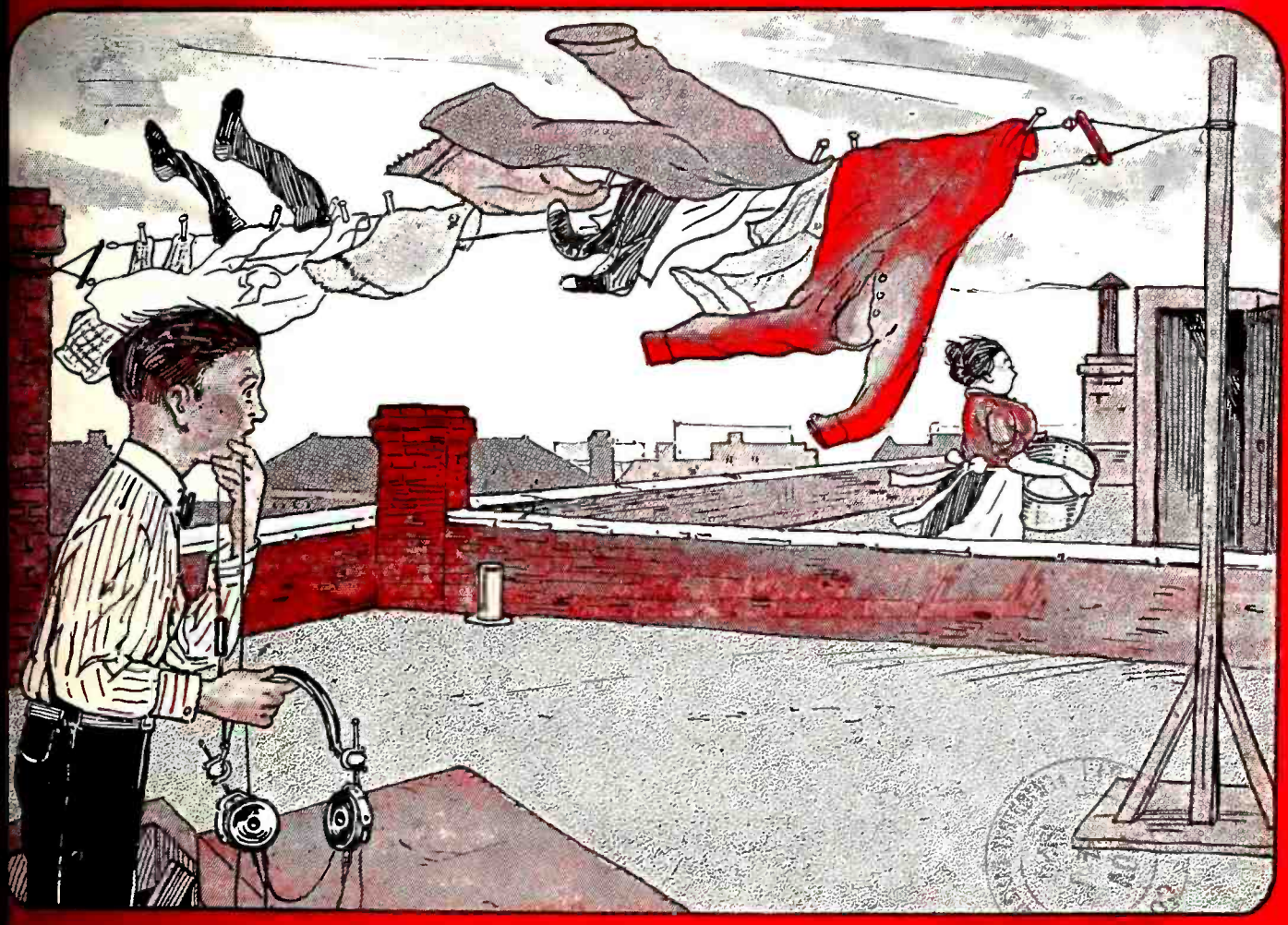
RADIO AGE

The Magazine of the Hour

MARCH
1924



In This Number

Koppràsch Circuit—Isometric drawing—Fully described. Super Heterodyne—Another fine Pearne article. Winding Heterodyne Transformers—A Rathbun feature. The Simplifigon Receiver—Text and drawings by Anderson. Complete corrected list of Broadcasting stations. More good hookups.

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1924 EDITION, ILLUSTRATED

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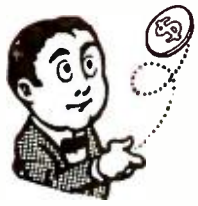
Two-Circuit Crystal



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RADIO AGE

The Magazine of the Hour

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What Readers Teach Us.

THOUSANDS of readers of RADIO AGE have written to us in the last sixty days ordering back copies of the magazine. Many of them wanted numbers dated back in the early part of 1922. In fact our supply of many of the issues desired has been exhausted. Most of the letters have specified the particular article in the back number which the reader desired.

Those letters, therefore, have been an education to the editor. He has learned that radio fans are more interested in some circuits than they are in others. He has ascertained what a majority of readers are striving to make, or to understand.

The result of all these letters will be reflected in the coming issues of RADIO AGE. We have already responded to the information thus obtained by presenting particularly good articles on the Reinartz, the Kopprasch, the Four Circuit Tuner, the Single Tube, the Selective Crystal Detector, the Heterodyne and various other hookups. In this number will be found good drawings and helpful information relating to the Heterodyne, the Simplifigon Coil, the Kopprasch and other circuits in which *we know* the radio public is keenly interested.

For those who were too late to obtain desired back numbers we have prepared a book called "Radio Age Annual for 1924," which contains a collection of the best hookups and drawings published in RADIO AGE. This book is being sold by the thousands because, like the magazine, it presents radio problems and solves them in a manner that is clear, accurate, comprehensive AND ORIGINAL.

Frederick Smith

—Editor, RADIO AGE

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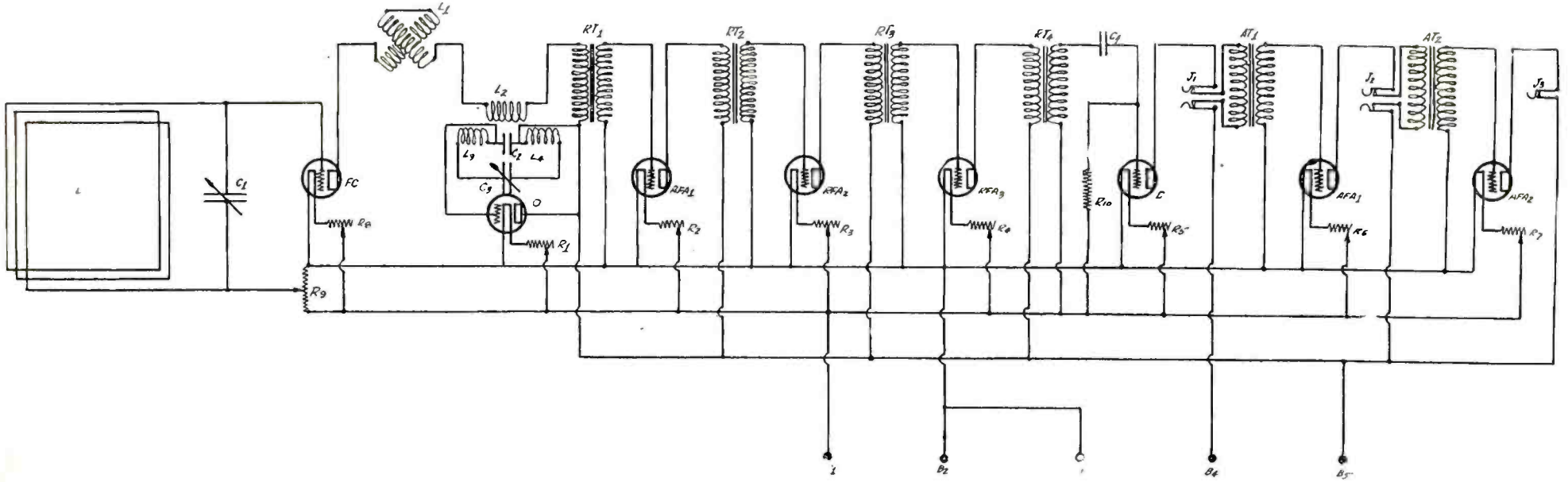


Figure 1. An eight tube Super-Heterodyne of unusual merit, which will give a consistent loudspeaker range to almost any station in the United States. Mr. Pearne describes the construction, principle and operation of this receiver in detail in the accompanying article. The legends have the following values in the circuit:

L—Loop
L1—Variometer
L2—5 turn Oscillator coil
L3—35 turn Oscillator coil
L4—25 turn Oscillator coil
C1—17 plate, .00035 MFD Vernier
C2—Fixed Condenser .001 MFD
C3—23 plate, .0005 MFD Vernier
C4—.00015 MFD Fixed Condenser
R1, 2, 3, 4, 5, 6, 7, 8, 25 Ohm Rheostats
R9—200 to 400 Ohm Potentiometer
R10—Interchangeable Tubular Grid Leak. 1-10 Megohms
RT1, 2, 3, 4, Iron-cored Radio Frequency Transformers
AT1—Audio Transformer 4:1 ratio
AT2—Audio Transformer 6:1 ratio
J1, J2—Two circuit jacks
J3—Single circuit jack
B1—Binding Post, A battery positive
B2—Binding Post, A battery negative
B3—Binding Post, B battery (22½ volt) negative
B4—Binding Post B battery (22½ positive) and 90 volt negative
B5—Binding Post B battery 90 volt positive
FC—Frequency changing tube
O—Oscillator tube
RFA1, 2, 3, Radio Frequency amplifying tubes
D—Detector tube
AFA1, 2—Audio Frequency amplifying tubes

RADIO AGE

"THE MAGAZINE OF THE HOUR"

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

Constructing the Superheterodyne

The Most Sensitive Receiver in the World

By FRANK D. PEARNE

THERE are many radio enthusiasts who ask to know what is the best kind of a receiver to build, regardless of cost, the idea being to get the greatest possible reception. The answer to this question is the "Superheterodyne." This circuit is without doubt, the most sensitive and best long-distance getter of all. This fact is conceded by most of the radio experts of this, and other countries and for the man who cares not for the cost but wants the best, it is always recommended. It may require more practice to learn just how to tune it and there are more controls necessary than those required in most receivers, but when properly constructed, one may feel sure that he can get any station which is on the air within a range of two or three thousand miles and they have been known to reach as far as seven thousand miles.

How it Operates

The current produced in the loop aerial by the cutting of the lines of force carried to it on the wave from the broadcast station will have the same frequency as that sent out by the transmitter. These frequencies from different broadcast stations will range from 500,000 cycles of the 600 meter wave, to 1,200,000 of the 250 meter waves, which are of course too high to be detected by the human ear. In the usual course of events this wave would appear as shown at "A" in Figure 2. The changes which take place in the amplitude of this wave is really what produces the sound in the

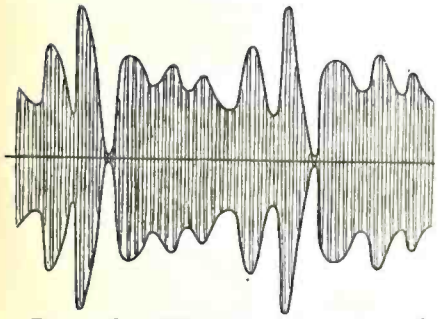


Figure 3. This curve shows how the transmitting station's wave is varied in amplitude when the letter "A" is spoken into the transmitter.

phones, or loud speaker. It must be understood that the frequency of the wave remains the same, but that sounds striking the diaphragm of the microphone at the broadcast station, merely change the height, or amplitude of the wave. An example of just how this change, or modulation of the wave takes place is shown in Figure 3. This is the modulation which occurs when the letter

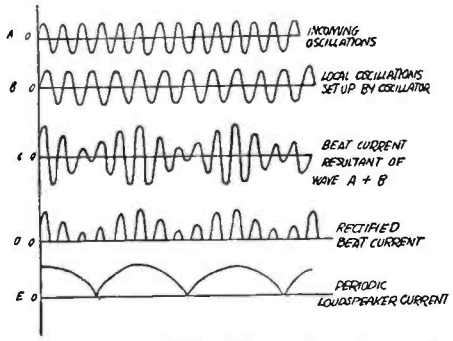


Figure 2. This illustration shows in chart form the action of the Super-Heterodyne receiver described herewith. At A, we have the incoming wave as radiated by some transmitting station. Upon these oscillations, oscillations generated by the oscillator tube of the set are superimposed. The local current is of slightly different frequency, as shown at B, and the combined frequencies A and B result in a so-called "beat" current shown at C. This beat current is sent through the radio frequency amplifiers and is tremendously amplified, effecting a much greater current to be rectified by the detector than would ordinarily be obtained. The detector permits the oscillations (or amplified beat current) to pass only in one direction, and the signal takes the form of the wave shown at D. The signal, in the form of a pulsating direct current shown at E, is then transposed into mechanical energy by the loud speaker.

"A" pronounced as in "father" is spoken in front of the microphone.

It will be noticed that the frequency remains unchanged, but the tops of the different oscillations are cut off according to the vibration of the microphone diaphragm. Figure 4 shows the same modulated wave after it has been rectified by the detector.

From this it will be plainly seen that the oscillations occur entirely too fast to affect the diaphragm of the receiver, but after they are rectified, as shown in Figure 4 it becomes a varying direct current, which varies according to the shape of the peak of the rectified current and this current being direct in its nature, will vary the diaphragm of the head phones, or loud speaker and cause it to reproduce the sounds produced in front of the microphone.

Now, in order that signals, music, etc., may be heard from a great distance, it is necessary to amplify them, or build them up to a greater strength than that at which they are impressed upon the loop. This is best done before they are rectified for the reason that no distortion takes place when they are amplified in their original form, or rather at the frequencies which are too high to be heard by the ear. This is called radio frequency amplification and by its use the strength of the incoming signal may be built up to such an extent that signals which are entirely too weak to be heard with an ordinary detector alone are magnified to an enormous strength before they are rectified and brought down to audio frequency, or in other words made audible in the phones. Here, however, is where the first serious difficulty is encountered. There are several methods of radio frequency amplification, the most popular being the transformer method.

Every radio frequency transformer has what is known as a fundamental wave length of its own, which means that there is one particular frequency at which it will work at very high efficiency, this efficiency falling off rapidly as the frequency varies from the fundamental. Various methods of changing this fundamental wavelength have been suggested, for the reason that so many different frequencies are used by broadcast sta-

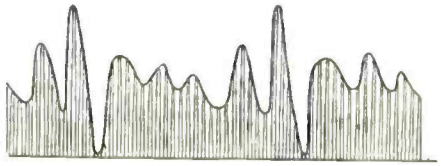


Figure 4. The same curve as illustrated in Figure 3, after being rectified by the detector tube of the set.

