the screw heads and the part of the wood which goes down into the neck of the jar should be coated with melted wax, or paraffine to prevent any gas or fumes from the solution corroding the screws, thereby causing a poor joint. Next, make up the solution with which the jars are to be partly filled, make a saturated solution (all the water will dissolve) of distilled water and phosphate of ammonium. It is necessary that the distilled water be used as it will not work if the water contains any impurities.

Fill the jars with this solution to within about one inch of the top, that is, the solution should be within one inch of the top when the plates are in the jars. It is a good plan to measure out enough water to fill the jars three-quarters full and then add the phosphate of ammonium, until no more can be dissolved. In dissolving this chemical, it should not be stirred with a metal spoon; use a piece of glass, so as to make sure that no impurities get into the solution. Figure 2 is a diagram of the circuit, which shows how the connections are made. The aluminum plates are marked "A" and the lead plates are marked "L" respectively. Lamps are connected in the circuit, which allow only a certain amount of current to pass from the alternating current wires to the rectifier. Each lamp added in parallel as shown will allow more current to flow. The direct current is taken off at the junction between the jars as shown. To recharge the battery, connect the positive direct current terminal to the positive terminal on the battery and the negative direct current terminal to the negative terminal of the battery.

The action of this rectifier is based upon the principle that the current will not enter the solution through the aluminum plate. It will enter the solution from the lead plate and flow out through the aluminum, however. Let us for example say that the circuit shown in Figure 2 is connected to a source of alternating current supply. If the first impulse comes in on the side of the circuit in which the lamps are placed, the current will not enter the aluminum plate in the jar on the left side, but will enter the lead plate on the right side, flowing out of the aluminum plate. It cannot enter the cell below it, because of the aluminum plate, but will flow out over the direct current terminal, through the battery and back on the negative direct current terminal, through the lower cell on the left side to the other side of the alternating current.

The next impulse is in the reverse direction and comes to the lower set of cells. The aluminum plate in the left hand cell prevents the current entering so it takes the path through the right hand cell, coming out of the direct current positive wire again, through the battery, back into the negative direct current terminal, through the upper left hand cell, to the other side of the alternating current line. Thus it will be seen that the direct current terminal on the right side of the drawing will always be positive, no matter which way the alternating current flows.

This rectifier will give very good service and will put a good charge in the battery in twenty-four hours. A small hole should be drilled in the wooden tops to allow any gas to escape. As it will be necessary to "form" the plates before the rectifier will function properly, the two direct current posts should be connected together for about ten hours while the alternating current is on, so that perfect rectification will take place when the battery is connected in the circuit. After the plates are once formed, then the battery may be connected on the terminals at any time. A more efficient method is to use a toy transformer, connecting the primary

(*Continued on page 47*)

What the Broadcasters are Doing

Broadcast Records

AMERICAN broadcasting stations are reaching out to such vast distances that it begins to appear that voice-radio communication with points up to 5,000 miles soon will be regarded as commonplace. The recent transatlantic tests called general attention to communication with English stations. But England had heard American broadcasters repeatedly before these tests and American receivers had frequently tuned in and picked up English stations.

To WDAP, the Chicago Board of Trade station, belongs the credit of having entertained an English listener throughout an entire program of several hours. The operator who received this Chicago program was Thomas E. Hamblett, Windle Mount, Hard Lane, St. Helens, Lancaster, England. It may be difficult for Americans to understand how any message, much less a radio, program, could find a Britisher who was hidden behind such a complicated address as that, but Mr. Hamblett was found out not only by WDAP but by KDKA, Pittsburgh. On September 25, Mr. Hamblett was listening to KDKA at 1:57 a. m. He wrote to KDKA saying he tuned out after twenty minutes because the market reports had driven him away. KDKA reached several other English listeners.

Reception of WGY, Schenectady, was so successful in Queenstown, Ireland, during the transatlantic tests on the morning of November 27 that A. N. C. Horne was able to make a fifteen-second log covering the transmission from the opening announcement to the "sign-off."

In his letter to the General Electric Company station, Mr. Horne stated that reception was made on three valves —dectector and two low-frequency, with an aerial twenty-five feet high and 250 feet long, inclosed by tall trees. He explains that he has studied radio for the last ten years and that the highest degree of accuracy was aimed at in recording his observations.

In his log Mr. Horne mentioned that the concluding number of the program, "God Save the King," was "good." That is an odd thing about radio. The patriotic hymn, "America," becomes "God Save the King" in England.

Mr. Horne sent records of WGY for November 22, 23, 24 and 25, indicating that he has little difficulty in picking up the Schenectady station whenever it is

'GENE McDONALD

He is owner of the Zenith-Edgewater Beach Hotel Station WJAZ, president of the Chicago Radio Laboratories, president of the Zenith Radio Corporation and president of the National Association of Broadcasters. He equipped the MacMillan arctic ship with radio receiver and transmitter and talks to MacMillan every Wednesday night from the Chicago station. On the night of Dec. 19 when talking to MacMillan his voice was heard in the Samoan Islands, more than 7,300 miles distant. So far as known this is a world record. Mr. McDonald is a hunter, and a yachtsman. He is leader of the great fight against the American Society of Composers, Authors and Publishers, who tried to force broadcasters to pay large fees for broadcasting popular music. His real name is E. F. McDonald, Jr., and it is a name that is growing bigger and bigger in radio. (Walinger.)

TIME SIGNALS

Each day at noon C. J. Waldron, of Medusa, N. Y., gets the time signal from Station WGY, the General Electric station at Schenectady. Right on the dot he pulls the rope and rings the village churchbell, thereby affording towns folk and farmers with the means of setting clocks and watches.

on the air. Accompanying the WGY records were logs on reception of English broadcasting stations, and it was observable that the WGY transmission faded less than that of the English stations.

Probably the most interesting long distance record made recently by an American broadcasting station was that of the Zenith-Edgewater Beach station WJAZ. On December 19, or early in the morning of December 20, Eugene F. McDonald, Jr., president of the National Association of Broadcasters and owner of the famous Chicago station, was talking to Donald B. MacMillan, ice-locked in his ship near the North Pole. United States Naval radio operators reported three days later that Mr. McDonald's voice had been heard clearly in the Samoan Islands, more than 7,300 miles away.

Away down there in the South Seas, twelve degrees south of equator, the operator of a radio receiving set was "listening in" for any bits that he might pick up from the world abroad.

Doubtless the Samoan operator was interested in the messages that were going out to Dr. MacMillan, but, being a good radio operator, he must have had quite a thrill when he realized that he was making a reception record that probably surpasses any other achievement thus far recorded.

First news of the remarkable incident reached the office of the Zenith Radio Corporation at 332 S. Michigan av., when the United States Naval Radio Station on the Municipal Pier, Chicago, called on the telephone and reported they had a message from Samoa reading as follows:

"YMG reports as follows: Please inform Zenith-Edgewater Hotel Radio Station that Chicago messages and music to MacMillan, North Pole, were received by me at 7:45, Samoa time, December 19.

"ROBERTS."

AMRAD'S RECORD

When two-way communication by voice was established for the first time in the history of radio, Friday evening, November 30, between Amrad WGI, Medford Hillside, Mass., and Station 2-LO, London, England, it was a remarkable coincidence that the first American station to participate successfully in this two-way communication was Amrad WGI, the world's oldest broadcasting station operating today, erected in 1915. It was a further significant coincidence that Mr. H. J. Power, founder and active head of Amrad, who conducted the early broadcasting in 1915 and '16 and now known as the "father of broadcasting," was at the microphone when the successful broadcast was made.

According to the schedule two-way communication was not to be tried until Saturday, December 1; but when 2-LO received the American station November 30, the British amateurs could not refrain from calling back and were heard by many American listeners.

Again on Saturday two-way communication was maintained between Amrad WGI and 2-LO London and complete confirmation followed after an exchange of cablegrams. The achievement was all the more remarkable as the American station used only 150 watts in the antenna.

WTAM's Record

The new high powered broadcasting station, WTAM, in Cleveland, Ohio, was heard in England before any special efforts were made in trans-Atlantic broadcasting.

Mr. Hamblett, from St. Helen's, also wrote that he heard the Willard Company's station quite clearly broadcasting its program on Wednesday evening, November 21.

He picked up WTAM at 3:48 a. m., London time which is five hours earlier than New York time, and heard the remainder of the Willard program with practically no interference until the station signed off at 4:13 a. m., London time. His letter stated that his reception of "The Lost Chord" sung by the Amphion Male Quartette was almost perfect. Hamblett's set is one of his own assembly, using one stage of radio frequency and detector tube. His aerial, according to his letter consists of a single wire antenna 100 feet long and 33 feet high.

A number of other applause letters have been received from foreign countries within the two months this station, operated by the Willard Storage Battery Company of Cleveland has been on the air.

Two Other Records

A. F. Combs, of Enid, Okla., and M. B. Norman, Eureka Center, Wis., reported what are believed to be long-distance receiving records for 3-tube sets.

Using receivers of the same type that were designed and built by Dr. Fulton Cutting and Bowden Washington, Minneapolis, Minn., Combs, at Enid, listened to three numbers—vocal, orchestra and piano—broadcast by 2-LO, London, Eng., and Norman picked up a station at Glasgow, Scotland.

Combs verified his feat through 2-LO's New York office and Dick and Adolph Danielson, of St. Croix Falls, Wis., who were listening in with Norman.

SUNSET STATION

KGO, the Sunset Station, has come on the air with the new year. On the western edge of the United States, at Oakland, California, two steel towers have arisen and from the antenna, on January 8, the new voice vibrated on the air. KGO is the second link in a chain of three super-broadcasting stations planned by the General Electric Company. The first is WGY, at Schenectady, N. Y., now completing two years of popular broadcasting, and the third will be erected at Denver, Colorado.

For the first time an entire building has been constructed to house a great station and its equipment to be used exclusively for popular broadcasting. This indicates that the General Electric Company has faith in the permanence of broadcasting.

The Oakland station in its studio, control-room and power station embodies the latest developments in the art. Its power and antenna systems, a thousand feet away from the studio building, include all the mechanical and technical refinements that have marked the new achievements in broadcasting. By means of KGO the listener in Maine becomes an air neighbor of the folks in California.

The Pacific Coast station is located on East 14th Street, Oakland. It is a two story brick building. On the first floor, near the entrance, is the office of the studio manager who plans programs, selects artists, and co-ordinates the duties of the office and broadcasting staff.

Close at hand is the correspondence room where the business of the station is carried on. Here a staff of assistants attends to the details of program-making, interviews callers, keep logs of every performance and answers and files the letters received from the listeners.

On this floor there is an attractive reception room covered, as is the entrance hall and stairway, with a rich, heavy piled carpet of a beaver taupe color. The woodwork is painted a soft antique ivory and is glazed a VanDyke brown. The walls are covered with a two tone gray and blue figured tapestry. Draperies of blue and taupe damask enrich the appearance of the room which is furnished with carved walnut furniture of the 18th century period. Adjoining the reception room is the ladies' rest room. On the first floor is also a large room for motor generator sets and storage batteries.

On the second floor are two studios similarly appointed, one large enough to accommodate a chorus or symphony orchestra; the other, a smaller room, for the broadcasting of solos and addresses. The use of the two studios also makes continuous broadcasting possible. The announcer has but to step from one room to the other at the conclusion of a number and find the next performer waiting for the word to begin.

It is in the main studio that the art of the decorator reaches its fullest expression but before the artist began his picture, working with tapestry, carpets and draperies, the engineer had lined the walls with a mesh of insulated wires connecting microphones with control apparatus in an adjoining room. After the wiring was completed exhaustive experiments were made to determine the reverberating qualities that the proper amount of "damping" might be secured to assure maximum musical quality. Walls and ceiling were covered with special sound-proofing material and then the studio was turned over to the artist. The decorator has hidden all evidences of the true purpose of the room.

Adjoining the studios is a "silent" room in which the performer is ushered to remain until summoned to the studio.

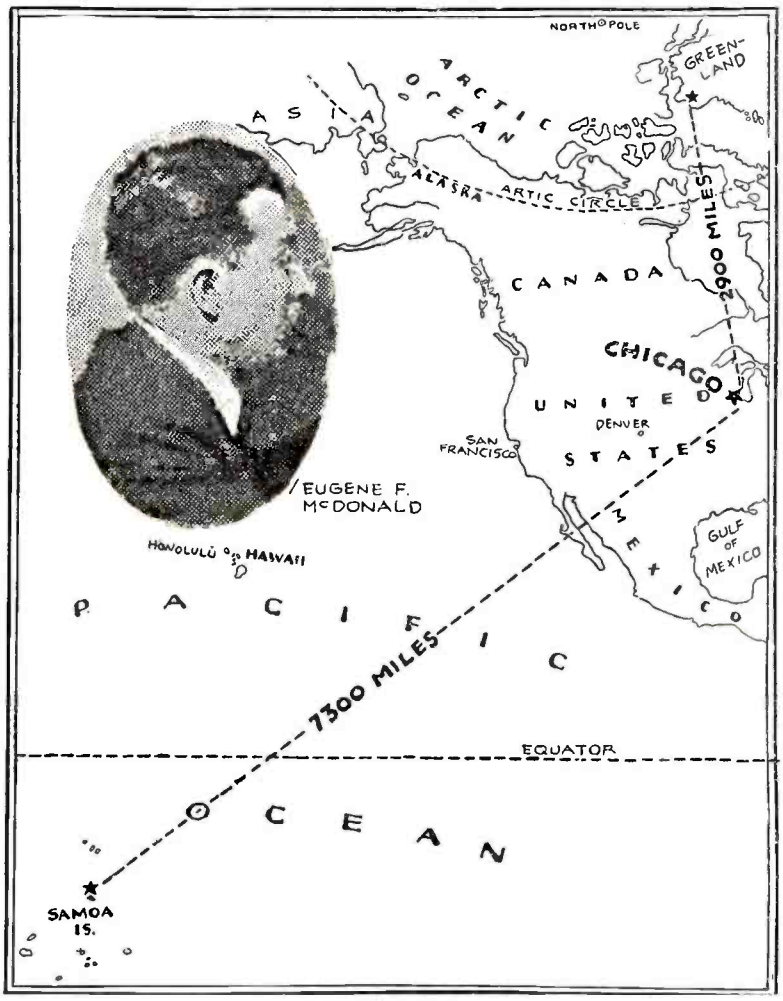
On the second floor, but unseen by the performers, is the control room. Here with headphones at ear, operators listen critically to every word and note compensating for differences in tone and volume among the artists and flashing warning through silent electric signals to the studio manager, when it is necessary to alter the position of the singer or instrumentalist in respect to the microphone. The control room has three stages of speech amplification consisting of two 5-watt tubes and four 50-watt tubes. A fourth stage of speech amplification is installed in the power house.

KGO is operated at 1000 watts, but the equipment is designed in excess of that power for purposes of conducting tests. In operating high-powered equipment below normal rating in broadcasting, tubes and rectifiers are not subject to occasional overloads and, as a result, superior quality and greater reliability of transmission is obtained.

The power house and antenna system are 1000 feet from the studio building. Nine motor-generator sets in the power house supply filament and plate current for the oscillator, modulator and kenotron rectifier tubes.

There are six tubes in the kenotron rectifier assembly, one metal plate oscillator tube, and one metal plate modulator. Every part of the equipment in the power house and in the control room is in duplicate, assuring uninterrupted service. If one outfit or part of an outfit breaks down during the operation period another outfit will be ready to be brought into the circuit.

The antenna is of the multiple-tuned type and is strung between two steel towers, each 150 feet high and 250 feet apart. Beneath the antenna is the counterpoise consisting of a network of wires, fourteen feet above the ground, covering an area of 150 by 300 feet. In addition to the power house which is one story high, 71x32 feet, there is a small building for the tuning apparatus



7,300 MILES

Among all the recent distance records recently made by radiophone broadcasting stations by far the most startling is that of WJAZ, the Zenith Edgewater Beach Station, Chicago. E. F. McDonald, Jr., was talking to Dr. Donald B. MacMillan, ice-bound near the North Pole and his message was heard by a radio operator in the Samoan Islands. The South Sea operator's achievement was reported three days later by the U. S. Naval radio station at Chicago, having been relayed back by naval operators.

and the end of the multiple-tuned antenna.

KGO, the Pacific Coast station of the General Electric will not be dependent upon its own studios alone for programs. Located as it is near the great cities of the Pacific Coast, it has a rich field from which to select music and eloquence. By means of broadcasting pick-up circuits, the Sunset Station will be equipped to broadcast the speeches of important public gatherings, the addresses of prominent citizens, sermons by pastors of leading churches, concerts, theatre productions and occasionally, important athletic events like baseball or football games.

The Oakland station will be on the air every Tuesday, Thursday and Saturday nights carrying instruction and entertainment to the great audience of the Pacific Coast and, when atmospheric conditions are favorable, to the fans throughout the country. The wavelength of KGO is 312 meters.

Martin P. Rice, director of broadcasting for the General Electric Company has charge of KGO, the new Oakland station, WGY at Schenectady and the proposed Denver station. J. A. Cranston, Pacific coast manager for the G-E, has direct supervision of KGO.

Portable Station

A SHORT wave radio transmitting set which may be transported to the scene of church services, concerts, dramatic performances or lectures, as easily as a motion picture cameraman is sent on news-weekly assignments, has been introduced as part of the broadcasting equipment of WGY, the Schenectady station of the General Electric Company.

This set is not used to broadcast directly to the listener, but is a radio relay which conveys the program to the broadcasting station. This first radio transmission can not be tuned in on the average radio receiving set.

The portable transmitting set is conveyed to the hall or church from which it is desired to broadcast an entertainment or sermon. Wire connection is established between microphone or pick-up within the hall or church and the transmitter of the portable set outside. The wavelength is too low to interfere with the usual receiving sets or broadcasting stations and it is also so low that there can be no interruption from spark transmitters.

By means of a sensitive receiving set located near WGY, the electrical vibrations into which speech or music has been converted are picked up, amplified and then conveyed to the main transmitting equipment of WGY, from which the program is put on the air on the licensed wavelength of the station, 380 meters.

Prior to the introduction of the radio relay it was customary for WGY to connect church and radio station by wires. Wire installations required considerable preparatory work and because of the time involved in making the necessary installations some programs that might have proved instructive and enjoyable had to be omitted. The small transmitting set is mounted in a covered truck and may be taken to hall, theatre or church, where in a short time the installation will be complete and ready for service.

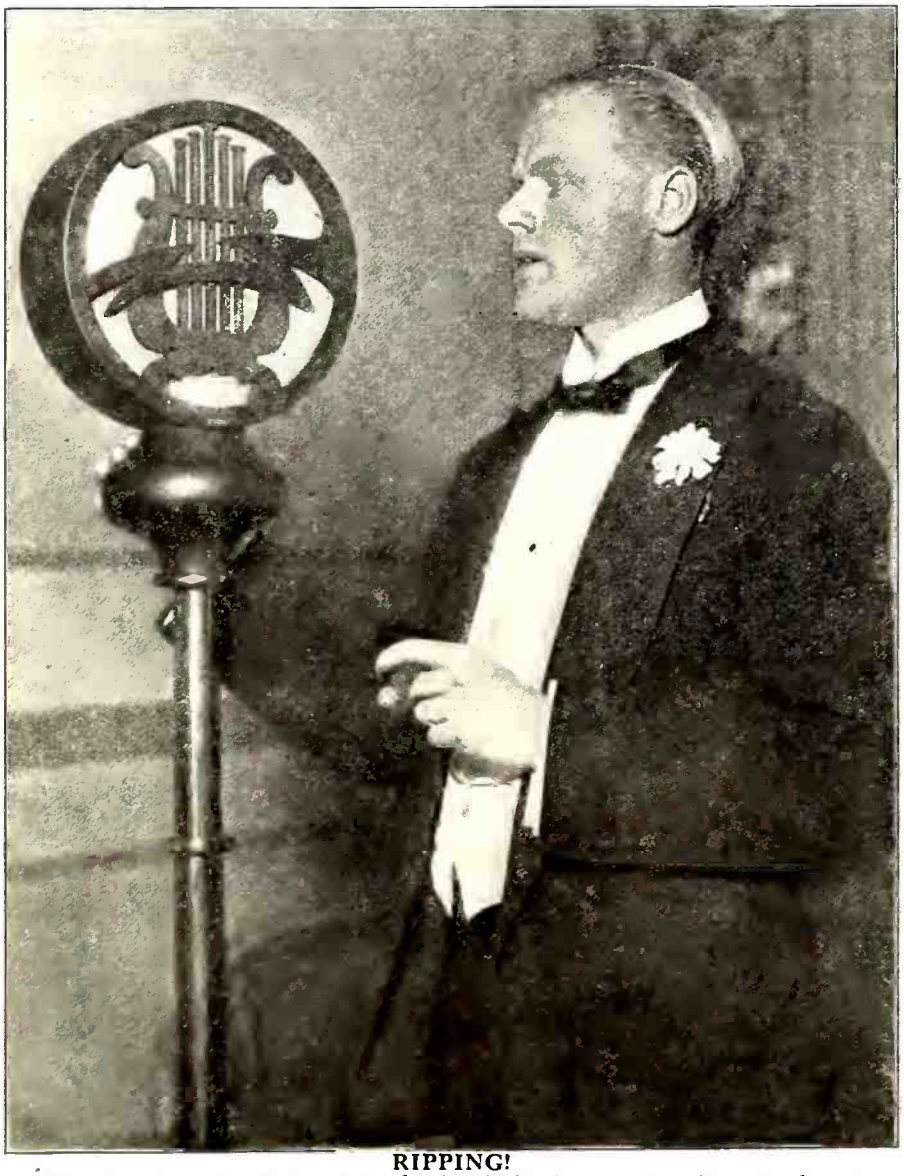
Re-broadcasting does not affect the quality of music or speech. WGY has made frequent use of the radio relay methods and the listeners were at no time aware that a radio transmitting set working on a low wavelength had supplanted the wire link in the system.

There is another and even more important use for the small transmitting set in radio relay and this use suggests a particularly interesting development for radio in the future.

In the relay now in common use at WGY, the small station is used to feed into the larger transmitting set through the introduction of a receiving set between the radio links. It is possible that the future will see many of these small transmitting sets scattered about the country and used to re-radiate on lower wavelengths, concerts received on a sensitive receiver from any one of a half dozen main stations, for the benefit of listeners with crystal sets or short distance receivers.

For example, such a receiving set might pick up the best of the WGY program from Schenectady and then a special feature from WJZ or other station and by the use of the transmitter re-radiate to the country side within a limited distance of the station.

This would give the man with the small receiving set the advantage of listening to a selected program, the best of the main stations. In this manner he would be able to get programs, and to get music that would not otherwise be available to him on his set. Many of the distant stations can be tuned in at will when atmospheric conditions are right but there are nights and days when the average set has difficulty in getting distance. The small re-radiating or relay station practically assures success to all the fans within a hundred miles, at least.

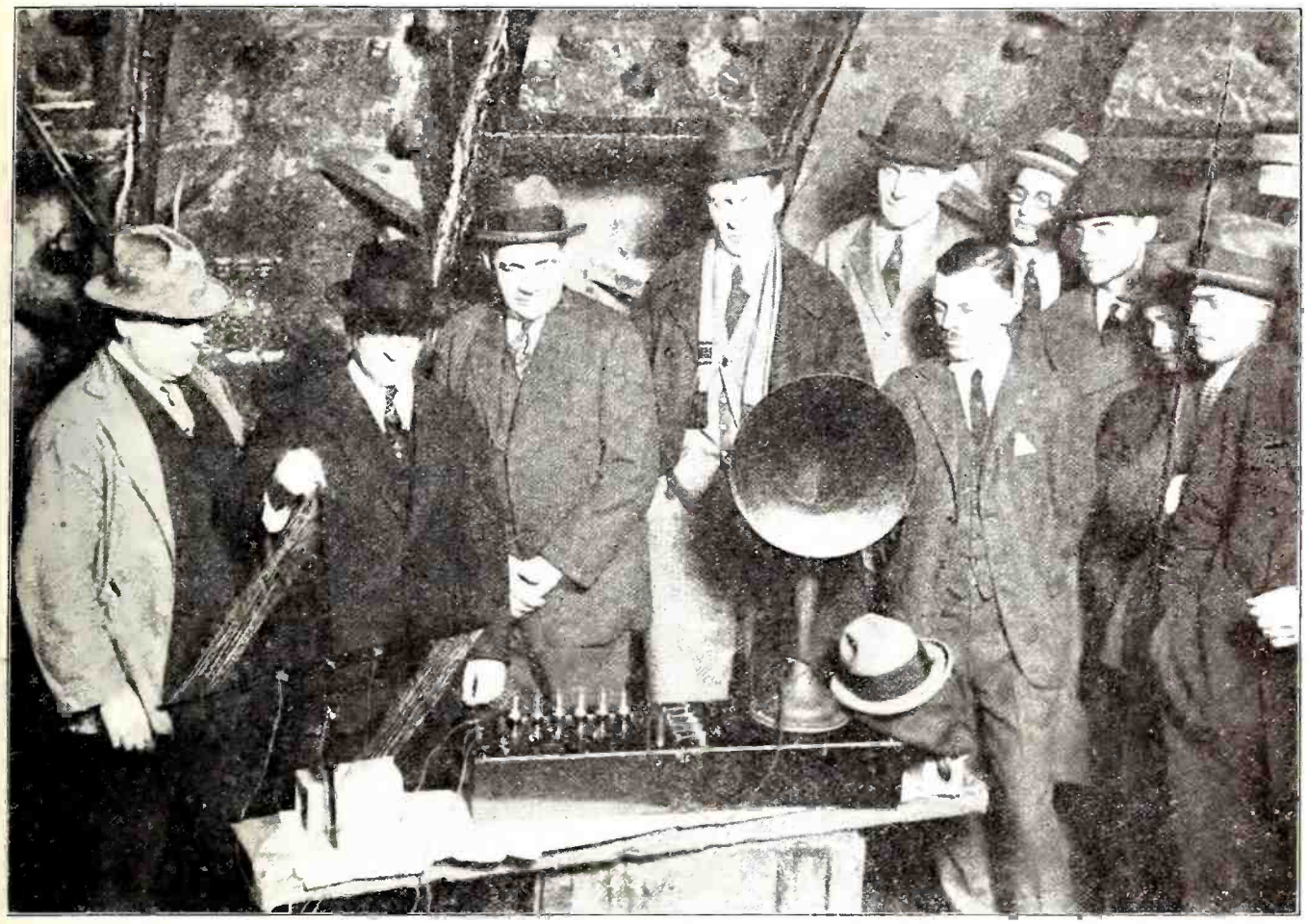


RIPPING!

That's what the Duke of Sutherland thinks about radio. He has been investigating American aviation and the picture shows him talking to American BCL's from Station WJZ, New York. Swagger microphone and topping haircut, we say. (Kadel & Herbert.)

Radio in Jail

"Four walls do not a prison make—nor iron bars a cage." The line from the old poem has been applied to many situa-



RADIO PENETRATES STEEL TUNNEL CASING

G. Y. Allen, radio engineer of the Westinghouse Manufacturing and Electric Company is shown testing reception conditions in the New York-New Jersey vehicle tunnel. Broadcasting was distinctly heard from Philadelphia, Pittsburgh and other cities. The radio waves passed through 500 miles of air, 70 feet of water, 30 feet of mud and through the heavy steel casing of the tunnel. (Photonews.)

tions since it was written. Now comes its application to radio.