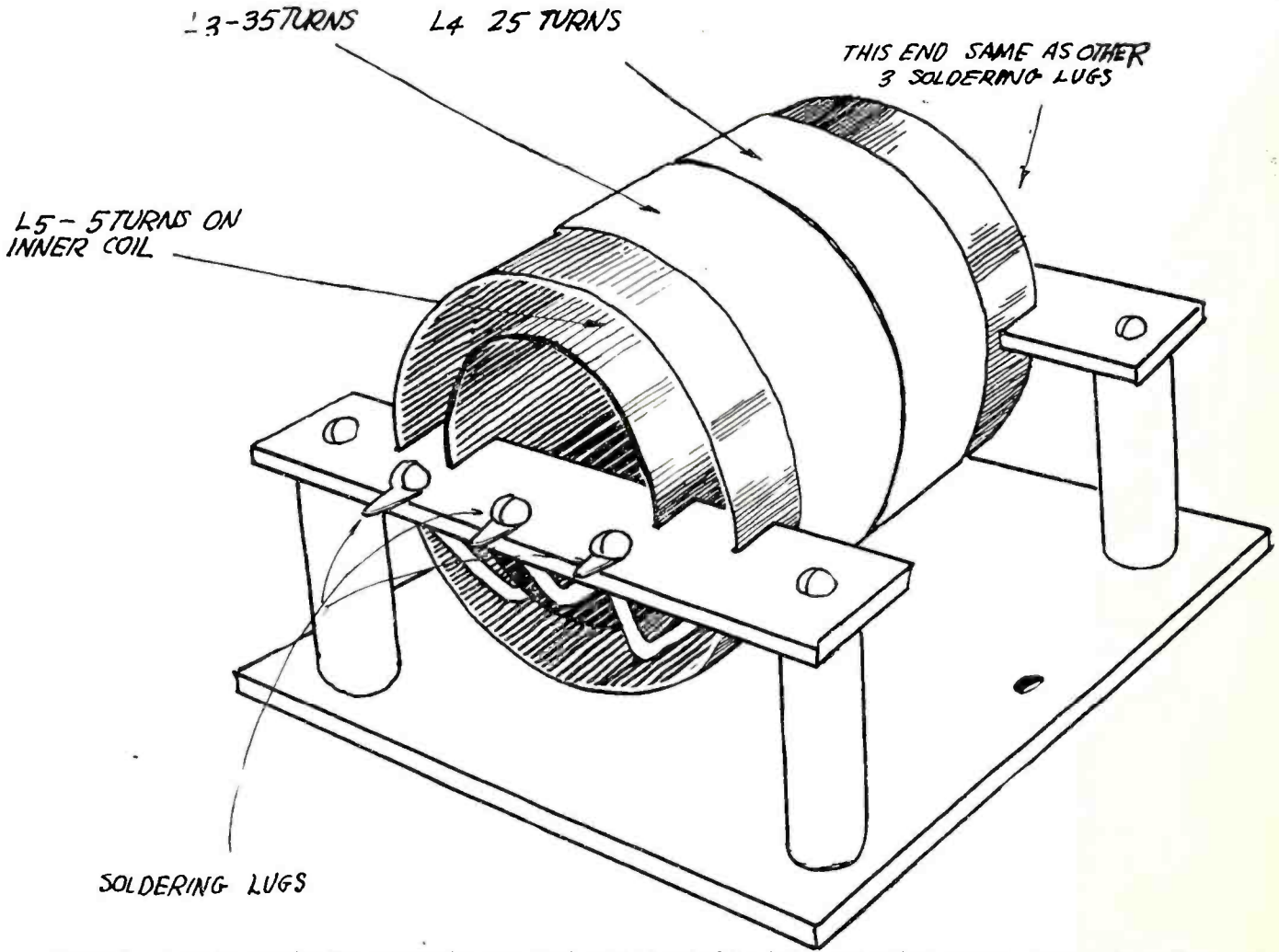


Figure 5. A sketch showing the construction and detail of the heart of the Super-Heterodyne circuit. This is the oscillator unit, which consists of one 25 turn coil, and one 35 turn coil, wound side by side on the same form, and the coupling coil (L5) wound on a tube of smaller diameter placed inside of the larger. The unit is mounted by slotting two pieces of bakelite as shown and inserting the coils. The entire unit is then mounted upon a bakelite or hard rubber base, and is securely bolted together upon four legs. The two end pieces, acting as supports for the tubes, also serve the purpose of a mounting for the connectors.

tions and in order that reception from any and all of them may be obtained at equal efficiency, it would be necessary to change this fundamental wavelength of the transformer to meet the particular frequency of the desired station. Such an arrangement is not very satisfactory as it is always found that one certain wavelength will be received much better than any other.

How Heterodyne Works

This is where the wonderful efficiency of the superheterodyne set solves the problem. Instead of varying the wave length of the radio frequency transformers the frequency at which they work most efficiently is ascertained and the frequency of the incoming wave is changed to that particular frequency, so that no matter what may be the length of the incoming wave, it is always the same frequency when it reaches the radio frequency transformers and consequently they always work at their greatest efficiency, regardless of the frequency of the incoming wave.

At first thought, it would seem that such an arrangement was impossible, but it can be accomplished by means of a local oscillator circuit which produces a frequency which may be varied at will. These local oscillations are super-imposed upon the incoming oscillations and the result of this combination is a "beat" wave which will have a frequency equal to the difference between the two. Because of the fact that the frequency of the local oscillating circuit may be varied, a beat oscillation which has the same frequency as the fundamental frequency of the radio frequency transformers may be obtained, no matter what the frequency of the incoming wave may be.

Thus it will be seen that the radio frequency transformers always operate at the same frequency, no matter what the frequency impressed upon the loop may be, and the result of such an arrangement is a highly efficient transformation system, building up the weak signals to such an extent that when they reach the detector they are rectified at great strength after which they may be again amplified at audio frequency to get any desired volume.

By reference to Figure 2 it will be noted that "A" shows the oscilla-

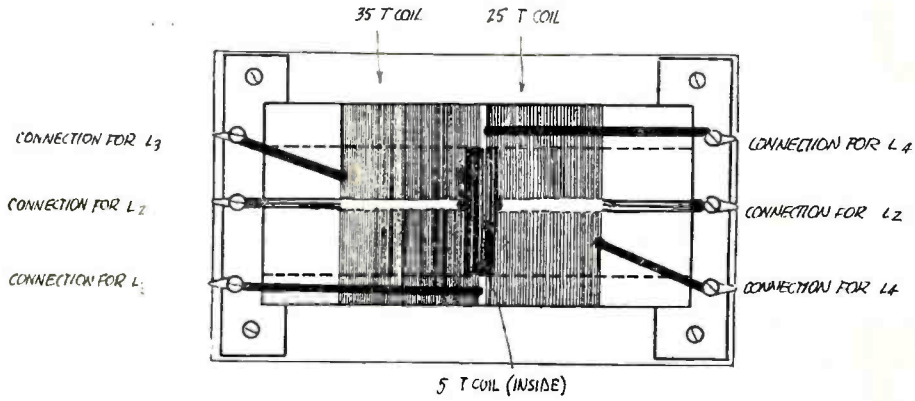


Figure 6. This illustrates the method of making the connections for the inside and outside coils of the oscillator unit. The center lug is used for the inside (L5) coil, and the two outside lugs form the terminals for coils L3 and 4 respectively.

tions of the incoming wave "B", shows the oscillations set up by the local oscillator, "C" is the resultant "beat" oscillations, "D" is the result of the beat oscillations when rectified by the detector and "E" shows the varying direct current which passes to the phones, or loud speaker.

In the circuit shown in Figure 1 the loop is tuned by means of a 17-plate variable condenser and the incoming wave is amplified by passing through an amplifying tube before passing to the oscillator. A variometer is placed between the plate of this tube and the oscillator coil. This variometer is used to control the regeneration. This oscillator coil consists of five turns of No. 22 double silk covered wire, wound in the center of a bakelite tube 1 1-2 inches in diameter and 3 inches long. The other two oscillator coils are wound upon a bakelite tube 2 1-2 inches in diameter and 3 inches long. The 5 turn coil is mounted inside of the tube carrying the two coils, by means of bakelite supports placed across the ends and slotted in the right places to allow the tubes to be held in their respective places when placed in the slots.

Assembling Oscillator

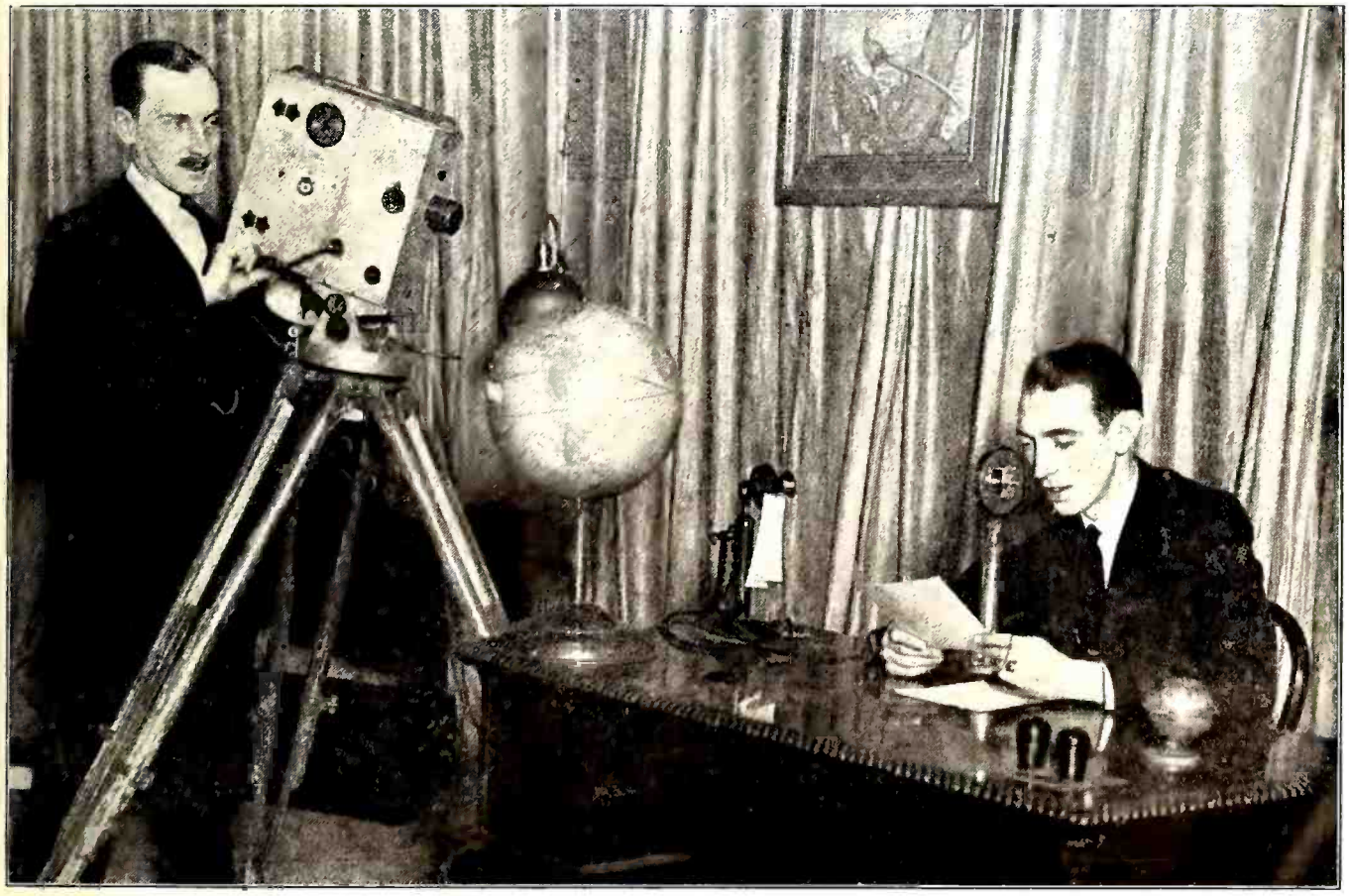
Figure 5 illustrates the method of assembling the oscillator. The 2 1-2 inch tube is wound with two coils, one having 35 turns and the other 25 turns. These two coils are wound in the same direction, the second being spaced about one-eighth of an inch from the first. Bring all terminals out inside of the tubes and connect the leads to clips which are mounted on the bakelite supports. Four brass legs are used as the main support of the oscillator. These are placed between the bakelite tube supports and the base as shown, and should be long enough to keep the coils of the oscillator at least one-half inch from the baseboard. A four-foot loop having 12 turns of wire No. 18 or larger will answer the purpose. This is wound in a solenoid form on four pieces of bakelite mounted on a frame which is made in the form of a cross. Stranded wire is to be preferred and the turns should be about one-half inch apart. A 17-plate variable condenser is shunted across the terminals of the loop as shown. The first tube, that is, the tube which precedes the oscillator is really a radio frequency amplifying tube, although some call it the first detector. This tube as well as all the rest with the exception of the detector tube should be either UV-201-A, or C-301-A.

The detector tube should be either a UV-200, or a C-300. The variometer may be any of the standard types on sale at the radio supply stores. This variometer is connected between the plate of the first tube and the 5 turn coil of the oscillator. The other end of the coil is connected to the post on the first radio frequency transformer marked "P." A .001 M. F. fixed mica condenser is placed between the two outside coils of the oscillator and a 23-plate variable condenser is connected across the two outside terminals of these coils. This is used to tune the miniature transmitting station which is formed by the oscillator.

The two outside terminals of these two coils are also connected to the grid and plate of the oscillator tube. The filament of this tube and the filament of the first tube are each controlled by a 25 ohm rheostat. From this point on, the circuit is the conventional radio frequency amplifier, detector, and two stage audio frequency circuit, all connections being plainly shown in Figure 1 and no difficulty should be experienced in connecting it up. The radio frequency transformers should have a wavelength of about 5000 meters and if any difficulty is found in procuring them, they may be made according to the method described by John B. Rathbun in an article on transformer construction in this issue.

Tuning Hint

In tuning, it will be found that if the first tube is tuned to an incoming wave and the condenser of the oscillator is adjusted so that oscillations of nearly the same frequency are set up, a beat note will be produced. If the oscillator is tuned to the same frequency as the incoming wave, no beat note will be produced. The oscillator is varied until the proper beat note frequency is obtained at which point the signal will be very strong.



MOVIES INVADE RADIO

Moving pictures were taken recently of two Chicago broadcasting stations in action. The above picture shows Norman Alley, of the International Newsreel, as he was "shooting" Jack Nelson, studio director of the Chicago Board of Trade Station, WDAP, in the Drake Hotel, Chicago. Moving pictures of this station and of Zenith-Edgewater Beach, WJAZ, are now being shown on silver sheets all over the country.