WTAM, the broadcasting station of the Willard Storage Battery Company, Cleveland, Ohio, received Christmas greetings from three prisoners in acknowledgment of radio programs received by them. Two of these were prisoners of sickness. The third is actually confined in a state prison.

Mrs. Harold N. Pember, of 14 Goshen Street, Hartford, Conn., sent a disinfected letter, saying she was quarantined with her daughter who has scarlet fever. "You will never realize what a boon the radio has been on these long, lonely evenings," she wrote in appreciation of WTAM programs.

Robert H. Bean, of Manitowoc, Wis., sent the season's greetings, saying there is no station in the United States he enjoys more than WTAM. Bean was a marine engineer on the Great Lakes before an accident left him paralyzed. Cleveland, the home of WTAM, is familiar ground, he says, and the concerts bring back the good times he has had in port there.

The third letter was from Ernest Graham, prisoner in Virginia state penitentiary, Richmond.

Graham is allowed a radio receiving set in his cell through the kindness of the prison superintendent. He says there are twenty-four head phones attached to his receiver and that his companions in nearby cells listen in to concerts after the lights are out.

"The radio helps us to pass the long nights as well as to keep up our courage and to appreciate what freedom means once we get it again," he writes.

"BIG BROTHER CLUB"

Boy and girl radio fans all over the East are becoming greatly interested in the newest Amrad broadcasting feature conducted at WGI, Medford Hillside, under the name of "The Big Brother Club." Over 200 boys and girls are enrolled as active members at the present time.

"The Big Brother Club" is not unlike the Boy Scouts and Camp Fire Girls in purpose and principle. It appeals to boys and girls from 9 to 12 years old, and, according to the by-laws, "any boy or girl owning or listening-in regularly on any receiving set is eligible." The dues are one letter each week to "Big Brother." Meetings held nightly from 6 to 6:15. Each new member is issued a Certificate of Membership Card duly inscribed.

It is expected that Big Brother Clubs will be established at other broadcasting stations in the near future. Address all communications to C. R. Emery, care of Amrad, WGI, Medford Hillside, Mass.

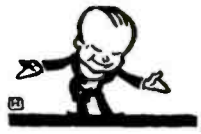
"Mike" Tests Nerves

Broadcasting has developed a new test for the nerves, according to several radio broadcast managers.

"Stage fright," "movie nerves" and "buck fever" are all well known to the public, but the little metal microphone, "the door to Radio land," has sent terror to the hearts of many seasoned entertainers who have performed before packed houses without a tremor.

Appearing for the first time before the "Mike" the artists, almost without exception, ask: "How many people will hear this?" What tone of voice shall I use? Do you think I have a good voice for this work?" and many other questions indicating nervousness.

Having performed before "Mike," who is cold and unresponsive, the artist waits impatiently for letters from the invisible fans, whose faces he could not read, to learn whether or not his act "went over." Unless he receives letters of applause his fever is likely to rise until it becomes dangerous.



Pick-ups and Hook-ups by our Readers

DIAL TWISTERS

Names	Addresses	Circuit
Norris Summers	Pee Wee Valley, Ky.	Single Circuit
Richard Jones	Milwaukee, Wis.	Single Circuit
Earle Kidney	Sterling, Ill.	Single Circuit
Harvey J. Duneka	2641 N. Central Ave., Phoenix, Ariz.	Ultra Audion
Curtis Springer	1224 N. Olney St.	Single Circuit
Kenneth Fischer	1219 N. Olney St.	Single Circuit
Both the above TWISTERS live in Indianapolis, Ind.		
John Bennett	Rockville Centre, L. I., N. Y.	Not Stated
Albenue Des Rosius	56 Bridge Av., Windsor, Ont., Can.	Reinartz
Alex Mack	1020 Cherry St., Norristown, Pa.	Hopwood Circuit

ONCE upon a time there was an Editor who wanted to give the fans a chance to compare records in his radio magazine and let the readers know that he wanted lists—

That's us. We like to give the fans what they want, and we try to please them in every way possible

Some time ago, we requested through this department that fans send in their lists of stations heard, and we got just what we deserved. No restrictions were published as to the length of the lists, and by looking over some of those submitted, you'd think you got a hold of the call book for all the stations of the world.

We find that it is an impossible thing for us to determine the record holder for the month, and we cannot find any real restrictions to impose on these fans who laugh at distance as far as radio listening is concerned.

It's this way. Willie Jones writes in telling us that he has heard station XYZ transmitting on sixteen meters, which is located four thousand miles from his house. Mr. Smith tells us that his set using a 23-tube ultra-superheterodyne has heard all in all six hundred stations from the Alps to Omaha.

The point is—whose should be considered a record?

We'll handle it this way. In order to give all the fellows a chance at this, we're going to establish the order of DIAL TWISTERS. We'll publish the lists of those fellows who do real long distance work from a standpoint of location, type of set, and operating conditions. When you write enclose your list neatly compiled, with data on the type of receiver, and any other information that you think would be of value in determining whether you are entitled to the name of DIAL TWISTER.

The Pickups editor will read them over carefully, note the lists, and conditions under which the work was done, and if he thinks it contains something of a feat, will put your name in the list of DIAL TWISTERS, and if space permits publish your letter.

Everybody has an even chance—no matter if you have a ten-tube superheterodyne or a one-tube first tube circuit. We will carefully consider them both, and if the one list and letter shows more meritorious work, we will publish that one.

What say fans! How many of you are going to be classed as dial twisters next month?

THE PICKUPS EDITOR.

Our December 1923 issue contained an interesting account of reception record made by Mr. E. L. Laudell, of Shelbyville, Illinois on a circuit of his own design. Mr. Laudell instructed us to say that fans could have a copy of his circuit by writing. In a later communication, Mr. Laudell says:

"I throw up my hands—I can't possibly answer the mass of inquiries that come in. While I am writing this, I have a splitting headache from writing and reading letters in answer to inquiries received in response to the offer I made. I have now received 500 letters."

We wrote Mr. Laudell for his circuit, and in reply he says:

RADIO AGE,

Gentlemen:

You will find enclosed the circuit on which I compiled the list of stations published in your December, 1923, issue.

Upon inspection you will see that the circuit needs no comment or special parts other than a common variocoupler which must be rewound to suit the circuit given. I am enclosing detailed information regarding the winding of the coils on this coupler, and trust that fans may find as good results awaiting them as I have received.

Very truly yours,

E. L. LAUDELL.

We are printing in Figure 1, a copy of the circuit which Mr. Laudell contends is superior to many others. The primary of the coupler has eighty turns of No. 28 D C C wire, with taps taken off as follows:

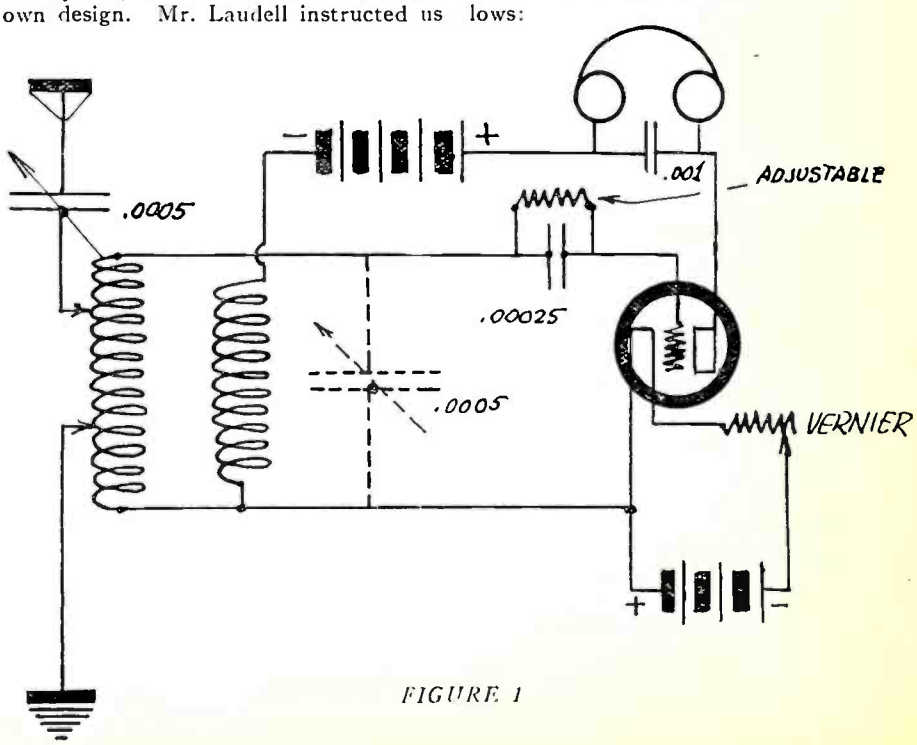


FIGURE 1

Tap the first ten turns every turn, and then wind seventy turns of the wire bringing out loops for taps every tenth turn. This makes the coil have seven taps of ten turns each and ten turns of 1 tap each. The secondary is rewound with the same size wire and had 64 turns. The secondary in the circuit really is not a secondary but is used as a tickler.

The remainder of the circuit is standard with respect to parts, and the diagram shows how the connections are made. Mr. Laudell would be pleased to hear from fans who construct this circuit.

On page 4 of the August issue, we printed a short item regarding reception of signals on short antennas by various fans, and Mr. B. O. Borgeson found that a score of people took the trouble to look up his address, and write him concerning his experiments.

Mr. Norris, Summers, Pinvee Valley, Ky., writes us:

RADIO AGE,
Gentlemen:

After reading Mr. Foltz's letter in the January number last night I decided to take down the stations heard before turning in.

So as a result I am sending my list which contains fifty stations all of which were plain and clear.

I do not claim this to be a record as I can easily do as well any good night. My set is a single tube type, using a U V 199, in the much ridiculed single circuit.

Very truly yours,
NORRIS SUMMERS.

Mr. Summers' list is as follows: CKAC, Montreal, Can.; WJAR, Providence, R. I.; WOAW, Omaha, Neb.; WCAE, Pittsburgh, Pa.; WWJ, Detroit, Mich.; WOR, Newark N. J.; WHAM, Rochester, N. Y.; WHAS, Louisville, Ky.; WDAP, Chicago, Ill.; WGY, Schenectady, N. Y.; WDAF, Kansas City, Mo.; WJAX, Cleveland, Ohio; KFKQ, Conway, Ark.; WCX, Detroit, Mich.; WTAS, Elgin, Ill.; WSAI, Cincinnati, Ohio; WBZ, Springfield, Mass.; WSB, Atlanta, Ga.; WMC, Memphis, Tenn.; KSD, St. Louis, Mo.; KYW, Chicago, Ill.; WIP, Philadelphia, Pa.; KDKA, Pittsburgh, Pa.; WEAF, New York, N. Y.; WFAA, Dallas, Texas; WJAD, Waco, Texas; WNAC, Boston, Mass.; WEAN, Providence, R. I.; WCAP, Washington, D. C.; WMAK, Lockport, N. Y.; WCAS, Minneapolis, Minn.; WOAN, Lawrenceburg, Tenn.; WLAP, Louisville, Ky.; WHN, New York, N. Y.; WOI, Ames, Iowa; WHB, Kansas City, Mo.; WJZ, New York, N. Y.; WBAP, Fort Worth, Texas; KFMQ, Fayetteville, Ark.; KFEX, Minneapolis, Minn.; KGO, Oakland, Calif.; KHJ, Los Angeles, Calif.; WJAZ, Chicago, Ill.; WLW, Cincinnati, Ohio; WBAK, Harrisburg, Pa.; KPO, San Francisco, Calif.; KFI, Los Angeles, Calif.; WJAN, Peoria, Ill.; KFDL, Denver, Colo.; KGW, Portland, Oregon.

Wot say, fans? Looks like the single circuits are coming to the front this issue. We remember way back when a

Pickups By Readers

(Continued)

fellow could look with pride at a record of thirty miles or so with an electrolytic detector—and now

Read this one and weep!

RADIO AGE,
Gentlemen:

I have read with interest letters in the Pickups Dept. Now I'm out with my record, which I believe takes honors from Mr. Foltz in the January number, and also Mr. Wright of Madison, Wis., in the same issue. I have a single tube single circuit receiver which I built myself and wouldn't trade it for any set regardless of make or price. I have heard 151 stations in thirty-two states. The following are stations over 1000 miles distance: KPO, KFDB, KFI, KWH, KHJ, PWX, CHBC, CFCN, WCAR, WCAK, WBAP, WPA, WFAA, KFDF, KFAF, WWL, WAAP, WFY, WEAH, WBL, WKY, KFKB.

A total of twenty-two stations with a 32,650 mileage. If any other reader can show twenty-two stations totaling that much with a single tube set, I would like to see it. I have heard as high as thirty-three stations in a single evening between seven thirty and eleven thirty. In three nights I heard 51 different stations and did not count any station twice either.

Here's another: I have listened to KFI at Los Angeles four consecutive nights for from 30 to 45 minutes each time. Perhaps I could have listened longer only the lure for more distant stations would not permit me.

I owe all my success to a good tube, and careful tuning.

Yours for RADIO AGE, and single circuits,

RICHARD JONES.

When you read over that, you'll probably say Ummm! Pretty good, pretty good, but we'll say—GOOD!!! HUH! THAT'S PERFECT! We think it's so good that we're putting Mr. Jones' name on the Dial Twisters list. Congratulations, Mr. Jones. You're one of the highest Dial Twisters for the month.