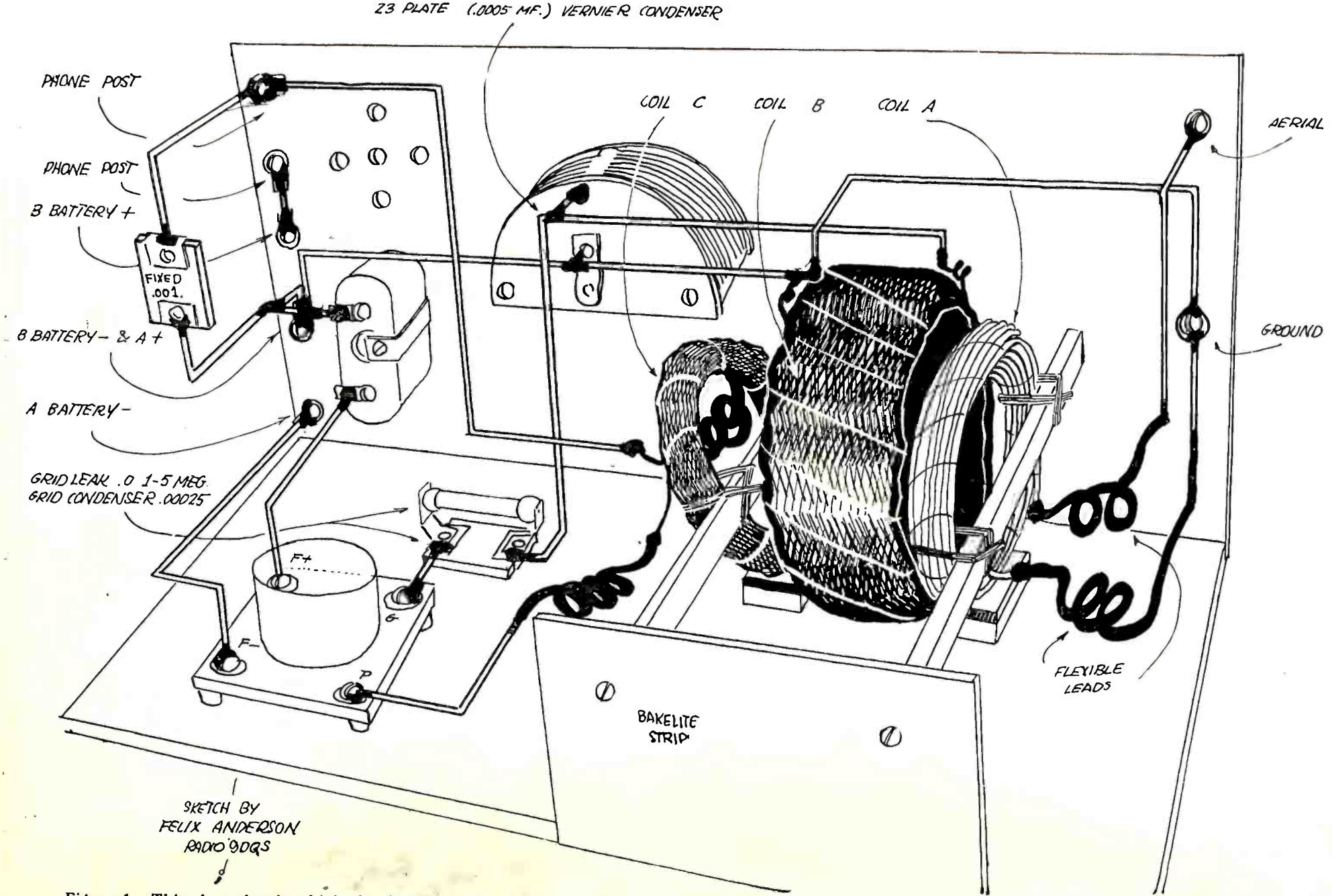


Figure 1. This is a circuit which should be of interest to the fellow who likes to make as many parts of his set as possible. Note the method of obtaining variable coupling between the coils.

How to Make a Simple Low Loss Tuner

By FELIX ANDERSON

Technical Assistant, Radio Age

IN THE course of their radio experiences, Radio Age readers have undoubtedly been afforded the pleasure of visiting the home of some fellow dial-twirler who possesses a receiver of the so called "haywire" type.

He has also probably felt the pangs of jealousy when the list of stations heard on his receiver were compared with the haywire set, and to his chagrin found that the "haywire" set beat his by a mile. In all probability he will recall that he wondered how in the world that mass of radio stuff (usually spread out on a superannuated table) could possibly work at all!

The whole secret lies in the fact that the owner of the haywire receiver in building up the set without all the customary fancy cabinets, nickel plated switches and other hardware that go with an imposing radio receiver, unconsciously eliminating many losses.

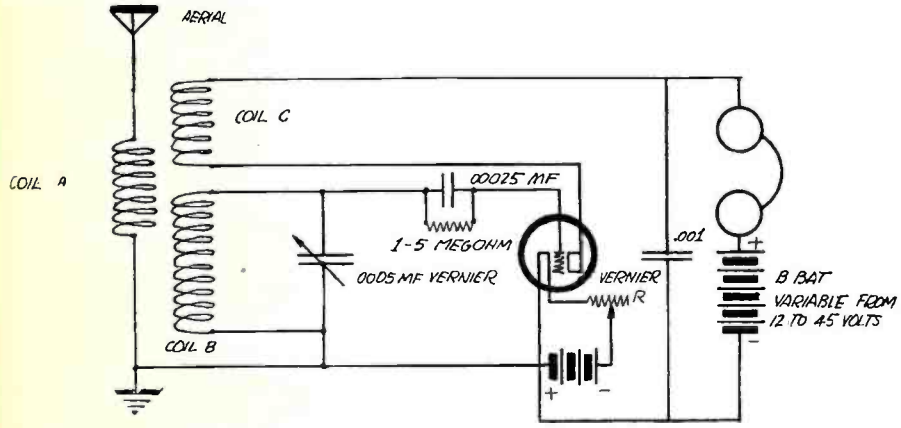


Figure 2. The wiring diagram of the Simplifigon receiver. This type of set is a very desirable one to the bug who is interested in speedy tuning, inasmuch as it has only two major controls and two minor ones. The 23 plate condenser and the tickler are about the only ones that need adjustment after the set has been adjusted in the filament and antenna circuits. Due to the fact that the apparatus is of low loss design and of small quantity the receiver will cover unusual distances.

Of late there has been a decided tendency toward better design, more carefully constructed, *simple* tuners. This movement, originating among amateur transmitting circles, and heralded by their American Radio Relay League organ, QST, has caused considerable interest among broadcast listeners. In recent papers, Mr. K. E. Hassel of the Zenith Corporation and Mr. S. Kruse, Technical Editor of QST, expound several sound rules regarding tuner design and construction, and the writer feels that these principles are so sound and logical that they will no doubt be of interest to Radio Age readers.

General Suggestions

The writer would like to give a few general suggestions on tuner design that can be applied to almost any receiver. In order to do so, it is necessary to define the meaning of a *good* tuner.

First of all, with the terrible interference we are subjected to, we want a tuner that will tune sharply. And we need it badly. Second, we want a tuner that will cover all the waves of the broadcasting stations, namely from 225 to 546 meters. Third, a tuner that will not reradiate and interfere with the reception of our neighbors. Fourth, be simple and with a few major controls. Fifth, be of reasonable cost, and easily constructed. Sixth and last, be reliable so that when a station is once logged it can be heard at will upon properly adjusting the controls to the proper values.

Resistance in Tuning Circuits

To make a tuner that will tune sharply, we must make one that will have little or no resistance in the tuning circuits. Resistance in circuits is something that almost every builder has been "ducking." Tubes, needless controls, dizzy circuits and more amplification stages are added in an effort to evade this problem. *It can't be done!* You can't build a perfect tuner without resistance of some kind or other, but there is at least the consolation that you can build it with as little as possible of resistance. Interference grows worse every day, and the ultimate thing will be to build a tuner with a low resistance, tuned circuit. Just remember that. Whether you are building an eight tube super-heterodyne or a simple first tube circuit, keep the resistance of that circuit as low as you possibly can. Your reward will come later in the form of a sharp tuning, real DX receiver.

How to Keep Resistance Down

Permit us to point out just where the trouble can be found. First of all we can cut down the resistance of our coils by winding them with air insulation. A good example of this type of air insulated coil is the Reinartz coil (the success of the Reinartz set will testify to that) or else the basket-weave variometer. If you must wind the coil on some form, it is highly desirable to wind them on a common *dry* cardboard tube. Laboratory measurements actually show that dry cardboard tubing has lower losses than some of the more expensive materials found in commercial receivers. The tubing can be carefully dried in an oven, and to render it permanently moisture proof, it is a good plan to "dope" it with a good lacquer or aeroplane dope, such as is used on airships. A good mixture is acetone, with a quantity of celluloid dissolved therein. When winding coils, the resistance can further be cut down by winding them with large sized wires (not larger than No. 12 and not smaller than 20 for use in the tuning circuits) and by spacing the wires slightly more than the insulation affords. This spacing will cut down the distributed capacity, which is responsible for the broadened tuning of the set. Solid wire should be used in all cases.

Avoid heavy varnishes and shellacs, and bind them into place instead of glueing them down with some highly resistant varnish. Use rosin for soldering, and keep the coils fully two inches clear of all other units of the receiver. This includes panels, rheostats, condensers and cabinet. A fan will often wonder why his set will work wonderfully outside of the cabinet, but the instant it is replaced will seem to lose its pep. The cause is due to the resistance which is coupled into the coil by the presence of a cabinet that is too small.

Connecting resistances into the circuit is another defect often found in receivers. It is a wise plan to use tube sockets of good insulating material, and to avoid the use of "moulded mud" camswitches or other switching devices. Avoid switches in the tuned circuit entirely. A porcelain socket is excellent if obtainable. Tapped coils in the tuned circuit is always bad business. If it is possible, wind the coils to cover the entire wave-

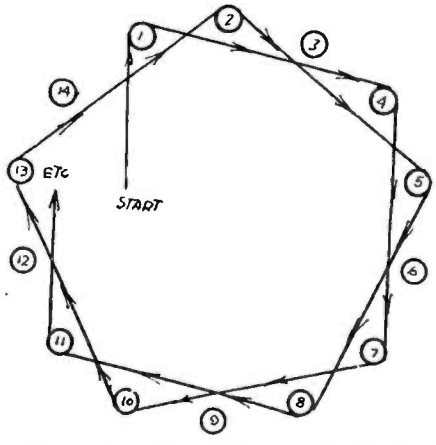


Figure 3. This illustrates the method of winding coils A and B used in the Simplifigon circuit. Fourteen steel pegs are driven into board in a circle (dimensions given in accompanying article) and the wire is wound around as illustrated until the required number of turns have been wound. This type of winding and mounting is applicable to any circuit making use of coils. You can even wind your own honeycombs by this method.

length suited, and if this is not possible, add an exterior loading coil placed at a good distance away from the main tuner. When running leads from the high side of the coil to the stationary plates of the condenser, and from there to the tube, run them high up in the air. Don't run the wiring of any grid circuit too close to the mounting board.

Condensers

The most important and probably most overlooked factor in making a close tuning receiver is the proper condenser. The market is certainly flooded with a lot of rotten condensers, and a great many fans have been duped into buying them because of their fancy vernier adjustments and frills.

You might have an excellent coil from a resistance standpoint, but the entire effect is lost when a rotten condenser is used. In general, a really good type of variable condenser is one of the air insulated type, with the insulating dielectric so placed that it is out of the electrostatic field as much as possible. The leakage paths should be so arranged that the current lost will have to travel over long paths, which means that the stator bolts should be as distant from the rotor bearing as possible. This material should not be too thick and wide. Where insulating bushings are used, they should be large and spool shaped, so that only the rims will touch. The use of thin insulating washers or bushings of small diameter is not good practice.

The insulation of the condenser should be of good hard rubber, pyrex glass or other similar insulator of high dielectric properties. Composition insulation is never to be trusted. Sheet bakelite, while not as poor as moulded composition or fibre bases is only average in insulating value as far as a good condenser is concerned.

A metal end plate condenser is very good, but care should be exercised in purchasing a condenser of this type to see that this metal end plate is not connected to the stationary plates of the condenser. The reason for it is this: It is always advisable to connect the "high" or grid leads to the stationary plates of the condenser. If the end plates are connected to these stationary plates you are going to have trouble in tuning due to "body capacity." The rotary plates should always be connected to the filament circuit when used as a secondary control, and when used in either antenna or ground, the rotary plates should go to the aerial or ground respectively.

Most condensers use hard rubber end plates, however, and the mounting screws are fastened thereto. Do not use a condenser with a separate vernier condenser, as the losses will be almost as high as in the main condenser. A friction or geared vernier is the best possible vernier that can be used. Choose one with a smooth, even adjustment.

Shielding of the panels or shafts is not good practice; it is often worse than needless. If a tuner is properly constructed with the stationary plates connected to the high voltage side (grid) of the circuit, no shielding will be necessary.

Fellows often complain that their sets will not work inside of the cabinets, which is only the rule that coils must be kept clear manifesting itself.

SANG TO PRINCE

Miss Gertrude Lawrence, of Charlot's Revue, the London production now playing at the Times Square Theater, New York, pictured singing to the microphone of radio broadcast station WEAF at 65 Broadway. Miss Lawrence cabled the prince that she was to broadcast and received word from him that he would listen in.

Amplifiers

Two stages of audio frequency amplification should certainly be sufficient to bring in the stations of average distance on the speaker; and will if the tuner is constructed to give a good, clear and loud signal to be amplified. The transformers should have a ratio of about 4:1 for the first stage and 6:1 for the second. Ratios higher than this only serve to distort the signals, and really do not offer any gain in volume when the signal is not clear.

A Simple Circuit

Summing up all these requirements and limitations on various radio accessories, we find that if we observe the above rules on any type of tuner the results will be pleasant.

The ear is a very poor judge in the matter; it is too sluggish to compare or notice small differences made in eliminating losses. If we took a tuner and eliminated three per cent of the losses, we would not notice any appreciable change in signal strength, but suppose we made 10 such changes, eliminating nearly thirty per cent of the losses, it would certainly make you sit up and wonder why you didn't do that before.

Now if we make a tuner incorporating the above requirements, we will have a tuner that incorporates close tuning properties, substantial range, and reliability. It is entirely possible to make a tuner that includes the remainder of the definitions.

We don't want to couple the set directly to the antenna, as in the case of the ancient single circuit receiver, because even if we make a wonderfully efficient tuning circuit, we spoil it all by coupling a highly resistant broad tuning part of the receiving system to the set. This explains the broadened tuning of the single circuit receivers. However, we can couple it loosely, and let the antenna act aperiodically as a collector only, and not as a part of the tuning circuit. If we do this, we also reduce the nuisance of reradiating receivers, as a circuit of this type is not so strong an oscillator.

The Simplifigon

With the requirements above mentioned in mind, we will proceed to build a tuner that will incorporate all these desirable qualities. The circuit shown in Figure 2, after a close glance, appears to be a "conglomeration," as Jack Nelson would say, of the single circuit receiver, the Reinartz, Haynes and a few others. We can't call it either or any of them, so for purposes of easier reference we will call it the "Simplifigon." Simplifi for the simpleness of it and the gon for old times' sake.

The circuit is the suggestion of Mr K. E. Hassel, and the mounting is a compound idea of Mr. Perry O. Briggs, Rado 1BGF, and the writer.

Construction

Before we construct, of course, we will need our parts, which are as follows:

1 7x14 Bakelite or Formica Panel.
1 23 plate, .0005 vernier condenser with gear or friction vernier.
1 Rheostat to suit tube used, vernier type.
1 Tube socket.
1 Grid condenser .00025 MFD.
1 Phone condenser .001 MFD.
1 Grid leak tubular type, interchangeable.
70 feet of No. 16 DCC wire solid copper.
16 feet of No. 18 Annunciator (bell) wire.
Two feet flexible lamp cord.
Waxed string, mounting board, binding posts, bus bar, and two hardwood

(Continued on page 17)

Junior Heterodyne Transformers

By JOHN B. RATHBUN

SHORTLY after the January number of RADIO AGE was issued, the office was in receipt of many letters and telephone calls requesting information on the subject of the long wave radio frequency transformers necessary for the Junior Super-Heterodyne. Such transformers were at that time difficult to locate, and owing to the Radio Corporation taking the UV-1716 off the market, the heterodyne constructors were at a loss as how to proceed. In many cases, we advised the use of the UV-1714 on a wave length of 3,000 meters, necessary changes being made in the two coupling coils to accommodate the lower wave length. This, however, was not entirely satisfactory as there was a pronounced "feedback effect" through the plate-grid capacity on this wave length, and a greater tendency toward self-oscillation in the tubes. The recommendation was simply made so that the enthusiastic builders could get on the job at the earliest possible moment.

It will probably be good news to the majority of readers to know that the transformer situation is clearing up and that in a short time that there will be a number of heterodyne transformers placed on the market. Both iron core and air core types are represented by these makers, and a wave length range from 3,000 to 25,000 meters is offered.

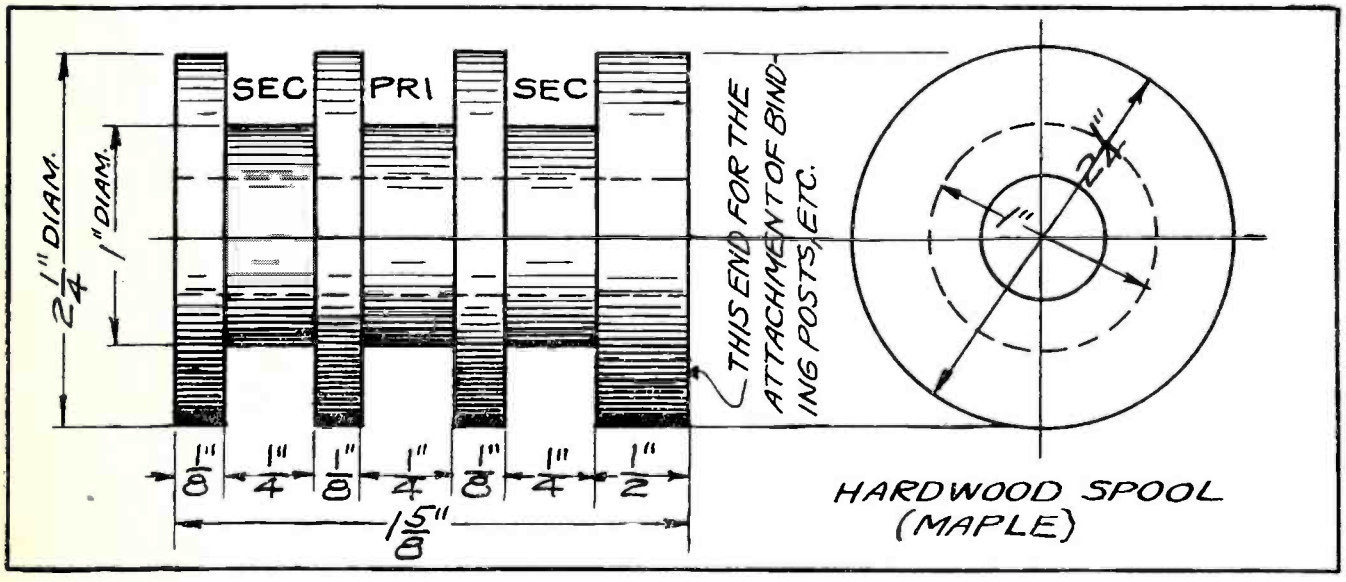
One great trouble with the commercial transformers of the present time is that the old radio frequency practice of a wide wave length band is followed, and this is not the proper characteristic of a heterodyne transformer. For example, a wave length range of from 5,000 to 25,000 meters in a single transformer lowers the possible amplification. According to heterodyne theory, such transformers should be rather sharply tuned so that a fairly narrow peak of amplification is shown. This is, of course, best attained by the use of air core type transformers since the introduction of a metal core tends to broaden the wave length band and introduces other difficulties as well.

So far as the hookup itself is concerned, it makes no difference whether the system operates at 3,000, 5,000 or 10,000 meters except that the size of certain units are changed. The connections are just the same in all cases, the difference lying in the number of turns of wire on the coils and the capacity of the condensers. As to the relative performance on different wave lengths, there is a great diversity of opinion at the present time but I note with satisfaction that there is a decided tendency toward wave lengths as great as 10,000 meters. At such high wave lengths there is little tendency toward capacity coupling between the various radio stages, less interstage coupling within the transformer itself, and less trouble with tubes that are mysteriously inactive. At 3,000 meters, the frequency is still high enough to cause appreciable capacity effects between the grid and plate of the tubes.

It is interesting to note that 10,000 meters corresponds to a frequency of 30,000 cycles per second, and that this frequency is only a little above audio frequency. For this reason, iron core transformers are more effective at 10,000 meters than at longer wave lengths since a deeper magnetic penetration is had in the core iron without extreme subdivision of the iron. Give us a long enough wave length and we can employ audio frequency transformers in place of radio frequency types, and on frequencies approximating 15,000 cycles per second the use of audio transformers is entirely feasible. It has often been the desire of the writer to experiment with the very low frequencies, just above audibility, using standard types of audio frequency transformers for the purpose.

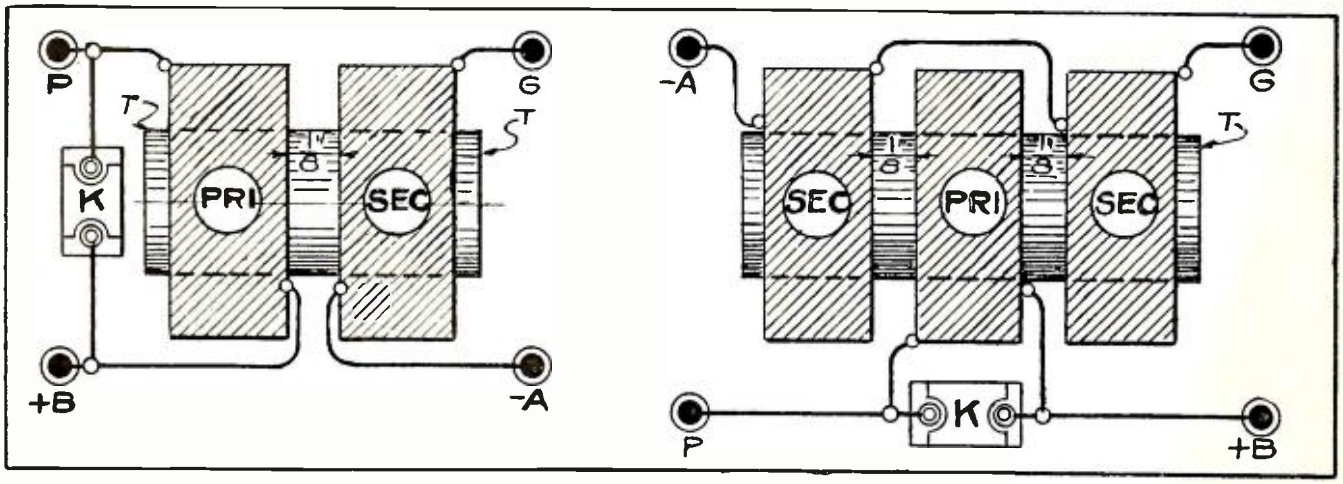
Transformer ratios of the long wave transformers is a variable quantity among commercial types, ranging from a ratio of 1 to 1, to 4 to 1 or even higher. Whether the higher ratios are justified is still a matter of experiment, but it may be said that a ratio of unity (1 to 1) is quite satisfactory, and the ratio permits of smaller units and coarser wire in both the primary and secondary coils. This gain due to the reduction in electrical resistance somewhat offsets the gain due to the high ratios. There has been much discussion on the subject of the proper ratio, and this is not yet settled so far as the average builder is concerned.

From various experiments performed in Chicago, it would seem that impedance coupling has many desirable qualities, not alone from the standpoint of cost but from the performance as well. In this form of coupling a single inductance coil is used, usually a honeycomb, with a fixed condenser connected across the outer ends of the coil. This is small and compact and it certainly functions well. The size of the coil and the condenser depends upon the frequency determined upon and is easily and cheaply built by any constructor. The "tuned impedance" is connected to the plate circuit of each stage of radio frequency, one coil per tube, with the remaining end connected to the positive "B" battery connection (*B). A small condenser is connected in the line running between the plate and grid of adjacent tubes to prevent the "B" battery current from paralyzing the grids.



In the following table is given the size of honeycomb coil and the size of the shunted fixed condenser required for the various wave lengths.

Size of Honeycomb in Turns	Size of the Fixed Condenser	Wavelength in Meters
200	0.001	2,870
250	0.0005	2,800
250	0.001	3,910
300	0.0005	3,490
300	0.001	4,900
400	0.0005	4,400



500	0.0005	5,750
500	0.001	8,070
600	0.001	11,600

To insure proper operation, all of the units should be carefully adjusted so that the impedances are as nearly equal in each stage as it is possible to make them. Testing each unit with a wavemeter is the surest method.

Honeycomb Coil Transformers

Very frequently the transformers can be easily built at home and good results can be obtained if the work is carefully conducted. The cost is very much lower, and this is a great factor when three or more stages of radio frequency amplification are used. Of these homemade devices, the honeycomb coil transformer is the most easily built since suitable honeycomb coils can be easily obtained on the market and can be quickly assembled. Very good results can be had.

Figure 1 shows how the two coils constituting the primary and secondary are placed side by side and mounted on a cardboard mailing tube. About one-eighth inch separation is allowed between the coils, but this is not a critical value. A fixed condenser (K is connected across the ends of the primary coil only to increase the natural wave length of the coil and to reduce its size. The number of turns in the primary and the corresponding size of the condenser K) for a given wave length can bedetermined from the table of impedances just given. In this case, where both coils are of the same size, the transformer ratio is of course 1 to 1, but if a higher ratio is desired the number of turns in the secondary can be increased but the size of the primary remains unchanged as this depends upon the wave length.

The terminals of the coil are marked as usual for the grid (G), the plate (P), the negative "A" (-A), and the (+B) battery connections. The grid connection (G) should be taken from the outside turn of the secondary winding. The wire should be No. 28 D. S. C. as is usual with the commercial coils of this size, but No. 30 gage can be used where the coil is to be reduced to its smallest possible dimensions. The paper tube, (T) is the only core, no iron being used. In assembling this transformer care should be taken that the direction of the turns is the same in both coils.

When a two to one ratio is required, we can either have a secondary coil with twice the number of turns, or else employ one primary coil with two equal secondaries mounted on either side of the primary, the two secondary coils being connected in series. This construction is shown by Fig. 2 where the primary coil (PRI) is sandwiched in between the two secondary coils (SEC). The secondaries are connected in series by the bridge wire (M) and particular care must be taken so that the windings of the coils are in the same direction. If this is not done, then the coils will "buck" one another and no transformation will take place. The fixed condenser (K) is connected across the primary coil as usual, and the size of this coil and the condenser are determined by the wave length table as before. This is a very bulky and rather expensive construction.

A more compact winding, particularly adapted to wave lengths above 5,000 meters where many turns are required, is the "spool type" transformer of Figure 3. This spool contains three grooves, the center groove containing the primary winding while the two outer grooves contain the two halves of the secondary winding. The secondaries are connected in series as in Figure 2, and needless to say, all coils are wound in the same direction. No tuning condenser is used for the primary coil as the natural wave length of this coil alone is sufficient to bring the wave length up to 10,000 meters without the aid of the condenser. As each half of the secondary contains twice as many turns as the primary, it is evident that the total transformer ratio is four to one.

The primary winding in the center groove consists of 500 turns of No. 30 D. S. C. wire. Each of the secondary coils in the two outer grooves consists of 1,000 turns of No. 36 D. S. C. wire making a total of 2,000 turns in the primary and giving a total transformer ratio of four to one.

After these coils are wound, and the outer ends are fixed by a dab of sealing wax we can place them within a metal container or else place them within a metal tube for protection and shielding. The four ends of the coil are then brought out to the binding posts after the two secondary coils have been connected in series as shown by Figure 2. To connect the coils of the secondary in series, the inside end of one of the outer coils is connected to the outer end of the other outside coil. Care should be taken to mark the outside end of the secondary by (G), thus indicating that this end goes to the grid of the following tube. This is important as the capacity effect is much less when connected in this way than when the inner end is connected to the grid.

One end of the central primary coil (+B) goes to the positive "B" battery while the other end (P) goes to the plate of the preceding tube. It is likely that the best results are obtained if the outer end of the primary is connected to the plate.

Of course this compact construction or spool wound transformer can be made for other wave lengths, but owing to the comparatively great amount of distributed capacity in a winding of this sort, it is not so effective on the shorter wave lengths as the honeycomb type of coil. It should be remembered that the capacity effect increases rapidly with a decrease in wave length or increase in frequency, and what might prove perfectly correct at 10,000 meters will not be efficient at 3,000 meters. When a number of turns are wound over each other in layers as in the last type of transformer, each turn acts as a plate of a condenser in regard to an adjacent turn, and this capacity between turns becomes an appreciable effect on wave lengths below 10,000 meters. Winding the turns in zigzag fashion as in honeycomb coils greatly reduces the capacity of the winding as succeeding turns are not parallel but cross each other at nearly right angles.

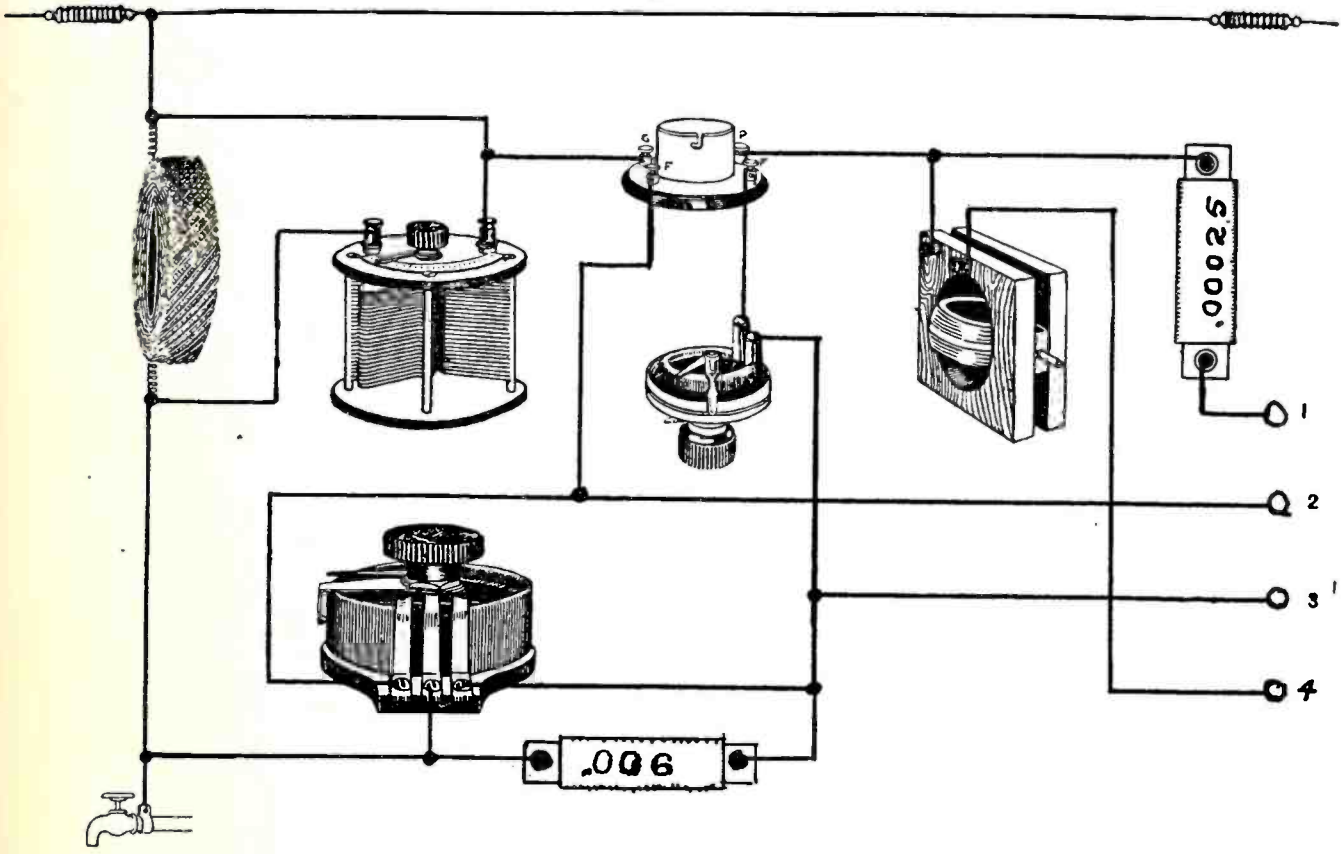
To insure proper insulation, the transformers should be carefully dried out in a moderately warm (not hot) oven until all moisture is expelled from the wire covering. They can now be slipped into their casings and seal up moisture tight. A metal casing such as a brass tube is desirable since it greatly reduces the stray field set up by the transformers and thus prevents inductive disturbances in the circuit. As an additional insurance against this "coupling" by the external field, adjacent transformers should be turned at right angles to each other, and separated by as great a distance as possible with the space allowed. It is well to follow neutrodyne practice in regard to the spacing of the tubes and transformers in the receiving set, keeping the tubes and transformers well apart to prevent coupling between the radio frequency stages.