And here's another single circuit bug:
RADIO AGE,
Gentlemen:

I have been reading some of the fine distance records made by fans, and want to contribute my list. I am using a single circuit tuner, and for selectivity and ease of control together with its great volume I don't believe it can be beat. I can't just remember the date but a week or two before Christmas I picked up the following stations from seven in the evening to ten: KYW, Chicago (Westinghouse Elec.): WOAW, Omaha; WLAG, Minneapolis; KDKA, East Pittsburgh; WGY, Schenectady; WLW, Cincinnati; WDAP, Chicago (Drake Hotel); WJAX Cleveland; WJY, New York City; WDAF, Kansas City Star; WCAE, Pittsburgh; WMAQ, Chicago (Chi. Daily News); WBAP, Ft. Worth; WJZ, New York City; WHAS, Louisville; WOAI, San Antonio; WBZ, Springfield, Mass.; WOC, Davenport; WSB, Atlanta; WHB, Kansas City; WWJ, Detroit News; WTAS, Elgin; WSAI, Cincinnati; WRM, Urbana, Ill.; WEAF, New York City; WFAA, Dallas; WCAP, Washington, D. C.; WBAH, Minneapolis; KSD, St. Louis; KFKX, Hastings, Nebr.; WNAV, Knoxville, Tenn.; Washington, Pa.; KHJ, Los Angeles, Calif.; CKY, Winnipeg, Canada; WJAZ, Chicago (Edg. Beach Hotel).

KHJ, KFI and CFCA and other Pacific stations all come in with surprising volume and clearness. I can pick them up when they are on the air at will. Last Saturday evening (January 12) I heard about twenty-three stations and not trying for records either. In the course of the evening I had heard among others PWX, KGO, KHJ, KFI, KGW, CKCE, WHN and KPO. Pretty good jaunt, don't you think? Local stations such as Chicago and Kansas City come in so loud that you can hear them 15 to 20 feet from the phones.

Let me hear from some other single circuit fans as to a record of stations heard as consistently as that!

Very truly yours,
EARLE KIDNEY.

Sterling, Ill.

The copy boy watching over our shoulder as we type this remarked with a whistle: "Whew! I'm gonna' go home t'nite an make me one of them tuners. Wotta list, wotta list." We're almost ready to follow the copy boy's example and junk that Rolls-Royce receiver of ours after reading that list. Fine work, Mr. Kidney.

Dec. 31, 1923.

RADIO AGE,
Dear Sirs:

I have been greatly interested by what RADIO AGE has to say on the Ultra Audion Circuit. For the past eight or ten years I have been trying the various hook-ups as fast as they have been foisted upon the unsuspecting experimenter, but even the ones with lots and lots of dials and switches can't beat the Ultra Audion for volume or selectivity.

At present I have only the 23 plate variable condenser, and a rheostat, on the panel, with 75 turns of No. 24 wire on a Quaker Oats box in the rear as a fixed inductance—no taps. I find this far superior to the other methods of winding coils; the variable condenser covers meters from 238 to 526 with a 75 foot aerial, and tuning is very sharp. Using one tube I regularly hear Chicago from Phoenix, Ariz., with KFAD, a mile away, making all the noise he can.

In thanking you in advance, I would like to add that RADIO AGE is exactly right—please, for everybody's sake, don't let it slide into the rut.

Sincerely yours,
HARVEY J. DUNEKA,
2641 North Central Avenue,
Phoenix, Arizona.

That's a little boost for the users of ultra-Audion receivers and here's another one:

RADIO AGE,
Gentlemen:

As a radio amateur of long standing, but who has only lately become acquainted with RADIO AGE, permit me to felicitate you upon the practical wisdom and sound judgment which its editorial contents show.

I read four different radio periodicals. Each is good of its kind. Yours is quite the most useful to the everyday semi-dumbbell like myself, who wouldn't know a heterodyne if it bit him on the ear, but who does admire for to fool away life building new circuits for his ownself.

Incidentially, even for those of a higher order of mentality than mine, I observe a definite authority and precision in your published utterances which are a pleasing contrast to the wide scope many radio editors seem called upon to allow themselves.

I specially congratulate your Mr. Felix Anderson upon the clarity and accuracy of his drawing. Nothing more helpful to me has come my way since first I dealt with radio.

I built the ultra-audion one tube circuit, described in your October number, from one of Anderson's drawings; and it is a marvel of compactness and efficiency. It outclasses a sixty-dollar "boughten" set in distance and selectivity, as well as in volume and freedom from distortion; while, as you can guess, it didn't cost anything like that money! May I suggest the addition of a vernier condenser similar to the Chelten Midget, which I am using in this circuit of yours and which I find a great help in cutting out interference.

The first night I hooked up the set I got QSADX on the following: CHYC; WIP; WDAR; WSAI; WEAF; WOC; WOO; and the rarely-heard (by me, at least) WOQ. These, in the order named, within an hour and a half, tuning through local broadcast from WWAP on 225 meters. Not so dusty, what?

Good luck to you!

Yours sincerely,
D. G. WYLIE.

And seeing that we are featuring single circuit sets this month, we give you a shot at this one compiled by two youngsters in the radio game:

RADIO AGE,
Gentlemen:

We have read several copies of your magazine. We have taken special interest in the "pickups." We are the proud jowners of a single circuit regenerative one-bulb set. We have a record which was made on the 11th of January, 1924, and we think this record cannot be equalled with such a set. We listened between the hours of 6 p. m. and 3 a. m. They are as follows: AA3, KDKA, KFGC, KFI, KFKX, KFMQ, KGW, KHJ, KYW, WBAK, WBAP,

WBAV, WBZ, WCAE, WCBD, WCK, WDAF, WDAP WDAR, WEAA, WEAY, WGY, WHAS, WHB, WHN, WIAO, WIP, WJAR, WJAZ, WMAH, WMAQ, WMC, WOAW, WOO, WOQ, WOS, WSB, WTAQ, WWJ, 3FA, 9BAC, 9BAQ, 9VC, WLW, WOC, WLAG, KFBC.

We also got a Canadian steamer, the Memphis. We are a couple of radio nuts of 14 years. In ten months we have received 276 stations all different. We have received stations in thirty-four states, District of Columbia, six Provinces of Canada, Alaska, Cuba, and Porto Rico. The night we got Alaska we were using three bulbs. We are positive we heard all of these stations for our both ears would not deceive us.

Yours very truly,
CURTIS SPRINGER,
1224 N. Olney St.
KENNETH FISCHER,
1219 N. Olney St.,
Indianapolis, Ind.

And here's another list from a radio bug not yet in his teens which surpasses some of the lists we have received from fellows who are twice his age and who have more than twice his radio experience:

I have seen quite a few records in the RADIO AGE and I think mine will beat them all. I have heard the following: KDKA, KYW, KHJ, KSD, WAAM, WBAA, WBAN, WBAP, WBS, WBZ, WCAU, WCX, WDAP, WDAR, WEAF, WEAN, WFI, WGI, WGR, WGY, WHAS, WHAZ, WHB, WHN, WIP, WJAR, WJAZ, WJZ, WLAG, WLAK, WLAW, WLW, WMAK, WMAQ, WNAC, WOC, WOO, WOR, WPAB, WQAO, WRW, WSB, WWJ, WMAF, WBAY, NAA, WJY, WSAI, WCAP, WCBD, WCAE, WRC, WDT, WNJ, WTAM, WEAM, WBT, WHAM, WCAO, WJAX, WBU, WTAS, WHAR, WOAW, WFAA, WDAF, WCAL, WNAV, KOP, CFCA, CKAC, 6KW.

I have heard a few stations that don't broadcast any more. I have heard eight amateur stations.

I am only twelve years old and I have a list of ninety-three stations in the last five months.

Yours truly,
JOHN BENNETT,
Rockville Centre, Long Island, N. Y.
P. S.—Will you please publish my list?

Laugh those two off, willya! And while you are laughing read this one:

RADIO AGE,
Gentlemen:

I think I have another good record of pickups for a two nights' try. I sent you a list some time ago, but this one has it beat a mile. I am a regular radio bug, and use a Reinartz three tube set with loudspeaker. Let's get this list off our chest right away: KDKA, KHJ, KSD, KYW, KFKB, KFKX, WBAP, WBAV, WBZ, WCAE, WCAL, WCAP, WCBD, WCK, WDAF, WDAP, WDAR, WDAX, WEAF, WFAA, WFI, WGR, WGY, WHAS, WGR, WHAZ, WHB, WHK, WIP, WJAR, WJAX, WJAZ, WJZ, WLAG, WMAQ, WMC, WOAW, WOC, WOO, WOS, WPAH, WRC,

Pickups By Readers

(Continued from page 37.)

WSAI, WSB, WSI, WSY, WTAM, WTAS, PWX, WCX, WWJ, KOP, and amateur stations 8WX, 8MR, 8CAX, 8IM, and 9XN.

Well, folks, how about that list? It's about time I have a little sleep now so guess I'll quit bothering you; but I want to say this—your magazine is a wonder.

I do not miss it any month, as I like it the best of them all. It gets better every month. The only trouble is that you don't get it out often enough. The list I submitted was all brought in on a loud speaker—no ear phones at all.

Very truly yours,
ALBENUE DES ROSIUS,
256 Bridge Av., Windsor, Ontario, Can.

Write that one on your cuff! Next: RADIO AGE,

Gentlemen:

I enjoy very much reading the pickup columns and would like to have a few of my records appear in your interesting publication. I am using a Hopwood circuit with detector and two stages of amplification employing WD 12 tubes. Although situated only 17 miles from Philadelphia with WDAR, WOO, WP and WFI going full blast, I have tuned around them almost at will. My crowning achievements and the ones of which I am most proud are as follows:

The tuning of stations WHB, WHAS, WLAG, SWB, WTAM and numerous stations close by using a three foot loop for an antenna.

The tuning of KFI, KHJ, KGW, and one morning I tuned in KFI, KHJ, and KGW between 12:30 and 1:30.

On the night of Dec. 28 I tuned in 43 stations from 7 p. m. to 12:45 a. m. (when I fell asleep at the switch). You will find the list attached. I also have a record of seventeen stations in three-quarters of an hour to which my better half acted as witness. Although "hearing is believing" I pride myself on the fact that before I log a station I always make sure of the call letters or verify the reception by reference to some program as published in newspaper programs with respect to programs. I submit a sample of my log.

I am a red hot radio fan and could write about it forever if I had the time but I will close hoping that I have not bored you to distraction.

Sincerely yours,
ALEX MACK.
1020 Cherry St., Norristown, Pa.

A Copy of Mr. Mack's Log Stations Tuned in on Dec. 28, 1923:

KOP, Detroit, Mich., police reports and orchestra.

KDKA, E. Pittsburgh, Pa., dinner music.

WCAU, Philadelphia, Hotel Pennsylvania orchestra.

WIP, Philadelphia, orchestra.

WFI, Philadelphia, orchestra.

WOR, Newark, bedtime stories.

WCX, Detroit, orchestra.

WCAE, Pittsburgh, orchestra.

WWJ, Detroit, Detroit News orchestra.

WEAF, New York, artists' concert.

WOO, Philadelphia, orchestra.

WGY, Schnectady, orchestra.

WNAC, Boston, artists' recital from WNAC.

WEAN, Providence, artists' recital from WNAC.

WTAS, Elgin, Ill., orchestra.

WHAM, Rochester, N. Y., reading.

WMAY, St. Louis, address on church work.

WHK, Cleveland, solos and orchestra.

WRAX, Gloucester, N. J., soprana solo, "Annie Laurie."

WCBD, Zion, Ill., xylophone and violin solos.

WJAR, Providence, R. I., orchestra.

WDAR, Philadelphia, Pa., Howard Lannins' orchestra and "Morning Glories."

WHN, New York, orchestra.

WHAS, Louisville, Ky., time signal.

WSB, Atlanta, Ga., address on A. R. R. L.

NAA, Arlington, Va., weather report.

WDAF, Kansas City, concert.

WJZ, New York, artists' concert.

WIS, Jefferson City, Mo., Missouri state prison band.

WRC, Washington, D. C., U. S. army band.

WFAA, Dallas, Tex., concert.

WOAW, Omaha, Neb., orchestra.

KYW, Chicago, Mary Garden in opera, Cleopatra.

KSD, St. Louis, chorus.

WBAP, Ft. Worth, Tex., Masonic orchestra.

WJY, New York, soprano solos.

3AYZ, Philadelphia, testing a new transmitter.

WBZ, Shringfield, Mass., orchestra.

WDAP, Chicago, songs and market reports.

KFKB, Milford, Kans., orchestra.

WMC, Memphis, Tenn., late frolic.

2XB, New York, testing new transmitter.

WJAZ, Chicago, quartet and concert.

Forty-three stations in fifteen states.

Total mileage, 18,501.

Time, 7 p. m. to 12:45 a. m.

The Pickups Editor wishes to acknowledge receipt of letters from the following readers:

H. J. Boyenga, Paul Baker, C. H. Peters, R. S. Merchant, B. P. Kessinger, P. Spencer, C. M. Bullard, H. W. Dillon, J. J. Drechsler, Max M. Barnhizer, Rev. R. A. Brook, and Drew D. Mac Dougal.

Rejectors

(Continued from page 13.)

rub comes in) and considerable patience will have to be exercised in winding a coil of 2,500 turns with so fine a wire as No. 34. It is possible that you may find coils of the dimensions given in some stores which handle transmitting apparatus.

The coil consists of the wire as mentioned above, wound on a tube three inches in diameter. This coil has the property of keeping the interference free oscillations which we have just tuned in, from straying off in the wrong direction, and steers them down the antenna post of the receiver instead. The coil is an absolute necessity in the unit.

The potentiometer, omnipotent in radio frequency circuits, should be of about 400 ohms maximum resistance, and is used to control the bias of the grid of the tube.

The filament posts of the unit may be connected to the common storage battery used for the remainder of the set. It is advisable if possible to use a separate B battery, connecting it to the specified posts, but if no additional batteries are available the voltage used on the remainder of the set may be applied. The voltage should be determined by the type of tube used, but as a general rule, about 80 volts is efficient.

Those contemplating the construction of this type of rejector should carefully observe the rule that good results are the fruits of painstaking care in construction, and discriminating choice of efficient apparatus.