A Tuned Radio Frequency Amplifier

Will Increase Signal Volume, Selectivity and Receiving Range of Any Standard Receiver

By J. A. CALLANAN

1



WHILE the most simple type of amplification is that of audio frequency, so named because it is handling currents of frequencies within the audible range, there is another type known as radio frequency amplification and which is at the present time the subject of much discussion and speculation and which is coming more and more into requirement for long range reception as well as in connection with short antenna systems and loop aerials.

In audio frequency, amplification is accomplished after the signal has passed the detector, while in radio frequency amplification the original signal wave is amplified before it is passed to the detector or rectifier. An advantage of this method lies in the fact that it amplifies the wave only and not the many, little irregularities and imperfections which exist in the receiver and audio frequency amplification equipment. Furthermore, most detectors have a critical point at which they begin operating. Signals that come in weaker than this critical point of the detector make no impression upon it and are entirely lost. Thus it is evident that any signal which has failed to actuate the detector will not be heard. With radio frequency amplification, on the other hand, there is virtually no critical point and even the weakest signals can be built up to the desired degree before being passed on to the detector to be rectified to audibility, and from there on for further volume through stages of audio frequency.

Radio frequency is by no means a simple matter and is only now emerging into popularity in this country. The subject cannot be completely covered in an article of this nature even though the author were in a position to essay the task.

Radio Frequency History

It may be interesting to include a bit of history concerned with the subject. This system of amplification dates back a little over ten years, a relatively long time in development of radio communication. At that period two Germans were diligently trying to solve the problem of more sensitive reception, and amplification of the radio signal before detection seemed to be the answer. So we see that it is not a new development, but rather one of the oldest. It made its advent at about the same time as the famous Armstrong regenerative circuit. It did not have the distinction of being born in America, but in Germany.

It came into its own almost immediately in Europe and during the late war there was practically none other in use for sensitive receivers. Its rather belated introduction to the fans of this country is heralded by many as the dawn of a new day.

The writer has experimented with radio frequency in its various forms of untuned and tuned with differing degrees of success.

It is admitted that the ordinary radio frequency transformer responds over a certain limit of wave lengths with a loss of volume on either side of such wave band. No matter what method is used to broaden the wave band with a transformer of fixed ratio there is still one band that is favored while efficiency drops off at either side making transformer coupling a serious problem.

Inductive coupling between the antenna and grid circuits is accomplished with a standard variocoupler and does not noticeably increase the selectivity.

(Continued on page 18)

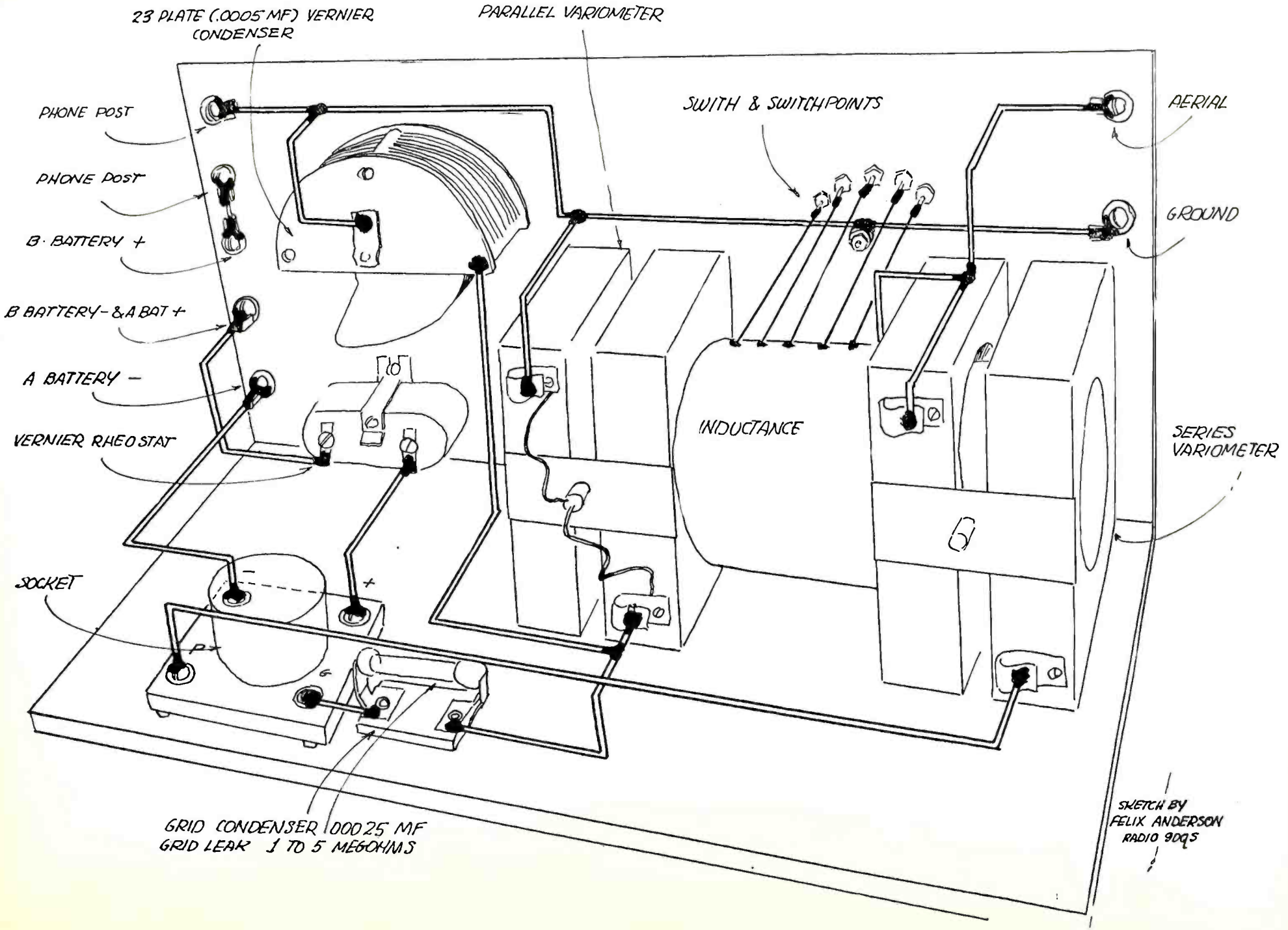


Figure 1. Back panel layout and working drawing of the Kopprasch circuit. The remarkable results obtained with this receiver make it highly popular among broadcast listeners. The secret of this circuit lies in the manner of connecting the variometers, and the clever use of the antenna inductance.

How to Make the Kopprasch Receiver

By FELIX ANDERSON

Technical Assistant, Radio Age

EVER since the original presentation of the Kopprasch circuit in the April, 1923, issue of RADIO AGE, there has been a rapidly increasing interest in that circuit for two major reasons. Primarily, because the Kopprasch circuit offers unlimited possibilities with respect to long distance reception, and secondarily, due to its ability to reach out and get the long distances even in dead spots without fading. Clarity of reception and freedom from tube noises is another one of its important assets, and due to the fact that it has figured prominently in the Pickups and Hookups section of this magazine, we are presenting it to our newer readers who have evinced a tremendous interest in it.

This set was designed by Mr. A. H. Kopprasch of Chicago, who spent many months in perfecting this novel and unusual circuit.

The strength of signals obtained when using this circuit is much greater than any average circuit, and it is even more pronounced when standard storage battery tubes are used. The music, once the set is adjusted, comes in very clearly and distinctively, and stations in California and Oregon have been clearly and distinctively heard in Chicago with but a single tube. These stations were not only heard but were held as long as desired without the customary fading away which is so common with reception at such great distances.

The outstanding feature of the set is the peculiar arrangement of the variometers, one of which is connected in parallel and the other in series. The antenna inductance is wound on a paper tube, which is placed between the two variometers and in inductive relation to them.

Figure 1 shows how this mounting is accomplished, as does the accompanying sketch.

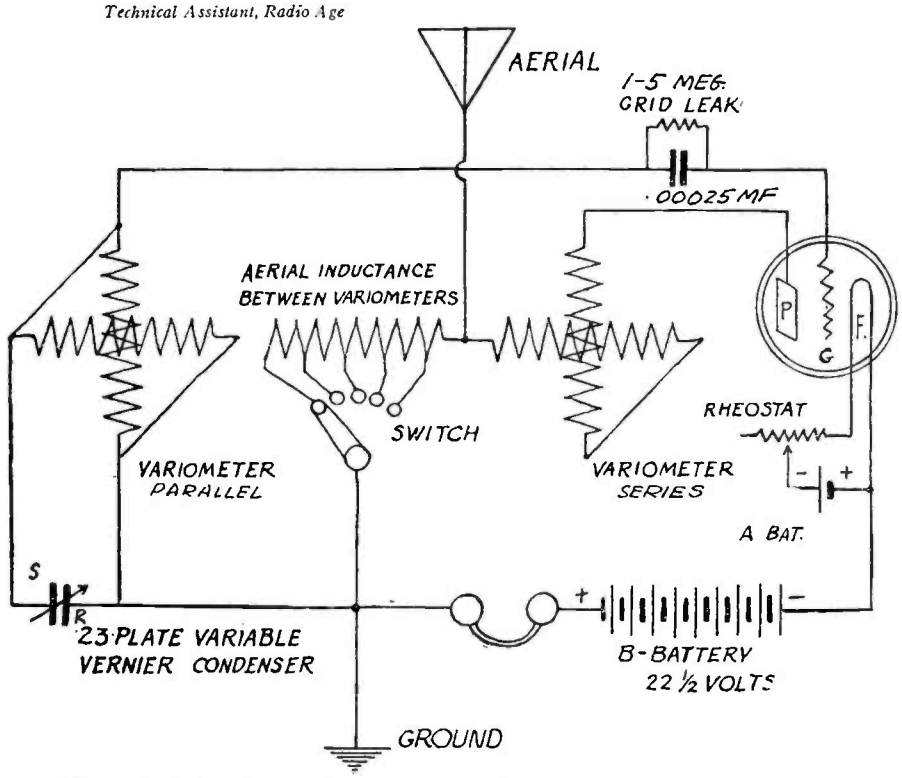


Figure 2—The wiring diagram of the Kopprasch receiver. Note the unusual connections of the variometers.

The tube is made of any heavy cardboard tube, two inches long, and of sufficient diameter to allow the rotors of the variometers to clear it. Fifty-five turns of No. 20 DCC wire is wound on the tube, tapping at every eleventh turn. These taps are connected to the switch points as shown in Figure 2.

This coil should be wound in the opposite direction to the stators of the variometers. The starting end of the winding of the antenna inductance is connected to the series variometer with the antenna post connected to the junction between them.

The variometer on the left is connected in parallel, that is, one end of the rotor winding is connected to one end of the stator winding as shown under "parallel" in Figure 3. The connections are made at the points indicated at C. A 23 plate vernier variable condenser is connected across the terminals C and C as indicated in Figure 2, on the wiring diagram.

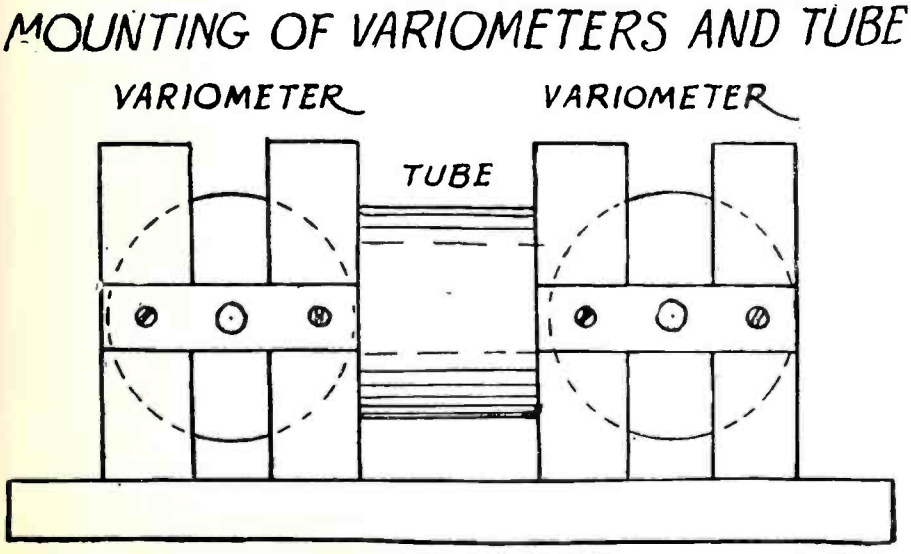


Figure 1

The remaining apparatus is standard, the grid leak being of the ordinary tubular interchangeable type, and the grid condenser of the conventional .00025 MFD capacity fixed type. The battery used will be determined by the type of tube used, as will the rheostat. A B battery of the tapped variety is preferred, as often tubes will function more effectively when about 16 or 18 volts is used to energize the plate. Phones should have a resistance of about 3000 ohms.

In mounting the variometers, it is a good plan to mount them firmly on the mounting board in such a way as to be able to force the inductance tube between them firmly. If the tubing slides down, it may be fastened with sealing wax.

Most all of the causes for trouble in this set are found in one of two places: either in the winding on the tube in the incorrect direction with respect to the direction of the stator coils on the variometers or else the value of the grid leak is not correct.

By carefully examining the stators, it is easy to find the direction of the wind-

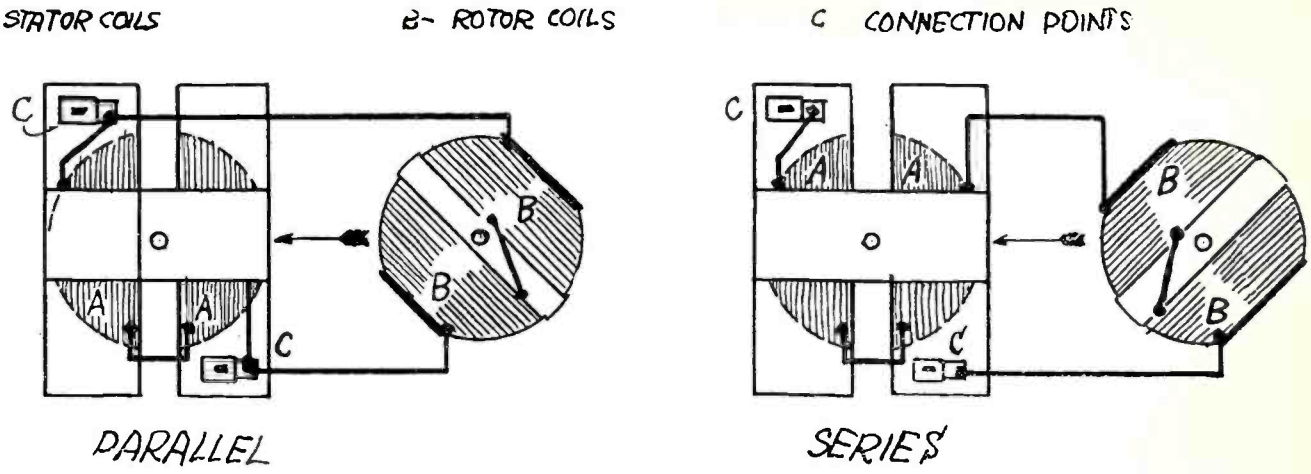


Figure 3. The above drawings illustrate the method of making series and parallel connections of the variometers used in the Kopprasch circuit. The rotors are shown as being outside, to illustrate the connections.

ing; when the two variometers are placed side by side the stators should appear to be a continuation of the winding in the same direction.