The writer wishes to take this opportunity to thank Mr. Frederick A. Smith, Editor of RADIO AGE, Mr. E. F. McDonald, Jr., of Station WJAZ for their efforts in bringing the writer's article in the January issue of RADIO AGE before the many fans, and wishes to acknowledge receipt of the many letters written him by grateful listeners in response to the results obtained from the instructions printed in that issue.

Simple Heterodyne

(Continued from page 8.)

is supplied to the plate of the tube and is fed back to the grid circuit through the two inductively coupled coils (N) and (M). The primary carrying the plate current is (N) while the secondary in the grid circuit is (M). The primary (N) contains about 60 turns of No. 26 D. C. C. wire while (M) has about twenty turns of the same size wire. In this way the plate current frequency is imposed upon the grid circuit, and the intensity of the energy can be controlled by the plate inductance or by varying the distance or coupling between the two coils, or both. The coil (M) should preferably be the rotor of a coupler while (N) is the stator.

Next to the plate of the tube is the inductance (L) which may be a 50 turn honeycomb coil. Connected across this coil is the 23 plate variable condenser (C2) by which the inductance is varied and by which the frequency in coil (N) is varied. This arrangement can be somewhat simplified by omitting the coil (L) and connecting the condenser (C2) directly across the ends of the coil (N). Coil (N) is now made a 50 turn honeycomb. However, the results obtained by this method are seldom as good as in the complete circuit shown.

Further increase in signal strength is due to "tuned plate" methods, the inductance (L) and Condenser (C2) bringing the plate circuit into or near to a state of resonance in regard to the grid circuit. The total result of all these systems is a circuit having excellent range and terrific signal strength on local broadcasting stations. The combined adjustment of condensers (C1) and (C2) give excellent selectivity and broadcasting stations only a few blocks away are completely eliminated when desired. I

have repeatedly cut out the powerful station WJAZ only two blocks from my home and have brought in out of town stations without a trace of WJAZ even during silent periods.

As the tuning of these units is very critical at all times it is advised that vernier condensers and vernier rheostats be used. Condenser (C2) is particularly critical and requires very close adjustment for maximum results. Both these variable condensers have a maximum capacity of 0.0005 m. f. Trouble with body capacity will be in evidence unless care is taken to connect the stationary plates of condenser (C1) to the grid circuit. If the movable plates are connected at the end of the grid condenser (K1) then the extended shaft of the condenser is at grid potential and every movement of the hand on this dial will detune the circuit. When an amplifying tube such as the UV-201A or C-301A is used the grid condenser (K1) should have a capacity of 0.00025 m. f. The instructions for other tubes will be found within the box.

As a rule, an amplifying tube is better than a soft detector tube for this purpose, and with the UV-201A a "B" battery potential of 67 volts is very satisfactory. This makes the tuning sharper and brings in distance much better than with the ordinary soft detector tube working with 22.5 volts on the plate. However, detector tubes can be used if the plate voltage is kept down below 25 volts. The resistance of the rheostat (R) depends upon the make of the tube.

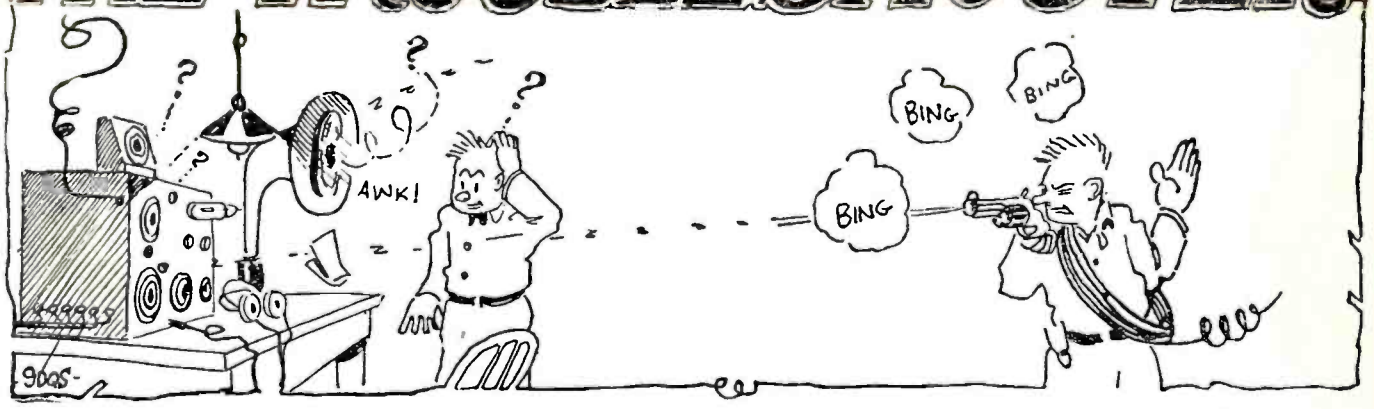
While a variometer can be substituted for the inductance (L), yet it will not perform so satisfactorily unless a fixed condenser of 0.00025 is connected across the terminals of the variometer. The variometer only adds to the expense of construction and in my opinion should not be used. Besides, it is likely to increase the body capacity and cannot easily be adjusted with vernier precision.

Sharp tuning and the other desirable characteristics of this circuit will be lost if a very long aerial is used. In no case should an outdoor aerial of more than 75 feet be used and 50 feet span is preferable, particularly if within a few miles of a broadcasting station. On 30 feet of indoor aerial I have had nearly all the stations on one tube, that is, the large broadcasting stations usually listed in the "pickups" column. With this short aerial, the set tunes sharply and is very selective over a range of from 200 to 600 meters wave length. The two controls are very easily handled after a little practice, and as a fixed type coupler is used, the dial of condenser (C1) can be logged for the different wave lengths and stations. Each station, when accurately on its assigned wave length, comes in sharply each time within one or two divisions on a four inch dial.

A variocoupler can be substituted for the fixed coupler shown but it is not desirable from any point of view. In the first place the number of controls are increased, and secondly it is then impossible to log the stations according to wave length. The variocoupler taps and inductance switches add to the losses in the circuit and of course this is to be avoided. The simplest and most effective coupler is the one shown here. The primary coil (P) consists of about 15 turns of No. 26 or No. 24 D. C. C. magnet wire, and is wound on a three inch cardboard or bakelite tube. The secondary coil (S) consists of from 60 to 70 turns of the same wire and is wound on the same tube spaced about 5-8 inch from the end of the primary coil (P). Do not place the coils closer together than this for the 5-8 inch of loose coupling must be provided to obtain selectivity and to avoid capacity coupling between the two coils.

The isometric view of Fig. 6 shows the typical arrangement of the circuit when placed on a 7" x 14" panel. The various parts in the isometric are lettered to correspond with those on the wiring diagram and the wires are numbered in agreement with the numbering of the wires in Fig. 5. This enables the reader to follow across from wiring diagram to the isometric assembly.

THE TROUBLESHOOTER



The technical department sends out many replies to questions in each day's mail. In order to assure prompt service to our subscribers the direct reply method hereafter must be restricted to those fans who are on our subscription list. Fans who are not subscribers may obtain this service by enclosing 50 cents with their question and the reply will be mailed at once, accompanied by circuit diagram where illustration is needed. All inquiries should be accompanied by self-addressed and stamped envelope.

G. S. B., Kenosha, Wis.

Question: After reading your article in the January issue, I proceeded to build an Eliminator as from your description. I built this especially to be able to eliminate Zion, Ill., Station WCBD. Inasmuch as they are only about six miles from us we like to get them out in some manner. I used a 23 plate condenser and constructed the windings as you specified. The coil I have fitted over and around the condenser. I used it tonight on a try out as WCBD was shooting with full power. The Eliminator stopped them dead, not a squawk from the station. I find however, that I can't tune any near stations by a rather wide margin. The Eliminator was hooked between the ground and antenna as illustrated in figure 9. When I tune out WJAZ, I am unable to tune in KYW. Why?

Answer: First of all I am of the opinion that you are not quite familiar with the action of the filter, judging by your description. The tuning of the filter requires patience, and perseverance to obtain the best results. Have you tried any of the other permutations possible with the filter to find out about the action with different connection? Also would advise that you place a 25 turn honeycomb coil in the antenna lead, which assists the filter in its purpose by raising the fundamental wave of the antenna slightly.

E. S. F., Chicago, Ill.

Question: As a subscriber to RADIO AGE I ask you to kindly print a circuit showing two stages of radio frequency amplification to the standard Armstrong Regenerative circuit. The circuit may use either tuned or untuned radio frequency transformers.

Answer: Figure 1 shows the diagram you desire.

C. T., Chicago, Ill.

Question: As a subscriber to your magazine would like it very much if you would send me diagrams and information on a five tube outfit 2 RF and 2 AF amplification using a loose coupler. I have a standard loose coupler and 43 plate condenser.

Answer: A diagram of the type you mention was printed in the November 1923 issue of RADIO AGE on page 18. The diagram calls for the type of apparatus you mention.

J. M. P., Dayton, O.

Question: Will you kindly advise me if your Push-Pull amplifier as outlined on Page 15 of the January RADIO AGE can be added to my receiver which is of the Westinghouse Aeriola Sr., two stage autio frequency amplifier?

Answer: The amplifier as described may be used as a third stage with a tremendous increase in volume by connecting the output of the amplifier of the set you are now using to the input of the Push-Pull amplifier as described in the January issue. The loud speaker should be connected to the output of the Push-Pull amplifier.

R. E. M., Stratton, Nebr.

Question: I recently constructed a set using the Rosenbloom circuit which you published in the January issue of RADIO AGE. Your diagram calls for a .0005 MF condenser between the antennae and variometer. I tried connecting it up, but it made a buzzing similar to that caused by a loose connection. Can you explain this? By leaving out the condenser I was able to pick up Los Angeles and San Francisco on the West Coast, and WJAZ, WOC, WOS, WHB, KFKA and WLAG with ease. I used fifty feet of ordinary insulated low tension wire strung around the garage for an antenna. Is this a good performance with a single tube? If you can suggest a reason for the performance of the condenser will be very much obliged.

Answer: The action you speak of is

(Continued on page 42.)

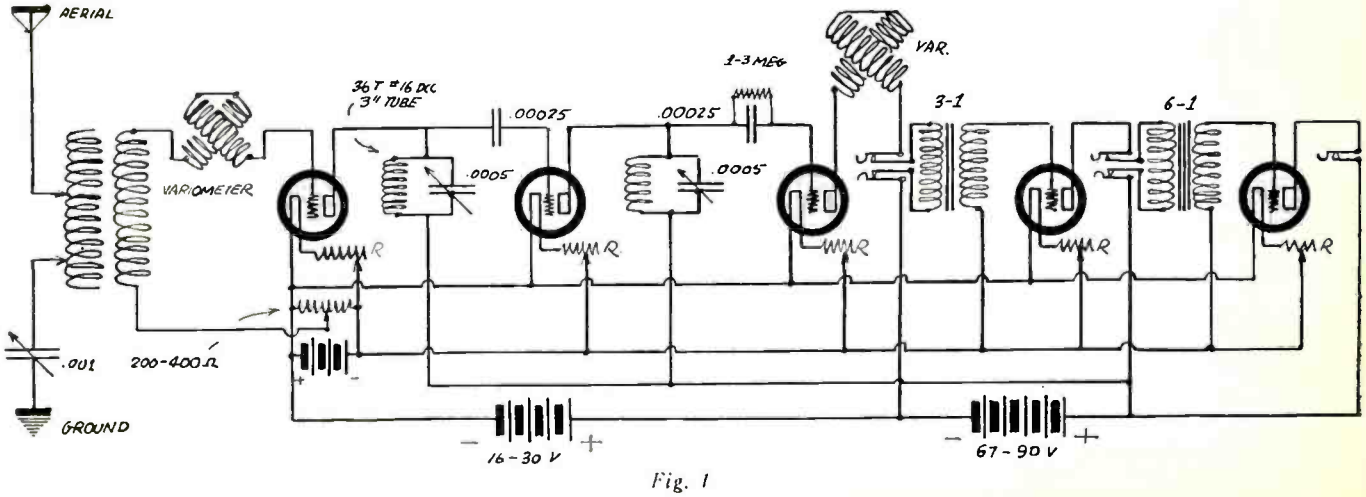


Fig. 1

Avoid "QRM"

(Continued from page 21.)

only half (or even less than half) of the tuning coil in the set, and doing your tuning with a variable condenser as I have just described.

Next let us take up type No. 11, the plain or non-regenerative audion detector used with a single tuned aerial circuit. There are not many of these in use, so far as I know, but they tune best when a series condenser in the aerial is used as I have explained for the simple crystal set.

Crystal Receivers

If your single tuned crystal set has the good features described above and still is not sharply enough tuned, you must go higher up the list. The easiest thing to do is to convert it into a type No. 10 set, which is the double-tuned crystal receiver. The most important thing you have to do for this conversation is to wind a coil of about forty turns of, say, No. 24 double cotton covered wire on a tube 3 1-2 or 4 inches in diameter and connect it in series with a variable condenser between your aerial and ground, which are to be *disconnected* from your single-tuned set. You then connect the aerial and ground binding posts on the set together by a wire if there is a variable condenser in the set. If there is none in the receiver, you connect one between these same binding posts. Then you put the new coil in line with and fairly close to the coil in the receiver and go ahead.

To adjust a double-tuned outfit of the kind that this now is, you must have both of the variable condensers at the right setting at the same time. Of course this correct scale. reading is different for every wave frequency, so the double-tuning feature gives a sort of combination lock effect that is harder to adjust but more selective than the single tuned circuit. You will find that the farther the two coils are apart, within reason, the better the selectiveness. Of course the crystal and telephone side-circuit should be connected across one half or less of the coil in the original set, as explained with regard to the No. 12 type of receiver.

A type of No. 11 single tuned audion set may be converted into a No. 9 double-tuned set in this same way, and will be much more nearly free from interference.