The other case of trouble which may be present is a beat noise in the phones. This may sound like a hum or a series of slow knocks, and often presents itself in the form of a screech. This is remedied by inserting a grid leak of lower resistance in the clips. Careful adjustment of this leak is necessary to obtain the best results, and several values should be tried out until the best one is found.

Without doubt there are fans who desire to add two stages of amplification, which is added in the manner exemplified in Figure 4.

Large Antennas

Hartford, Conn.—It is seldom that an amateur radio long distance test is accomplished without there being uncovered some technical truth destined to have a far-reaching effect on amateur transmission and frequently radio communication in general. Recently amateurs in France and Connecticut succeeded in carrying on the first short wave communication between the two continents. After thoroughly going over the construction of French 8AB and American 1MO, the two stations most prominent during the tests, S. Kruse, technical editor of QST has been able to draw some interesting conclusions.

Mr. Kruse believes the transatlantic success was due primarily to the fact that each station participating used antennas that are large for the waves they are working. "Working an antenna that way," he says, "gives high radiation efficiency. The moment that statement is made the tribe of amperehounds will rise in protest. Nevertheless we are putting more power into the ether than ever before, though the antenna current does drop.

"The idea has now been put through some weeks of steady work with amateurs and in every case the successful American stations have been using big antennas with series condensers. Most of us do not have 'X' licenses, so we cannot work on 100 meters, but the lesson is just as good at 150 meters. Be sure to give your antenna a fundamental wave length of at least 220 meters."

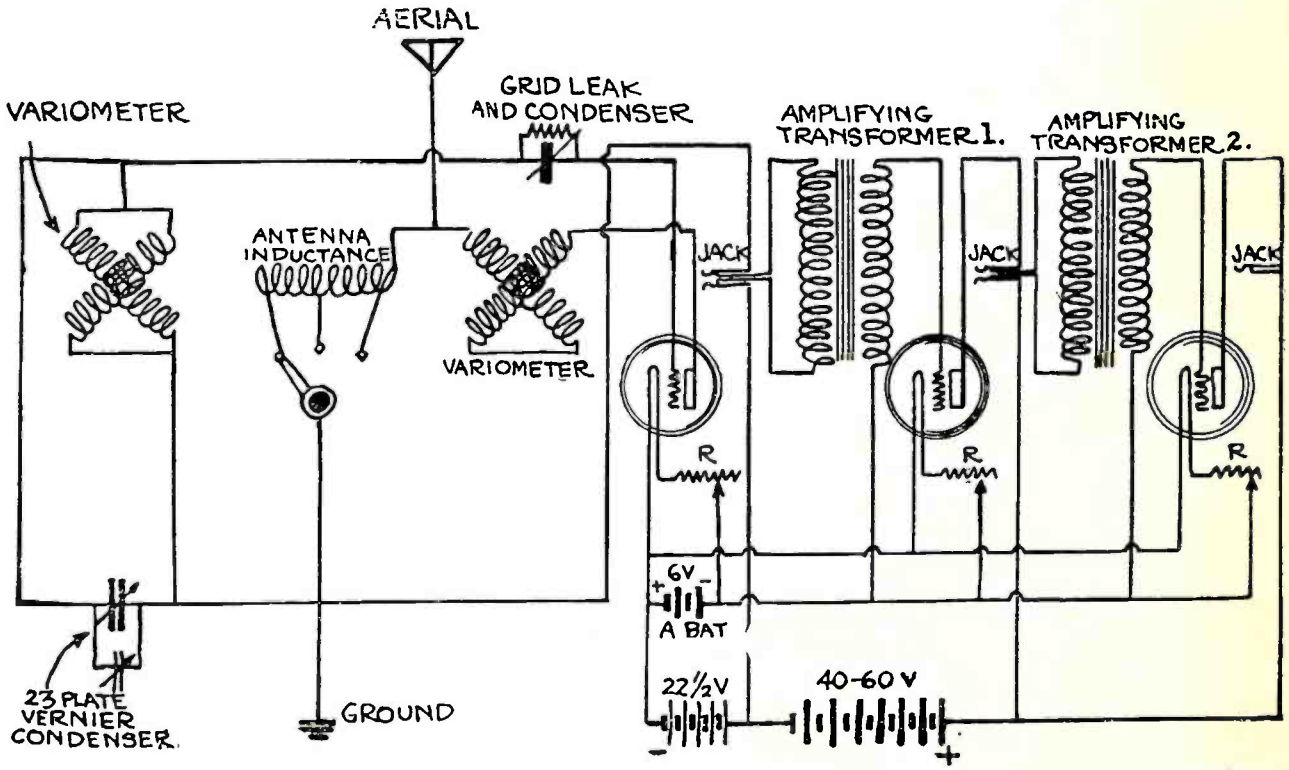


Figure 4. The Kopprasch circuit in connection with two stages of audio frequency amplification. A receiver of this type will bring in distant stations with considerable volume on the loudspeaker. Amplifying transformer No. 1 should have a ratio of about 3 1-2 or 4 to 1 while the second should have a ratio of not greater than 6:1.

The Simplifigon Receiver

(Continued from page 10)

sticks boiled in paraffine. Batteries, cabinet and phones.

1 piece of Bakelite or Formica, 6x4 inches.

After you have assembled this list of apparatus, lay the panel out according to the sketch shown in Figure 1. The tuner shows how simple the general lay-out of the set is. If you wish, suit your own individual taste in the matter, so long as the foregoing requirements are kept in mind.

Winding the Coils

The only hard part of the entire set is the winding of the coils. This however, requires no skill, but a goodly exhibit of patience.

Starting with coil A, procure a cardboard tubing or other form which has a diameter of 3 inches. Around this form, wind 10 turns of the No. 16 DCC wire and allow a few inches at each end for connections. Slip the coil off the form, and bind the wires together firmly with a piece of waxed string as shown at A in Figure 1. With another piece of waxed string, fasten this coil to the wooden shaft or stick which has been boiled in paraffine, as also shown. This completes coil A.

To wind coils B and C is a little harder. Procure 14 steel pegs (finishing nails without heads will do) and set them in a 4 inch circle as shown in Figure 3. Starting at peg No. 1, with the remaining No. 16 DCC wind around peg No. 4, skipping 2 and 3, from 4 to 7 inside of 5 and 6 and so on as shown. Coil B should have from 45 to 50 turns. This number will vary, due to the fact that hand wound coils cannot be made uniform. In all probability some of the No. 16 wire will be left over, and this can be slipped into spaghetti tubing for wiring. The coil is bound up in the same manner as was coil A, with the wax thread, and is supported by winding the wax thread firmly around a heavy piece of cardboard and mounting the entire coil and cardboard on two small blocks as shown at B, Figure 1.

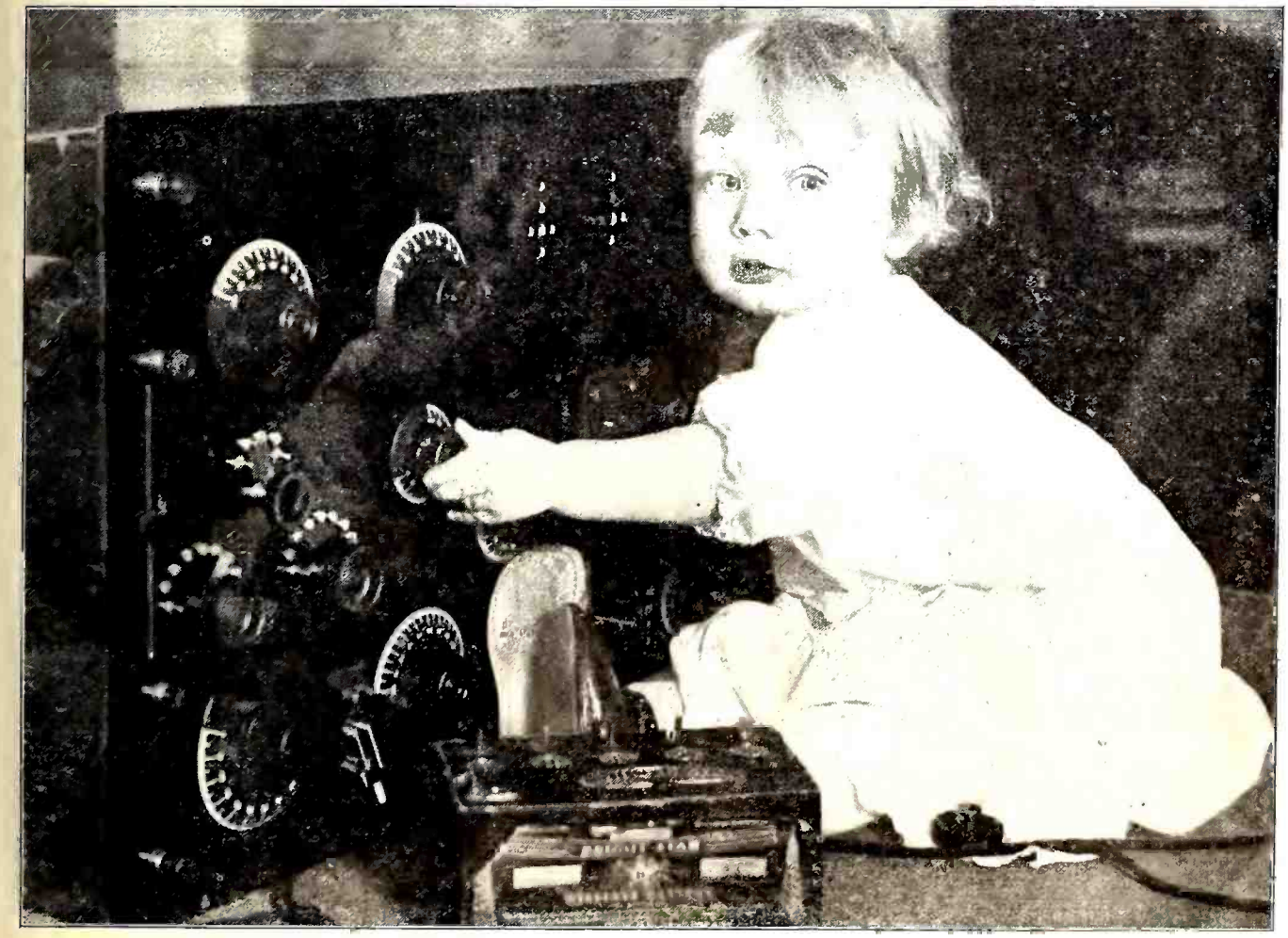
Coil C is wound in the same manner as coil B, with the exception that the circle in which the pegs are set is only 2 7-8 inches in diameter. The winding is done in the same manner, and should be of from 18 to 22 turns. It is best to wind it with about 22 turns and decrease this number until the right value of tickler for the particular tube you are using is found. This coil is also fastened to one of the sticks.

These sticks are screwed to knobs or dials, and are used to vary the coupling of the coils.

Connections to the two movable coils are made with the flexible lamp cord, permitting the coils to be rotated. Wire the set according to the diagram shown in Figure 2, or, if you choose, Figure 1.

Connect the antenna, phones and batteries to the posts indicated and set the filament, rheostat and tickler so that the tube oscillates gently. Rotate the secondary tuning condenser until a signal carrier wave is heard, and clear up the signal with the tickler and rheostat.

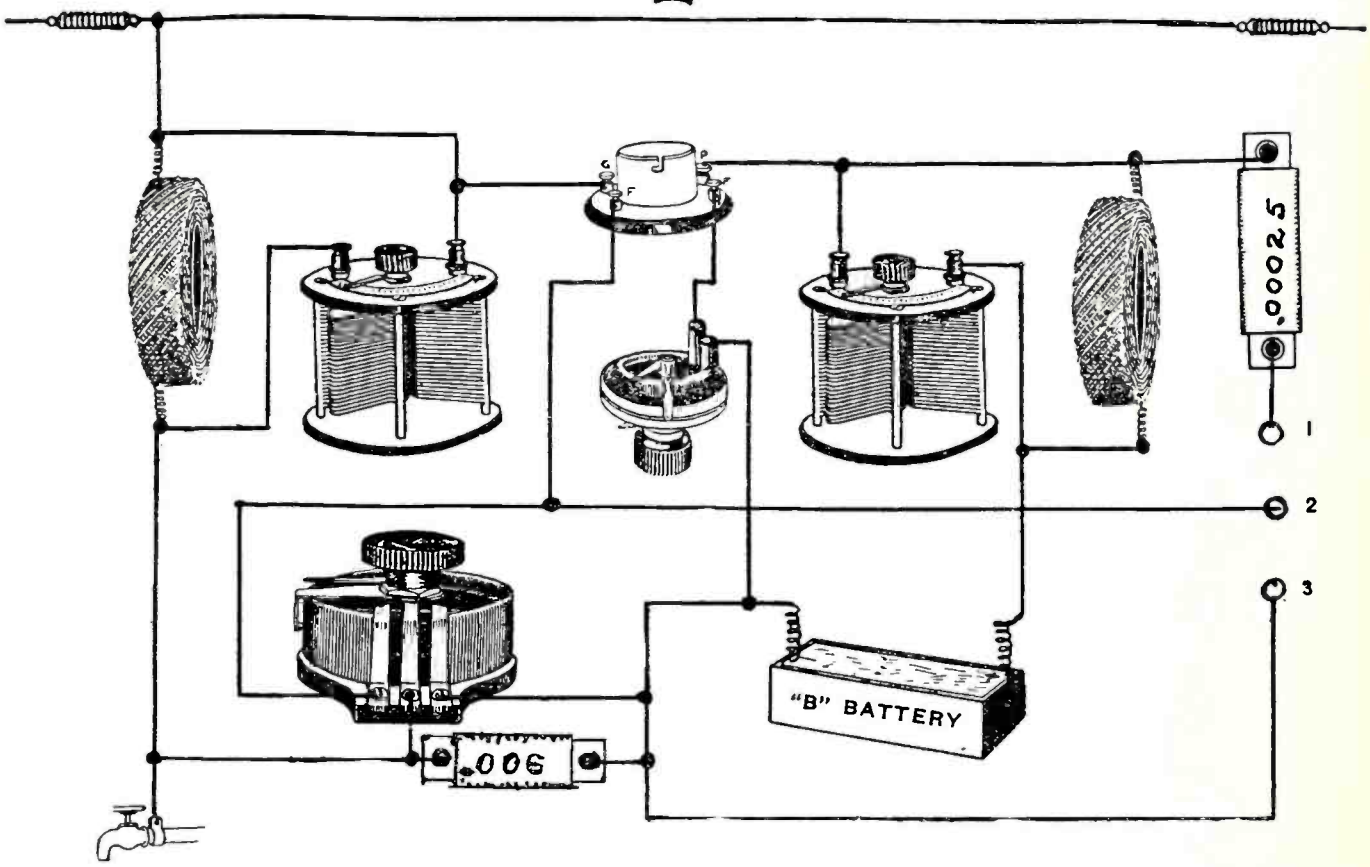
While this is only one of the many efficient circuits that can be constructed upon these principles, it is entirely emblematic of the ideals of low loss principles set forth in the foregoing paragraphs and with two stages of audio frequency amplification built into a separate cabinet as described in the August, 1923, issue or the RADIO AGE ANNUAL, this set should prove equal to any three-tube set devised. The writer does not advise the use of radio frequency with the Simplifigon, feeling that if you desire anything better than a good regenerative circuit with two stages of audio frequency amplification *build a Super-heterodyne.*



IN WONDERLAND

Little Miss Noreen Alley, a Chicago fan, will tell you all about the six-tube receiver made by her daddy, Norman Alley, of the International Newsreel, as soon as she has given it a thorough tryout. She is shown trying to pick up KGO on the loud speaker.