The next most selective set, as we go up the list, is type No. 8. This is the multiple-stage radio-frequency-amplifier outfit that uses fixed or untuned radio frequency transformers. Many of the popular "reflex" sets are made up in this way. Nearly all of them include a stabilizer or variable resistance for adjusting regeneration, but many are not sharply tuned in spite of that. It would take a long time to diagnose and explain the faults in design, in construction and in operation that are common in these outfits; consequently the most helpful thing I can do is to suggest that if you have a set of this type you can probably improve its selectiveness by making up and adding to it a separate antenna-tuning circuit such as I have described for the crystal set. If this does not stop your interference troubles you will either have to improve the general design of your set or else get another that is better or higher up the list.

We now come to type No. 7, which is the popular single-circuit regenerator. A large proportion of interference encountered by radio listeners may be attributed to the inefficiency of receiving sets of this design.

Recognizing Voices

Recently, a new announcer handled his first program through WEAF. On returning home he asked his mother whether she had heard the program during the afternoon. "Yes" she responded, but made no comment. A little surprised he asked how she had liked the announcing. Again a monosyllabic answer. Finally he learned to his astonishment that his mother had not recognized his voice—so carefully had he applied the art of correct tone and enunciation for the microphone in acquiring a "radio" voice.

On the aother hand, not many days previous, another new announcer had been heard for the first time through WEAF for a few brief special announcements. Later in the evening, a friend who had not seen or heard of the announcer for more than three years telephoned a message of congratulation. He had not questioned for a moment but that the announcing voice was that of his friend, so perfect and convincing was its reproduction.

If your newsdealer has sold out his supply of Radio Age you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in you subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.50 a year. We send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

Troubleshooter

(Continued from page 40.)

no doubt caused by some queer freak in your wiring and arrangement of parts to supply the necessary capacity. It might be that your condenser was shorted, causing the buzz you speak of, and when you omitted it from the circuit the remaining wires and apparatus connected to the set furnished enough capacity to offset its removal from the circuit. The list you enclosed is a good list considering the antenna you mention.

N. D. S., Mendon, Mich.

Question: Can you offer any suggestions how I can remedy my set Reinartz of its habit of fading away and then coming back strong as ever again, and sometimes even stronger. I use two stages of audio frequency. I have a reflex transformer. Would like to know if I can add one stage of radio to the present set and use that transformer. Will you send me a hookup using a coupled circuit tuner with a variometer and a condenser. I want one that will tune easy.

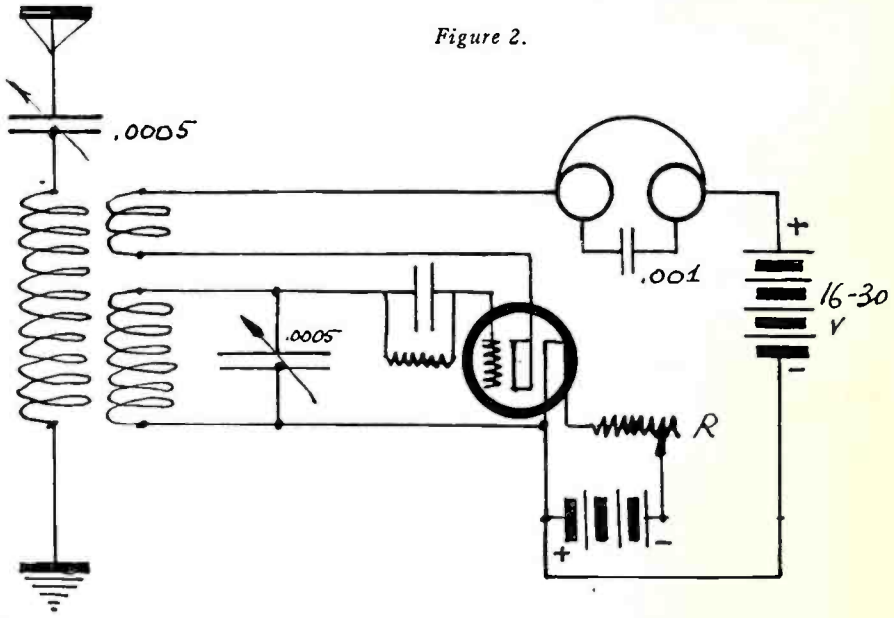
Answer: Fading, I am sorry to say, is a phenomenon that we mere human beings cannot control, and about which we know very little. If you keep your batteries up to the mark, see to it that no loose connections exist etc., it is about all you can do. The transformer you mention will not efficiently function in the circuit. A circuit of the type you desire was printed in the October issue of RADIO AGE on page 5. The diagram showing two stages of amplification was printed in the December issue.

G. R. S., Clinton, Ia.

Question: I have completed the 4 tube neutrodyne, on which I can get stations but not loud. I can put the antenna on the detector and get most of the stations just as loud as without the RF. All my batteries are OK, and I am using good parts. I find that I have to force the radio frequency tubes considerably to get results. Would appreciate your giving me some general hints on the adjustment of the set.

Answer: Would suggest that your limitations are caused by insufficient capacities in the neutrodons to balance the valves properly. A piece of copper about 1 1-2 inch square for each plate of the condenser as illustrated on the enclosed sketch should help. Adjust the neutrodons with the condenser settings at about 55. When adjusting the neutrodons, it is a good plan to pick out a good loud signal, or you may not find the proper place to balance the set.

Figure 2.



S. E. M., Washington, D. C.

Question: I am a subscriber to your wonderful magazine, which I think is a great help to all radio fans, and noticing that you offer assistance, desire a hookup of a single tube set in which I can use the following list of apparatus: 1 23 plate condenser, 1 variometer, 1 variocoupler, WD 11 tube and accessories.

Answer: A circuit adaptable to your apparatus appeared in the July, 1923, issue of RADIO AGE on page 19. The set is a regenerative one, and we have seen it giving very good results.

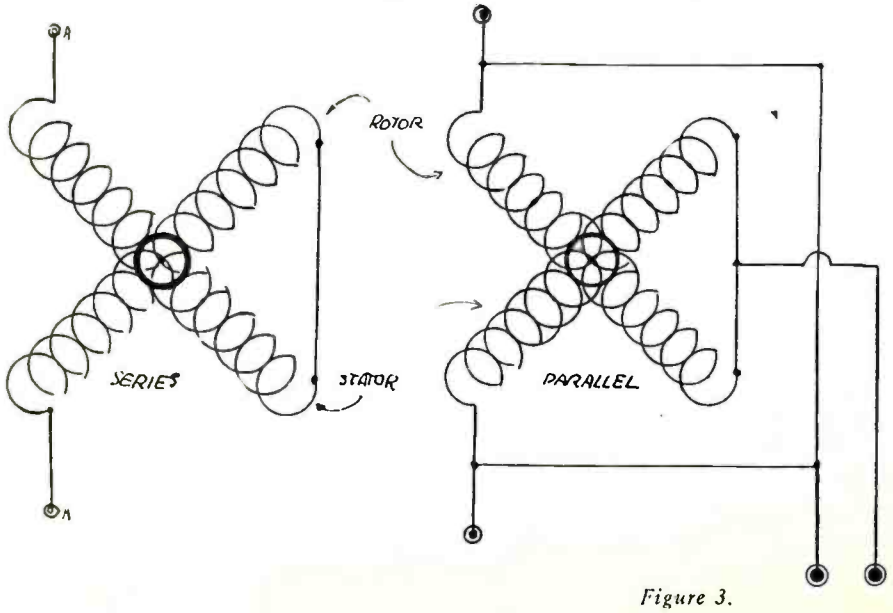
H. G. G., Long Beach, Cal.

Question: Will you kindly publish the best known hook-up for the 3 coil Honeycomb set using Duo-lateral wound coils for waves from 200 to 500 meters. Object sought—to cut out local broadcasts and bring in long distance. Desire to use 300 tube on detector if OK, and would appreciate a list of parts. Your RADIO AGE is a loud speaker, and I wish you great success.

Answer: I am printing in Figure 2 the proper connections for the parts you mention. If you are having trouble in cutting out local stations why not build one of the rejectors or eliminators as described in the January issue of RADIO AGE? Thank you very much for your comment on RADIO AGE. We hope you will find it more interesting and instructive in the future.

C. F. G., Jr., St. Louis, Mo.

Question: I have been trying the Kopprasch circuit for some time which was described in April, 1923, issue but I don't get the proper results. I saw in your answer to D. P. of Racine, Wis., in the November, 1923, issue several suggestions as to the improvement of reception with this circuit, but after carrying them out find my results little changed. I am afraid that I don't quite understand the connections of the variometers. That is I don't quite get what



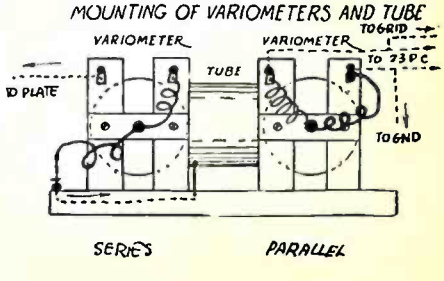


Figure 3.

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Complete Each Issue

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

			Wave length
KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	252
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDYW	Smith Hughes & Co.	Phoenix, Ariz.	360
KDYX	Star Bulletin	Honolulu, Hawaii	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	The Rhodes Co.	Seattle, Wash.	455
KDZF	Automobile Club of Southern California	Los Angeles, Calif.	278
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing	Denver, Colo.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	Mcarthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	330
KFAF	Western Radio Corp.	Denver, Colo.	360
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	The Electric Shop	Moscow, Idaho	360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAU	Independent School District of Boise City, Boise High School,	Boise, Idaho	270
KFAV	Abbot Kinney Co.	Venice, Calif.	224
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.	Phoenix, Ariz.	238
KFCD	Salem Electric Co. (F. S. Barton)	Salem, Oreg.	360
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCK	Colorado Springs Radio Co.	Colorado Springs, Colo.	258
KFCM	Richmond Radio Shop (Frank T. Doeing)	Richmond, Calif.	360
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Tex.	360
KFCY	Western Union College	LeMars, Iowa	252
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDA	Adler's Music Store	Baker, Oreg.	360
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tucson, Ariz.	360
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDL	Knight-Campbell Music Co.	Denver, Colo.	360
KFDO	H. Everett Cutting	Bozeman, Mont.	248
KFDR	Bullock's Hardware & Sporting Goods (Robert G. Bullock).	York, Nebr	360
KFDU	Nebraska Radio Electric Co.	Lincoln, Nebr.	240
KFDV	Gilbrech & Stinson	Fayetteville, Ark.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanic Arts,	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEJ	Guy Greason	Tacoma, Wash.	360
KFEL	Winner Radio Corp.	Denver, Colo.	360
KFEQ	J. L. Scroggin	Oak, Nebr.	360
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Douglas, Wyo.	263
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co.	Kellogg, Idaho	360
KFEZ	American Society of Mechanical Engineers (F. H. Schubert,)	St. Louis, Mo.	360
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFO	Dr. E. H. Smith	Hillsboro, Oreg.	229
KFFQ	Marksheffel Motor Co.	Colorado Springs, Colo.	360
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	228
KFFV	Graceland College	Lamoni, Iowa	360
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pincus & Murphy	Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portable)	228
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	360
KFGJ	Missouri National Guard, 138th Infantry	St. Louis, Mo.	268
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGV	Heldbreder Radio Supply Co.	Utica, Nebr.	224
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHB	Rialto Theater (P. L. Beardwell)	Hood River, Oreg.	280
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHF	Central Christian Church	Shreveport, La.	266
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFHS	Clifford J. Dow	Lihue, Hawaii	275
KFHX	Robert W. Nelson	Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFIB	Franklin W. Jenkins	St. Louis, Mo.	244
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oreg.	360
KFIK	Gladbrook Electrical Co.	Gladbrook, Iowa	234
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFID	North Central High School	Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIY	Brott Laboratories	Seattle, Wash.	236
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fond du Lac, Wis.	278
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	235
KFJD	Weld County Printing & Publishing Co.	Greeley, Colo.	236
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsaeg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFJV	Thomas H. Warren	Dexter, Iowa	224
KFJW	Le Grand Radio Co.	Towanda, Kans.	226
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Tex.	254
KFKA	Colorado State Teachers College	Greeley, Colo.	246
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKH	Denver Park & Amusement Co.	Lakeside, Colo.	226
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	286
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Frankliuton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLH	Erickson Radio Co.	Salt Lake City, Utah	261
KFLP	Everette M. Foster	Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, N. Mex.	254
KFLU	Rio Grando Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KFLX	George Roy Clough	Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMS	Freimuth Dept. Store	Duluth, Minn.	275
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMU	Stevens Bros.	San Marcos, Texas	240
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	283
KFMY	Boy Scouts of America	Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club	Roswell, N. M.	250
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	360
KGN	Northwestern Radio Mfg. Co.	Portland, Oreg.	360
KGO	General Electric Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach.	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Rev. Sebastian Ruth)	Lacy Wash	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer,	Seattle, Wash.	360
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	509
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	278
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash.	263
KNV	Radio Supply Co.	Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	238
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Applo City Radio Club	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkeley, Calif.	278
KSD	Post DisPatch (Pulitzer Pub. Co.)	St. Louis, Mo.	546
KSS	Prest & Dean Radio Co. and Radio Research Society of Long Beach, Calif.	Long Beach, Calif.	360
KTW	First Presbyterian Church	Seattle, Wash.	360
KUD	Examiner Printing Co.	San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co.	Los Angeles, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	250
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KWH	Los Angeles Examiner	Los Angeles, Calif.	360
KXD	Modesto Herald Publishing Co.	Modesto, Calif.	252
KYQ	Electric Shop	Honolulu, Hawaii	360
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	380
KZN	The Deseret News	Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash.	360
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	368
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	288
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	269
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co.	Emporia, Kans.	380
WABA	Lake Forest College	Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence	Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co.	Anderson, Ind.	220
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABJ	The Radio Laboratories	South Bend, Ind.	240
WABK	First Baptist Church	Worcester, Mass.	252
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABN	Waldo C. Grover	La Crosse, Wis.	244
WABD	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	286
WABQ	Haverford College Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABS	Essex Manufacturing Co.	Newark, N. J.	244
WABT	Holiday-Hall, Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABV	John H. DeWitt, Jr.	Nashville, Tenn.	263
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263

Troubleshooter

(Continued from page 42.)

you mean by series and parallel connections. How can I determine the proper way to wind the antenna coil. I am enclosing some sketches which I trust will help clear my trouble. My variometers seem to be wound from right to left while the antennal coil is wound from left to right. I feel sure that my trouble lies in the connecting of the variometers in series and parallel. Can you help me?