2



A Tuned Radio Frequency Amplifier

(Continued from page 13)

and somewhat decreases sensitivity because of the losses always entailed in inductive coupling.

It is important, then, to the experimenter what method of radio frequency amplification is employed. In the experience of the writer straight tuned radio frequency is considered the most stable and easily adapted to practically any standard circuit.

A single stage of radio frequency amplification in the manner of our schematic diagrams is in the nature of a wave trap designed to amplify the frequency to which it is tuned.

The following circuits were developed as affording the best results on all receivers of experiment conducted.

While we are showing two amplifier circuits it will be seen that they differ only in that one uses a variable capacity (condenser) and the other a variable inductance (variometer) to tune the plate circuit. Results were favorably comparable in either method.

Apparatus

In both circuits the same type of antenna tuning unit is employed. In No. 1 the plate circuit is tuned with a standard variometer. The connections as shown provide for the use of common A and B batteries for receiver and radio frequency amplifier. No negative B connection is indicated as it is made through the A battery wiring in the receiver.

Both coils shown in No. 2 are fifty-turn honeycomb coils. These can be substituted by their equivalent which is accomplished in two coils wound each with forty turns of No. 22 DCC wire on three-inch cardboard tubes. Both condensers are twenty-three plate variables, not necessarily vernier. While No. 2 shows use of a separate B battery it is understood that either method can be used, being optional in either circuit. Results afforded are of equal satisfaction.

A by-pass condenser, .002MF is connected in parallel with the B battery, to prevent radio frequency losses in it.

A U V-201 tube was demonstrably the best radio frequency amplifier tried. A 400 ohm potentiometer is effective for either a six volt or a peanut tube. The value of rheostat is determined by the tube used. The condenser to be connected between the output of the radio frequency amplifier and the antenna binding post of the receiver circuit is a .00025MF (Dubilier preferred). (Be careful to have no grid leak on condenser).

Binding Post Connections, in either circuit, No. 1 to antenna binding post of receiver. No. 2 to positive A. No. 3 to negative A. No. 4 to positive B.

How to Tune

A good operator will never use an oscillating detector to receive radio phone broadcast. . . . The oscillating detector interferes not only with neighboring receivers but will not give stability and good quality of reception.

Oscillations are presented by turning the potentiometer "stabilizer" arm toward the positive side. A radio frequency amplifier tends to oscillate as the grids are placed negative, and amplification is at maximum at a point just below where oscillation starts.

The following pointers may be useful. The writer has observed many times that operators in using a one-step tuned radio frequency set will turn the radio frequency tube to full brilliancy and then go ahead and turn up the impedance variometer or condenser until oscillation starts, imagining that he is then operating at full efficiency and in proper fashion. This is, however, not the case. Most tubes will start oscillating some time before the correct impedance value is reached.

The way to realize as much as possible from a tuned radio frequency amplifier is to keep oscillation down until the correct impedance value is reached. This is found as described herein; it will be observed that as the radio frequency tube is turned down, the band through which oscillation occurs as the impedance is varied narrows down very rapidly. By carefully lowering the filament temperature we eventually find a point where the tube will oscillate through but one or two degrees of scale on the dial. That point represents the value for which we aim. If you simply turn your tube all the way up, and then go ahead and tune your impedance until oscillation starts, you might as well junk your outfit as you are not realizing the possible gain of efficient operation. To get that gain you must resort to a possibly tedious method of keeping the tube low until you find the impedance value for the particular wave you are working up, and this means taking time.

A word about construction is in order. When building this radio frequency amplifier patience and skill are rewarded. Wiring must be neat and all joints secure. The individual units and the circuit should be tested individually before trying the receiver as a whole.

Adding Radio Frequency to the Variometer Set

By BRAINARD FOOTE

THE OLD two variometer and variocoupler regenerator was a good set in its day but the advent of newer circuit arrangements puts it out of date today. The owner of the standard regenerative outfit, however, doesn't want to throw away or junk most of his receiver just to get a better receiving range, because of the expense involved. And yet, nothing has been offered to him in the way of improvement which doesn't mean just that.

However, there's nothing the matter with the variometer, and it may be utilized very effectively in a radio frequency circuit which implies no additional equipment other than another tube, socket and rheostat. The variocoupler is made into a radio frequency transformer, and the left-hand variometer in the set becomes the secondary. The aperiodic antenna system is adopted, and the tuning range of the first variometer is boosted by means of a small shunt condenser.

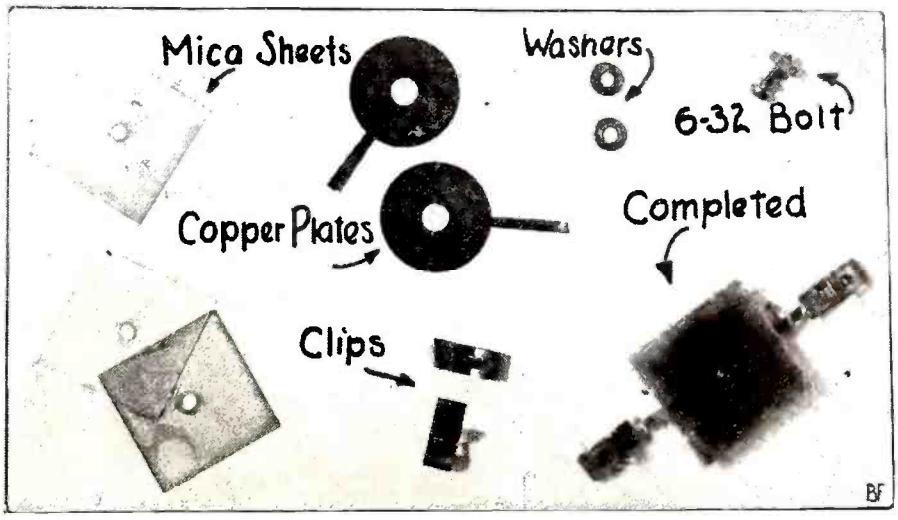


Figure 1—Close-up of the parts used in making the shunt condenser for boosting the tuning range of the variometer. Paraffined paper may be used with as good results as obtained with mica sheets.

What is Gained

The advantages of the change are several, foremost among them being, of course, a considerable increase in DX reception. Selectivity also is improved, and the operating controls are reduced to two only, although there may appear to be more than that in the drawings. Besides the regular equipment of the standard variometer set, the following parts are needed:

UV-201-A tube.
Tube socket.
Rheostat.
Piece of copper or aluminum sheet, 2 by 1 inch.
Piece of mica or heavy paraffined paper, 2 by 4 inches.
Ten or twelve feet of bell wire.

Figure 1 illustrates how the parts for the little shunt condenser are cut and put together. This is condenser "C" on the circuit diagram, and it is needed to raise the wave length range of the variometer, which now is to function as the secondary all by itself. If one hasn't facilities for drilling the copper plates, which are cut to a diameter of one inch, the hole in the center may be roughly punched out with a small chisel. The actual capacity of the condenser is not of particular importance, since the thickness of the paper or mica between the two plates may be altered by the use of more or less sheets until the correct capacity is determined. This may best be done by experiment. The connecting clips for the condenser are cut off from an old "B" battery and soldered to the projecting lugs of the condenser plates. The hole in the plates must be large enough so that the 6-32 holding screw cannot touch them as it passes through.

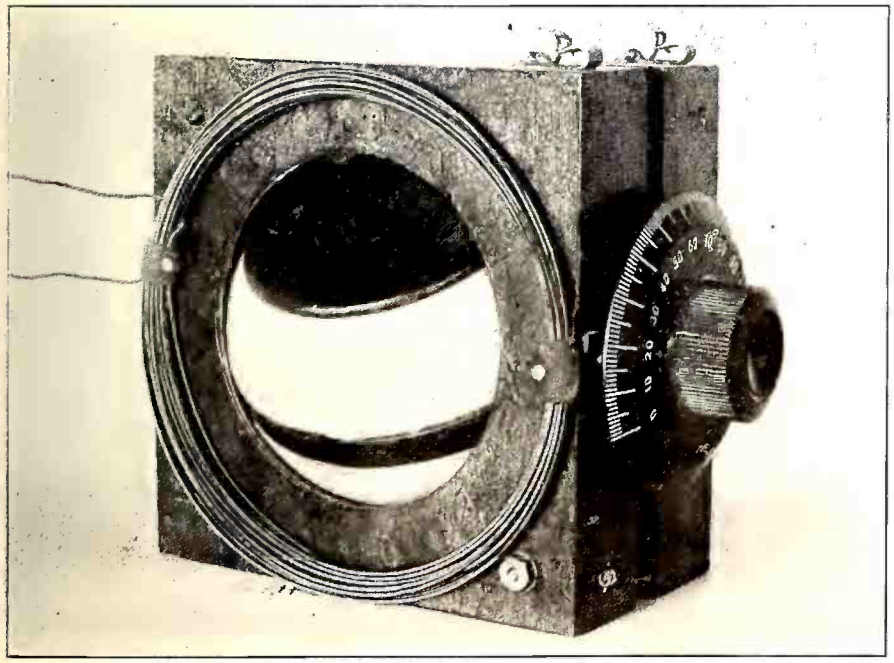


Figure 2—View of the antenna coupling coil in place alongside the variometer. Bell wire, seven turns, form the coil, and it is held in position with the aid of some strips of tape and two little tacks.

The Coupling Coil

Figure 2 illustrates the method of mounting the antenna coil. It is important to determine which side of the variometer is to be connected to the grid, and then to mount the coupling coil at the OTHER end, so that it will be at the "low potential" end of the variometer. This insures high voltage applied to the grid. Moreover, if the variometers are of a type that use the front shaft as a connection, this must be the filament end, or there will be some hand capacity effect. The coupling coil is made of eight turns of the bell wire, wound first on a tubing or other cylinder about four inches in diameter and affixed by a couple of tacks to the side of the variometer. Two strips of tape hold the coil in shape

The remainder of the connections aren't complicated. The primary of the variocoupler now becomes the primary of the radio frequency transformer, and the plate terminal of the R. F. amplifier socket is joined to one of the switch arms. The other switch lever is wired to the plus "B" battery. Thus the number of turns in the primary may be varied at will. The grid circuit of the detector is

left intact, but it is essential that there be a .001 by-pass condenser connected from the detector plate terminal to one side of the filament. The UV-201-A tube is recommended as a superior detector for this type of receiver, although the UV-200 is almost as satisfactory.

The ground is connected to the negative side of the "A" battery, as is the "grid return" lead of the radio frequency tube. The "B" battery should be at least 67 1-2 and preferably 90 volts. Of course, if the UV-200 is used as the detector, the detector plate circuit should be tapped in at the 22 1-2 volt point instead of the 90 volt point, as illustrated in Figure 3.

How to Operate It

First of all, set the switches to include at least half of the variocoupler's primary winding, and set the rotor at the position of maximum coupling, where it may be left, and need not be touched again. Then set the left-hand variometer at about half its scale reading and turn the other one until you hear the customary "rushing" noise of regeneration. Reduce the number of turns in use on the variocoupler until regeneration is heard only over a very few (5 or 6) degrees of the variometer scale. Then swing both variometers up and down their scales, keeping them in tune so that regeneration is taking place, until the carrier wave of a broadcasting station is heard. This is evidenced by the usual "whistle."

Now still further reduce the number of turns on the coupler until oscillation stops. Then retune the variometers until the station is heard clearly without any oscillation. When this position is found, it will usually be possible to tune up and down the scale without starting oscillations at all, but with adjustments set so that the point of oscillation is very close. Thus the set cannot radiate and annoy other listeners, and at the same time, the volume of the DX stations will be very much increased, doubled and tripled in many cases. The selectivity will be found surprisingly sharp, so that it is necessary to tune slowly for fear of passing over a station's wave without noticing it at all.

Should the high wave broadcast stations come in with the left hand variometer set at less than two-thirds scale, the shunt condenser has too large a capacity. This may be remedied by unscrewing it and inserting another sheet of insulation to double the distance between the plates. Another sheet may be added should that also fail to "spread out" the tuning on that variometer sufficiently.

The variocoupler makes a very convenient radio frequency transformer when used in this manner, and the tens and units taps are ideal for close regulation of the coupling. The more turns in use on the primary, the greater will be the feed-back to the grid circuit of the first tube, and sufficient turns should be cut into circuit to bring the set up to the position of maximum sensitivity just before oscillation begins. The actual tuning controls resolve themselves into two, since the coupler controls never need be touched unless perhaps to "put a damper" on some extra loud local station, or to "pep up" the volume from a very faint fellow. The clearness obtained with this arrangement is pleasing indeed, and the volume also is quite a bit greater. The increase in receiving radius is the addition which will be of most value, and the ease of tuning and absence of hand capacity will make the set a joy to use.

Next month: How to reflex the set.

No S O S From NERK

By CARL H. BUTMAN

Although the 300-watt radio transmitter on the "Shenandoah" was disconnected and wet, when she tore loose from her mooring mast at Lakehurst recently Gunner J. T. Robinson, in charge of radio, had his set connected, dried and working within an hour and sent out a reassuring message to the naval air station.

While the "Shenandoah" was undergoing her mooring tests, her 300-foot aerial was also being tested for capacity, inductance and resistance, according to Gunner Robinson, who was abroad on the wild night trip. The radio apparatus was disconnected and replaced by testing instruments to ascertain the efficiency of the present aerial, in anticipation of installing the newly designed 1,000-mile set now building at the naval radio laboratory at Belleview, Md., Mr. Robinson explains.

When the former ZR-1's nosecap gave way, officers and men jumped to controls, engines and ballast releases, but Gunner Robinson, in his radio shack in the control car, sprang to his set. Tearing loose volt-meters, ammeters and other testing instruments, he began hooking up his transmitting and receiving sets, so as to establish communication with the home station. But he found his apparatus was wet from the driving rain and had to dry it all out before he could use his phones or key. In less than an hour he had his set working, but it was not an SOS that he sent, as most sea craft would have been forced to do under the circumstances—he ticked off a message that the "Shenandoah" was under control, which put at rest any fears the navy may have had and allayed alarm among the families of the officers and men.

Out of the silent darkness came a call for NERK, the "Shenandoah's" radio call. It was WOR, at Newark, giving him his first position report, verified later by Lakehurst. The navigators then knew where the gale was driving their ship.

"Communication was then good for the remainder of the trip," says Gunner Robinson. "We kept the base well informed and they gave us weather data," he adds, summing up his brief description of an unprecedented experience fraught with great danger.