Answer: I am printing in Figure 3 some suggestions for wiring up the variometers of the Kopprasch circuit, and feel sure that it will clear up the difficulty without trouble. If you have the antenna coil wound in the opposite direction to the STATOR coils of the variometer you should not have any trouble providing that you have the connections of the rest of the set correctly made.

H. R. H., Jamestown, N. Y.

Question: I am building the eight tube super described in your November issue, and am thinking of using the resistance coupled amplifiers instead of the Audio Transformer coupled type of amplification. I would like to get a diagram of the super with the following diagram added to it instead of the one stage of audio frequency as shown. Would like to know that method is used in tuning an inside loop circuit. Is there any law against my selling this set to a friend? Can I use U V 200 tubes for oscillator and detectors in this circuit? Is it possible to take taps off the B battery used in the amplifier c rcuits for the oscillator circuit?

Answer: You can use the resistance coupled amplifier you submitted a circuit of by merely connecting the input of the resistance coupled amplifier to the output of the second detector at the points indicated for the primary of the audio transformer. The same batteries as are used on the radio amplifier and second detector may be used on this amplifier. When a loop is used with the circuit you mention the connections are made according to the diagram shown in Figure 5. As long as you do not manufacture the set on a large scale, no one will interfere with your selling sets to friends. Separate batteries must be used on the amplifier and oscillator circuits.

Antenna Analogy

(Continued from page 10.)

between the two parts. Every aerial contains a certain amount of inductance and capacity and the primary coil of the set which is in circuit with it furnishes a large amount of inductance. The capacity offered by the aerial is due to the fact that the ground acts as one conductor and the aerial as the other. The higher it is placed, the less the capacity and the greater the length of the vertical part, which will intercept more lines than if it were short. If the aerial has too much capacity, it may be compensated for, by including a variable condenser in its circuit. This will also aid in tuning the set.

As an illustration of just why capacity is necessary in the aerial Figure 8 is submitted. This consists of two closed water tanks connected by a pipe and partly filled with water. A plunger which fits tightly in the pipe is arranged so that it can be moved back and forth from the outside. If the tanks are small, the plunger cannot move very far in either direction, due to the small capacity of the tanks, but if their size is increased, it will be possible to get a greater movement of the plunger. Letting the two tanks represent the aerial and ground and the plunger represent the current produced in the aerial and the lines of force, the power which moves the plunger, one can readily see how too small a capacity would prevent a free movement of current of low frequency and why very little capacity would be necessary for high frequencies of short duration.

From the description given here one always remembering that however it may be constructed to meet his particular needs, the ohmic resistance should be as low as possible, which means that the cross section of both the aerial and the ground wire should be as large as possible.

Contact Across Pacific

Tacoma, Wash.—An unknown American radio operator situated in Tokio, Japan, recently sent a radio message to his mother at Cambridge, Ill., through the amateur radio station, 7HG, in this city, operated by Charles York, marking the first two-way short wave communication across the Pacific ocean. With only a fleeting contact, barely allowing time for the message to come through, York had considerable difficulty in distinguishing the foreign operator's call, JUPU.

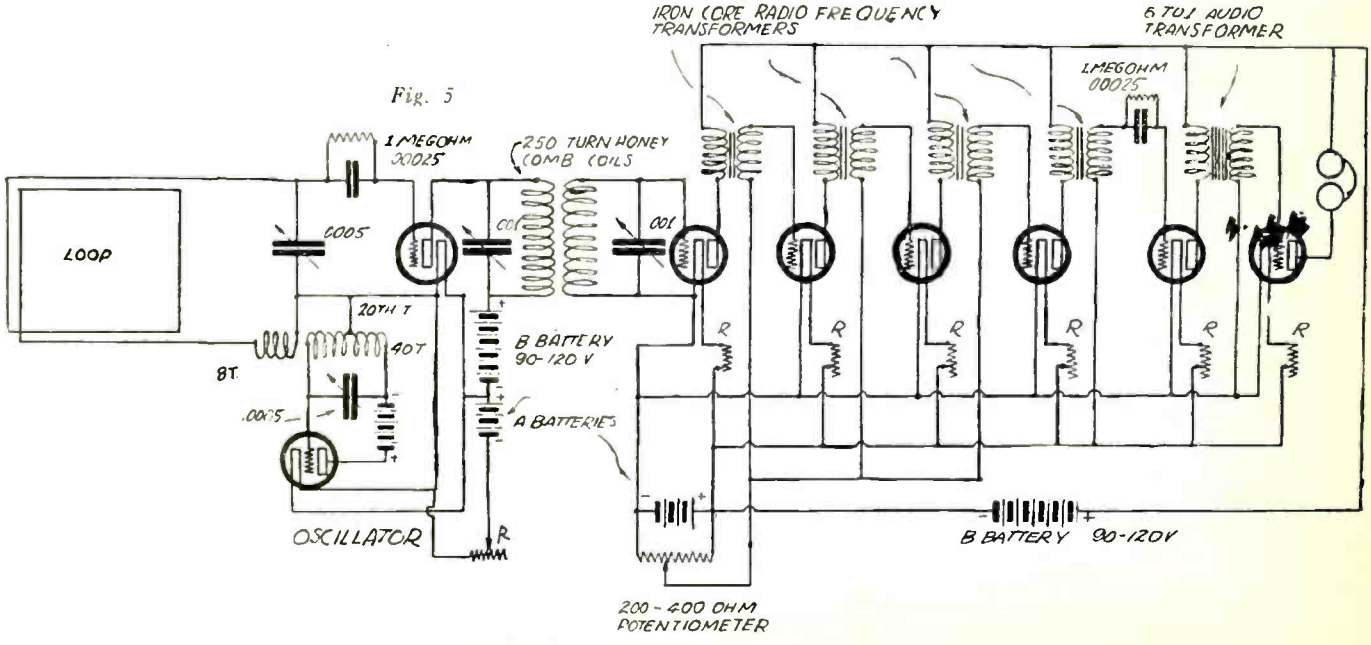
While the signals of amateur transmitters in the United States have been reported by ship operators in remote sections of the Pacific, and as distant as the island of Ceylon in the Indian ocean, this incident is the first in which an amateur has worked both directions across the 4,760 mile stretch of ocean. The message was delivered via the American Radio Relay League traffic system.

The contact hardly had been made and the message copied when communication was interrupted by heavy interference. It was about 1:00 a. m. when York heard a station with pure CW calling on 200 meters and signing with the unfamiliar Japanese call. For a brief interval signals were good at both stations.

The station operated by York is situated on one of the highest hills in that country. He has done a great deal of long distance work, his best previous two-way record being to communicate with Canadian amateur station 1AC situated in Nova Scotia. He had also worked 6CEU in Hawaii and amateurs in every radio district in the United States with the exception of those in the second and fourth.

His antenna is supported by a 65 foot pole at the free end and a 40 foot pole at the lead in end. It is a six-wire flat top 50 feet long with a counterpoise directly underneath. The transmitter uses the Hartley circuit with two Telefunken D. R. P. tubes.

Fig. 5



Complete Corrected List of U. S. and Canadian Broadcasting Stations

WBAA	Purdue University	West Layayette, Ind.	360
WBAD	Sterling Electric Co.	Minneapolis, Minn.	860
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Ermer & Hopkins Co.	Columbus, Ohio	390
WBAW	Marietta College	Marietta, Ohio	246
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laberateries	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBF	Georgia School of Technology	Atlanta, Ga.	270
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBL	T & H Radio Co.	Anthony, Kans.	261
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc.	Newark, N. J.	360
WBT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clyde B. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	Uuiversity Place, Nebr.	360
WCAK	Alfred P. Daniel	Houston, Tex.	360
WCAL	St. Olaf College	Northfield, Minn.	360
WCAM	Villanova College	Villanova, Pa.	360
WCAO	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn.	246
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark.	360
WCAX	University of Verment	Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Co.	Milwaukee, Wis.	261
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCM	University of Texas	Austin, Tex.	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurance Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WOAO	Automotive Electric Co.	Dallas, Tex.	360
WOAP	Board of Trade	Chicago, Ill.	360
WOAR	Lit Brothers	Philadelphia, Pa.	395
WOAS	Samuel A. Waite	Worcester, Mass.	360
WOAU	Slocum Kilburn	New Bedford, Mass.	360
WDAX	First National Bank (Appamoose County Farm Bureau)	Centerville, Iowa	360
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WOZ	James L. Bush	Tuscola, Ill., Star Store Bldg.	278
WEAA	F. D. Fallain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillion, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	252
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	Baltimore American & News Publishing Co.	Baltimore, Md.	360
WEAS	Hecht Co.	Washington, D. C.	360
WEAU	Davidson Bros. Co.	Sioux City, Iowa	360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Tex.	360
WEB	Benwood Co.	St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co.	Houston, Tex.	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAB	Carl F. Weese	Syracuse, N. Y.	234
WFAF	H. C. Spratley Radio Co.	Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.	Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrument Co.	Asheville, N. C.	360
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	380
WFAQ	Missouri Wesleyan College	Cameron, Mo.	360
WFAT	New Columbus College	Sioux Falls, S. Dak.	258
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	360
WGAW	Ernest C. Albright	Altoona, Pa.	261
WGAY	Northwestern Radio Co.	Madison, Wis.	360
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y.	319
WGV	Interstate Electric Co.	New Orleans, La.	242
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	283
WHAB	Clark W. Thompson	Galveston, Tex.	360
WHAO	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schubel	New York, N. Y.	360
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Tex.	360
WIAD	Howard R. Miller	Ocean City, N. J.	254
WIAF	Gustav A. DeCortin	New Orleans, La.	234
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAI	Heer Stores Co.	Springfield, Mo.	252
WIAJ	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis.	224
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAR	Paducah Evening Sun	Paducah, Ky.	360
WIAS	Home Electric Co.	Burlington, Iowa	360
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Nebr.	360
WJAD	Jackson's Radio Engineering Laboratories	Waco, Tex.	360
WJAF	Press Publishing Co.	Muncie, Ind.	360
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	360
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo.	360
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
WJH	W. P. Boyer	Washington, D. C.	273
WJX	Deforest Radio Telephone & Telegraph Co.	New York, N. Y.	360
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	268
WKAO	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Tex.	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKAW	Turner Cycle Co.	Beloit, Wis.	242
WKAY	Brenau College	Gainesville, Ga.	280
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.	Waco, Tex.	360
WLAK	Vermont Farm Machine Corp.	Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.	Tusla, Okla.	360
WLAN	Putnam Hardware Co.	Houlton, Me.	283
WLAP	W. V. Jordon	Louisville, Ky.	360
WLAQ	Arthur E. Schilling	Kalamazoo, Mich	283
WLAT	Radio and Specialty Co.	Burlington, Iowa	360
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind.	281
WLB	University of Minnesota	Minneapolis, Minn.	360
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	309
WMAB	Radio Supply Co.	Oklahoma, Okla.	360
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.	Kansas City, Mo.	275
WMAK	Norton Laboratories	Lockport, N. Y.	360
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	288
WMAP	Utility Battery Service	Easton, Pa.	246
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	268
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Precision Equipment Co.	Cincinnati, Ohio	248
WMU	Doubleday-Hill Electric Co.	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	R. J. Rockwell	Omaha, Nebr.	242
WNAM	Ideal Apparatus Co.	Evansville, Ind.	560
WNAN	Syracuse Radio Telephone Co.	Syracuse, N. Y.	286
WNAP	Wittenberg College	Springfield, Ohio	231
WNAQ	Charleston Radio Electric Co.	Charleston, S. C.	360
WNAR	C. C. Rhodes	Butler, Mo.	231
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Tex.	360
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAV	Peoples Telephone & Telegraph Co.	Knoxville, Tenn.	236
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNJ	Shotton Radio Manufacturing Co.	Albany, N. Y.	360
WOAA	Dr. Walter Hardy	Ardmore, Okla.	360
WOAC	Maus Radio Co.	Lima, Ohio	268
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WOAE	Midland College	Fremont, Nebr.	360
WOAF	Tyler Commercial College	Tyler, Tex.	360
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Tex.	383
WOAJ	Ervins Electrical Co.	Parsons, Kans.	258
WOAL	William E. Woods	Webster Groves, Mo.	229
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	380
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAP	Kalamazoo College	Kalamazoo, Mich.	240
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Henry P. Lundskow	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOK	Pine Bluff Co.	Pine Bluff, Ark.	360
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	300
WPAH	Wisconsin Department of Markets	Waupaca, Wis.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak.	360
WPAL	Superior Radio & Telep. Equipment Co.	Columbus, Ohio	286
WPAM	Auorbach & Guettel	Topeka, Kans.	360
WPAP	Theodore D. Phillips	Winchester, Ky.	360
WPAQ	General Sales & Engineering Co.	Frostburg, Md.	360
WPAT	St. Patricks Cathedral	El Paso, Tex.	360
WPAU	Concordia College	Moorhead, Minn.	360
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WPG	Nusawg Poultry Farm	New Lebanon, Ohio	234
WQAA	Horace A. Beale, jr.	Parkersburg, Pa.	860
WQAC	E. R. Gish	Amarillo, Tex.	360
WQAD	Whitall Electric Co.	Waterbury, Conn.	242
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	278
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAH	Brock-Anderson Electrical Engineering Co.	Lexington, Ky.	254
WQAL	Coles County Telep. and Telog. Co.	Mattoon, Ill.	258
WQAM	Electrical Equipment Co.	Miami, Fla.	360

WITH THE MANUFACTURERS

Duostat

The Premier Electric Co., Chicago, recently announced a new and unusual apparatus. This new instrument is called the "Duostat"—so named because it does the work of two Rheostats. The manufacturers claim for it many unusual features. The windings are independent of one another. Each operates one tube. Simplifies wiring. The base is Bakelight moulded, dial silver etched, winding "Nichrome" wire. It is made for all types of tubes. Greatly simplifies installation. Drill one hole, fasten to panel with nut supplied, and Presto—you have a finished job for any 2 stage amplifier.

Liberty Audio Transformer

The Liberty Transformer is very neatly encased in nickled brass with a top of molded condensite. All binding posts are nickle and plainly marked as to terminals. The entire instrument is small in size, the form being upright rather than horizontal. The transformer takes up a space of two and one-half by one and three-fourths inches of panel or base space and is strongly constructed. It has a ratio of five to one, which is sufficient for all needs in the average set not calling for a special high ratio winding.

The transformer proper is well-made of good Swedish steel with the windings well insulated and there is not the least chance of a break or short-circuit due to wires being exposed as the entire transformer is enclosed and no wires can be reached by any means.

The people manufacturing this transformer, by enclosing the transformer in a metallic case, have overcome intercoupling or magnetic coupling between stages, causing howls and shrieks. It is manufactured by the Liberty Transformer Company, Inc., Chicago, Ill.

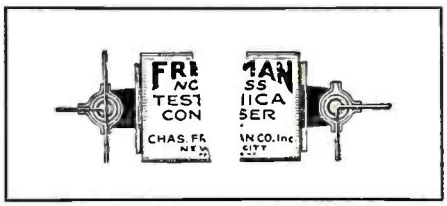
The Willard Storage Battery Company, Cleveland, O., publishes a monthly quality organ, "The Connector." The publication presents fiction, trade news, trade suggestions, news of the company's already famous broadcasting station, WTAM, and excellent illustrations.

Condenser Construction

A proper soldering connection for a Fixed Condenser has long been the desire of all manufacturers of radio sets as well as amateurs who build their own.

It is, of course, comparatively easy to solder one connection to each terminal of every good Mica Condenser. But the task of making 4, 3, or even 2 clean connections to a Fixed Condenser has always resulted in a very messy job.

With an evident realization of the importance to clear-toned radio reception, of affording the best possible soldered connections and neatly soldered joints, the CHAS. FRESHMAN CO., of New



York City have made a radical improvement in the design of all capacities of their Tested Noiseless Mica Condensers, which should prove a boon to manufacturers and radio enthusiasts who build and tinker with their own outfits.

A lug of special construction is riveted by means of an eyelet to each terminal of the Mica Condenser. The lug is so designed that three or more different wires may be soldered to it, giving exceptionally good contact and allowing right-angle bends. The lug is equipped with three grooves, permitting the wires to be laid properly, and held in place while being soldered.

Another most important advantage is that in wiring a set the connection can be made temporary without soldering. All that is necessary is to lay the wires in the lugs which are so constructed that they can be made to hold the wires without soldering by merely bending over the sides of the grooves to form a contact with the wire. In this way the circuit can be tested and varied so as to give the most efficient results. When this is attained the connections are then soldered.

The accompanying illustrations show several methods in which the wires may be laid through the grooves in the lug, allowing bends of various kinds.

In order to assist users of the Bremer-Tully Vernier Tuning Unit in getting the most out of that instrument the Bremer-Tully Manufacturing Co. has issued a booklet "Better Tuning." The pamphlet contains some interesting photographic illustrations of assembled circuits and several diagrams. The Bremer-Tully Mfg. Co., 532 Canal Street, Chicago, places a price of ten cents on the booklet, which is valuable to the radio fan, whether he uses Bremer-Tully products or not.

The Western Coil & Electrical Co., Racine, Wis., favors us with circulars presenting facts about two outfits produced by that company. The Radiodyne Type W C 10, is one of the receivers described. Superior sensitiveness is claimed for this six-tube outfit. Dry cells or storage batteries may be used. There are only two adjustments. There is a third knob for compensating for long or short balancing wires. The receiver is of the compound circuit type and requires nothing more than a twenty or thirty foot wire for balancing purposes. This wire may be thrown on the floor or strung up behind the picture moulding of any room, or strung up in the attic. No outside antenna is necessary. The outfit is enclosed in solid mahogany rub finish. It weighs 14 pounds and is priced at $150, exclusive of tubes.

The same company produces the W C-5, which receives messages within a radius of 2,000 miles and is priced at $80. It is a four-tube circuit. In order to make it super-sensitive one stage of tuned radio frequency amplification is employed ahead of the detector. It works well with an indoor antenna or without a high or expensive outdoor aerial.

The rapidly increasing number of radio experimenters and receiver constructors has created a growing demand for convenient tools with which to make and assemble sets. Among the manufacturers who specialize in producing such tools is the Simon & Skidmore Mfg. Co., Santa Ana, California. They are makers of the Simore Lightning Change Tools. Their products include, squares, magazine screw drivers, containing three tools, and a magazine tool that contains knife blade and two screw drivers.

Mahoganite

The American Hard Rubber Company asks that the following be published:

"Our attention has been directed to the fact that certain manufacturers of radio materials and parts have recently

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Tex.	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAV	Huntington & Guerry (Inc.)	Greenville, S. C.	258
WQAW	Catholic University	Washington, D. C.	236
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WRAA	Rice Institute	Houston, Tex.	360
WRAD	Taylor Radio Shop (G. L. Taylor)	Marion, Kans.	248
WRAF	The Radio Club (Inc)	Laporte, Ind.	224
WRAH	Stanley N. Read	Providence, R. I.	231
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis, Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	360
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRAY	Radio Sales Corp.	Scranton, Pa.	280
WRAZ	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WRC	Radio Corporation of America	Washington, D. C.	469
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Tex.	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAG	City of St. Petersburg (Loren V. Davis)	St. Petersburg, Fla.	244
WSAH	A. J. Leonard, Jr.	Chicago, Ill.	248
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	360
WSAL	Franklin Electric Co.	Brookville, Ind.	246
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Tex.	268
WSAW	John J. Long, Jr.	Canandaigua, N. Y.	278
WSAX	Chicago Radio Laboratory	Chicago, Ill.	262
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	278
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvidere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	236
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAN	Orndorff Radio Shop	Mattoon, Ill.	240
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son	Osseo, Wis.	226
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station	Oak Park, Ill.	226
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	485
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	226
WWAC	Sanger Bros.	Waco, Tex.	360
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.	Camden, N. J.	250
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	278
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	268

Canadian Stations

CFAC	Western Radio Co., Ltd.,	Calgary, Alta.	430
CFCA	Toronto Star	Toronto, Ont.	400
CFCF	Marconi Co.	Montreal, P. Q.	440
CFCH	Abitibi Power & Paper Co. Ltd.	Iroquois Falls, Ont.	400
CFCI		Vancouver, B. C.	410
CFCJ		Quebec, P. Q.	410
CFCK		Edmonton, Alta	410
CFCL		Victoria, B. C.	400
CFCN	W. W. Grant Radio, Ltd.	Calgary, Alta	440
CFCO		Bellevue, P. Q.	450
CFCW		London, Ont.	420
CFQC		Saskatoon, Sask.	400
CFUC		Montreal, P. Q.	400
CHCB		Calgary Alta.	410
CHCD		Quebec, P. Q.	410
CHCE		Victoria, B. C.	400
CHCL		Vancouver, B. C.	440
CHYC	Canadian Northern Elec.	Montreal, P. Q.	410
CJCA	Edmonton Journal, Ltd.	Edmonton, Alta.	450
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Vancouver Sun	Vancouver, B. C.	420
CJCI	McLean, Holt & Co., Ltd.	St. John, N. B.	400
CJCN	Simmons, Agnew & Co.	Toronto, Ont.	410
CJCX		Olds, Alta.	400
CJGC	London Free Press	London, Ont.	430
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse	Montreal, P. Q.	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Can. Ind. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Publishing Co.	Regina, Sask.	428
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY		Winnipeg, Manitoba	450

started to use the name 'Mahoganite' on some of their devices. This name is one of our trademarks for radio material and for panels, dials and other radio parts. Realizing that the unauthorized use of this name by others in the past may have been inadvertent, we are taking this occasion to bring to the notice of the trade the fact that we own the exclusive right to the use of the name 'Mahoganite' for radio materials and parts and that we shall look upon as an infringer anyone who uses this name upon similar products."

An attractive booklet is issued by the Atlantic Radio Electric Co., 308 South Clark Street, Chicago. The pamphlet contains illustrations and descriptions of the well-known "Bestone" radio merchandise. This line is a complete one, including everything from complete tube and crystal sets to switchpoints, variocouplers, variometers, headsets, condensers, and transformers are particularly well presented and attractively priced.

New Grid Leak

The Allen-Bradley Company, manufacturers of the Universal Bradleystat and Bradleyometer, have added another item to their line of graphite disc radio products.

The new device is an adjustable grid leak, known as the Bradleyleak, which was developed to meet the insistent demand for a high-grade, dependable grid leak. It is similar in external appearance to the Universal Bradleystat and is equipped with an adjusting knob which conforms, in general design, with the approved tapered knob now used in most radio equipment and matches perfectly with the adjusting knobs of the Bradleystat and Bradleyometer.

The Bradleyleak can be adjusted between the limits of 250,000 ohms and 10,000,000 ohms or, as usually stated, between one-fourth megohm and ten megohms. The entire range of grid leak resistance between these limits is instantly obtainable without noises, steps or jumps by simply turning the adjusting knob. It is a significant fact that all intermediate values of resistance can be accurately obtained at any time which is a feature not often found in many types of adjustable grid leaks.

The base of the Bradleyleak is recessed to receive a small fixed condenser which is furnished as an extra attachment if desired. The grid condenser is accurately adjusted to a capacity of 0.00025 microfarads.

"Battery Charger"

(*Continued from page 28*)

directly to the alternating current mains and the secondary directly to the rectifier. The voltage of these toy transformers is usually adjustable, so that the rate of charging may be regulated by the controlling switch on the secondary of the transformer. This method will charge the battery faster, and is much more efficient.

New Crosley Factory

In order to meet the demand for Crosley-made radio receiving sets, Powel Crosley, Jr., president of the Crosley Manufacturing Company, has purchased the four-story factory building now occupied by the Thomas J. Corcoran Lamp Company, on Colerain Avenue at Sassafras Street, in Camp Washington, Cincinnati. This real estate transaction involving more than $150,000, surely meets the question of whether the radio industry is an established business or a passing fad, for preparations are being made to manufacture nearly 5,000 radio receiving sets every day in this new plant which will be ready for occupancy by early spring.

The large building will house, in addition to the general offices, manufacturing and assembling departments of the Crosley radio products, the radio broadcasting station, WLW, which will have all of the latest improvements of this particular field in the radio world, making the station one of the finest in the world.

There is a floor space of over 100,000 square feet in this new four-story building, as compared with 30,000 in the present Crosley factory, at Alfred and Colerain, and this large space will be fully utilized with the manufacture of radio receiving apparatus. It is the intention of Mr. Crosley to manufacture radio parts in the present building and to use the new one for the making of the complete outfits. There is a B. & O. and Southwestern Railway company siding which goes to the plant, facilitating the shipping of the raw and finished products.

Reinartz Adaptions

(Continued from page 6.)

Queer as it may seem, the use of radio frequency amplification with the Reinartz circuit is not always according to "Hoyle," but if care is exercised in constructing the set, the results are particularly gratifying.

The reversal of the reactance coil marked "x" in the diagram is often necessary when a second tube is added for radio amplification, but is a matter of experiment. One experimenter winds the entire Reinartz inductance on a 3-inch cardboard tube according to the regular specifications, but instead of placing the plate coil winding "x" alongside of the antenna coil, winds it on a separate smaller tube and inserts it inside of the larger coil. The winding should be in reverse direction to the larger antenna grid coil. The circuit shown makes use of the tuned impedance type of radio amplification, which is highly efficient in covering a large band of waves.

Figure 4 shows the method used by an English amateur who uses the Reinartz hookup for obtaining the best results with radio frequency amplification. With the exception of a few changes in constants it is practically the same as that of Figure 3. He, however, uses only 1 B battery, and gives the following specifications for the winding of the coils.

The entire coil is wound with No. 22 DCC on a 3-inch tube. Ten turns are first wound with taps at every turn. The tenth tap connects to the potentiometer and ground. Twenty additional turns are then wound and a tap is taken off for the grid switch, then fifteen more are wound, and last the coil is completed with fifteen more, making the total number of turns from the tenth tap of the antenna coil to the last grid tap fifty turns.

The plate coil should consist of 40 turns of the same size wire wound on a smaller tube, in the opposite direction to the antenna-grid coil. This smaller tube is inserted at the antenna end of the larger coil, as mentioned before.

The auto transformer coupling arrangement consisting of 36 turns of No. 16 wire on a 3 inch tube should be placed at right angles to the grid inductance, and as far away as possible to offset any inductive effects which might exist.

If an audio frequency amplifier is added, it is necessary to leave the phones connected in the plate circuit of the detector, in order that the phone resistance may act as an impendance.

The writer hopes that these suggestions may develop some successful long distance receptions with two tube Reinartz sets, and would be pleased to hear from fans with regard to any new kinks or wrinkles they may chance to discover in working out these circuits.

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One Tube with Loop Aerial
Wave Trap, Filter, Eliminator
Loading Coils
Transformers
Code Instruction
Reinartz
Hopwood
Haynes
Cockaday
Neutrodyne
Three-circuit Tuner
Super-Heterodyne
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Ultra Audion
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Portable Reinartz
Wave-Meters
Two-Circuit Crystal

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