It is evident that radio had considerable to do with the remarkable navigation of the aerial cruiser, in advising of her safety, and in bringing in reports from her base. The reports from NERK came through especially well, as the air had been cleared for this mobile station, which proved indeed mobile.

The old set, now almost historic, will soon be replaced with long distance and medium range transmitters, ultra modern receiving sets, and a radio compass for use in the Arctic explorations.

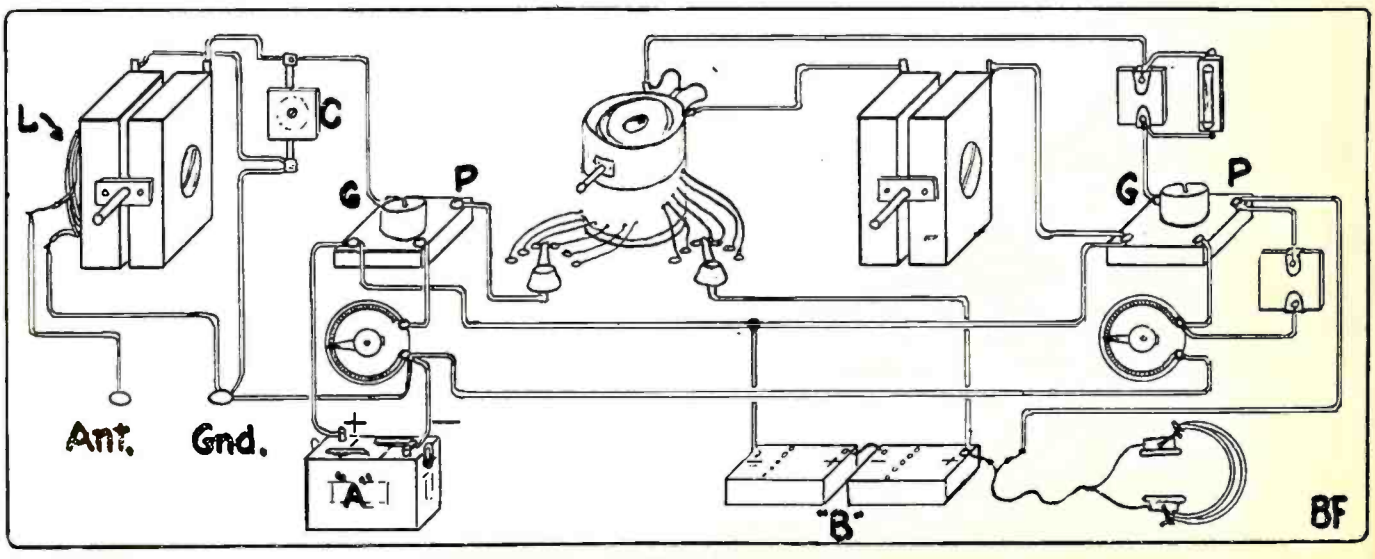


Figure 3

Whistling Interference—Causes and Effect

By JOHN V. L. HOGAN

In the ninth of his series through WEAF John V. L. Hogan, former president of the Institute of Radio Engineers and author of "The Outline of Radio," discussed "Whistling Interference—Its Causes and Cures." In the course of his remarks he said:

THERE are two kinds of whistling interference. Both are caused in the same general way. One kind sounds, in the telephones or loud speaker, like a high note of practically constant pitch and strength. It may quaver a little in pitch and may gradually increase or decrease in intensity or in pitch, but the sound is generally an almost uniform high note. If you listen to distant stations on the 833 kilocycle (360 meter) wave you have often heard such a uniform whistle in the background. Sometimes it is not strong enough to prevent fairly good reception, but whenever you can hear it you may expect the quality of music or speech to be partly or wholly spoiled by it.

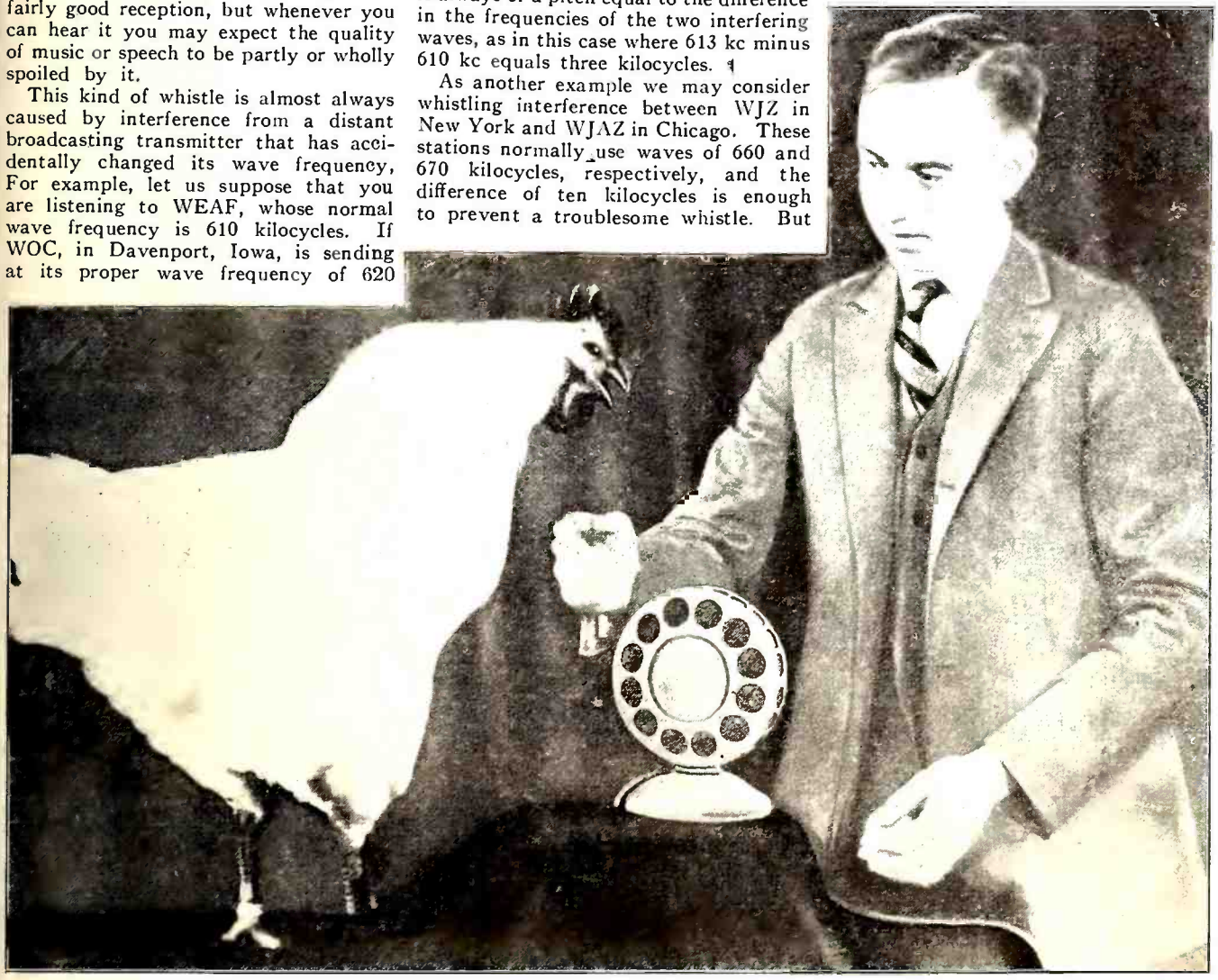
This kind of whistle is almost always caused by interference from a distant broadcasting transmitter that has accidentally changed its wave frequency, For example, let us suppose that you are listening to WEAF, whose normal wave frequency is 610 kilocycles. If WOC, in Davenport, Iowa, is sending at its proper wave frequency of 620 kilocycles it will not interfere. But if (as has happened once or twice) WOC's wave frequency should drop to say 613 kilocycles, there would be a whistle in the background of each station's programs. People living about half way between the two stations might hear cross-talk in addition to a very loud whistle, people who were too far from either one of the stations to hear its programs, but who could hear the other, would be troubled by the whistle.

Key of Whistle

If the waves of the two interfering stations are, as we have assumed, 610 and 613 kilocycles, the whistle that is heard whenever both waves are received has a pitch of three kilocycles or 3,000 cycles. This corresponds to the highest G on the piano keyboard. The whistle is always of a pitch equal to the difference in the frequencies of the two interfering waves, as in this case where 613 kc minus 610 kc equals three kilocycles.

As another example we may consider whistling interference between WJZ in New York and WJAZ in Chicago. These stations normally use waves of 660 and 670 kilocycles, respectively, and the difference of ten kilocycles is enough to prevent a troublesome whistle. But on some occasions either or both waves have slipped away from the normal frequency, if they became, for example, 662 and 664 kilocycles, the difference would be only two kilocycles or 2,000 cycles and the whistle would have the pitch of the third C above middle C on the piano.

Interference of this kind, where two inaudibly high frequency waves (such as radio waves of 610 and 613 kilocycles) interact to produce an audible frequency equal to their frequency-difference, is called beat or heterodyne interference. A quite similar effect is had in music, for if two sounds of almost equal pitch or frequency are played together, their waves will interact to produce pulsations or beats at a rate equal to the difference in their frequencies.



RADIO ANNOUNCER

"Billy," a prize white rooster owned by J. O. Maland of the Northwest Farmstead, is a "regular" radio broadcasting station announcer. Mr. Maland is in charge of the Northwest Farmstead's lecture hour program at WLAG, Twin City Radio control operated at St. Paul and Minneapolis by the Cutting & Washington Radio Corporation. A lusty crow from "Billy" into the microphone announces that the lecture hour is about to begin. He also signs off with another crow.

"Billy" receives letters from chickens all over the United States, and presents, consisting of corn, apples, pies, etc.

Listeners Should Act

Constant-pitch whistling interference caused by interfering broadcasting transmitters is becoming more and more scarce, for most of the stations are doing better in holding to their assigned wave frequencies. The only cure for it is to keep the stations adjusted to radiate their correct wave frequencies, and there is nothing that either you or I can do to stop such cases as do occur except to report them to the broadcasting station that is interfered with. If it were not for the fact that this interstation whistling is so much like the second kind of whistling interference, and so convenient for explaining it, I would not have been justified in giving it so much time.

I hope that the foregoing has made clear to you that whenever your receiver picks up two continuous radio waves whose frequencies are quite nearly alike, you will hear a whistling note whose pitch is equal to the difference in the radio wave frequencies.

This brings us to the second type of whistles, which are usually not uniform in pitch or intensity and which are not caused by interference between broadcast transmitters. These whistles change in pitch, either uniformly or in jumps and sometimes slowly and sometimes so rapidly that they sound like chirps. Sometimes they are faint in the background, sometimes so loud that they completely spoil reception from nearby stations.

If you have a simple regenerative receiver of any type, you have heard just such whistles as you turned the tuning knobs. When you have had your tickler coupling or your plate variometer too far up the scale, you have heard a loud whistle in your telephones or speaker and have probably noticed that you could control its pitch by turning your tuning dial.

I wonder how many of you realize that when you hear such a whistle in your own set, a whistle that drowns out the station you are listening to and whose pitch you can control on your own tuner, you are making the same kind of interference for all your radio neighbors.

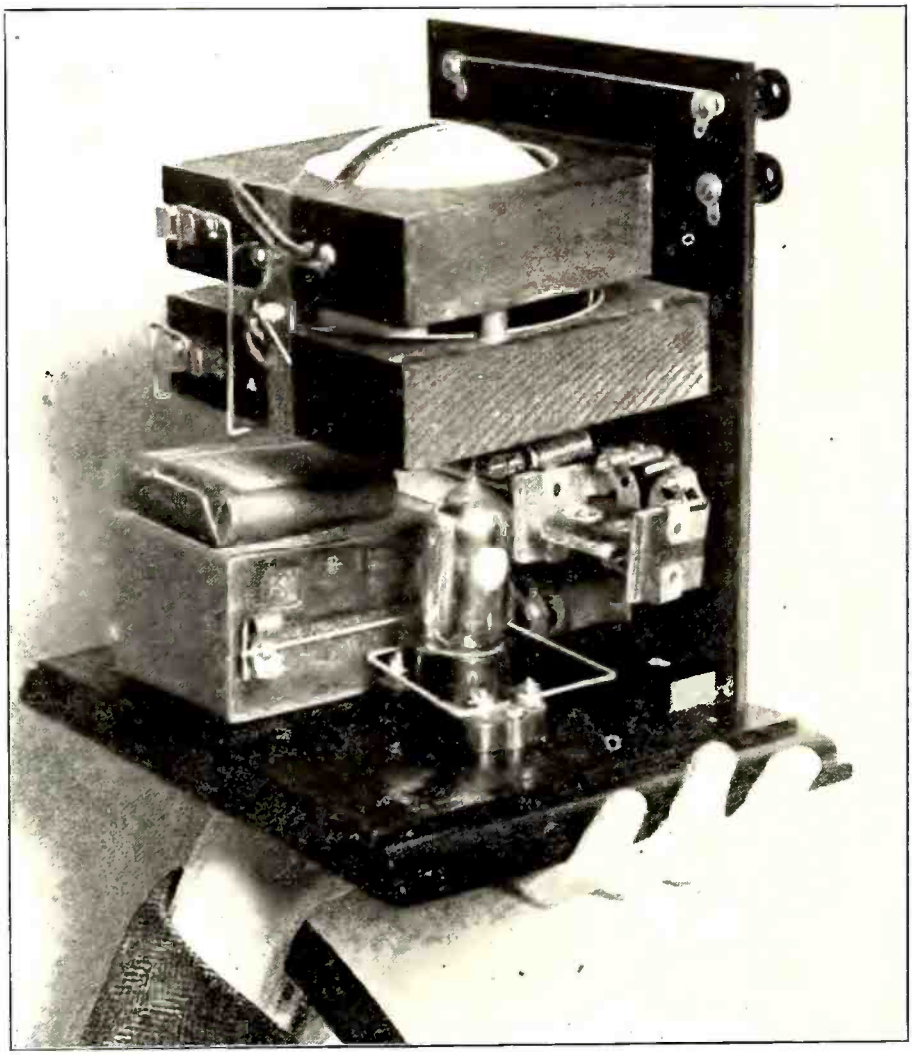
When your receiver whistles in this way, it is acting as a miniature transmitting station.

The whistle is the same kind of beat note that I have already explained, but its pitch usually varies because the waves sent out by the oscillating receiver change in frequency as tuner knobs are turned.

Your Neighbor

To stop a regenerative set from making such interference, you need only reduce the tickler or regenerative variometer dial setting until the receiver stops generating oscillations; you can tell that it has stopped interfering because you will no longer hear the loud whistle.

Whenever you hear a loud, varying whistle of this kind, a whistle whose pitch you can not control with your own tuner, you may be sure that it is caused by some radio neighbor.



MINIATURE RECEIVER

This interesting miniature radio set was built by Raymond Chassevent, a Bronx amateur. Using but one dry cell vacuum tube and a novel hook-up, it will receive when using a ground only, no aerial whatever being necessary. Chassevent uses a variometer and several fixed condensers, the fixed condensers taking the place of a variable condenser. Each condenser covers one broadcasting wavelength, and will bring that wavelength in with maximum efficiency. For instance, one condenser will respond to "WEAF" another to "WJZ" another to "WOR," etc. The various condensers are cut in and out by taps. It is entirely self-contained, dry cells only being used and is so small it can be carried about at will. Note method used for mounting condensers, allowing extra condensers to be added at will.

Standing by

Washington, D. C.—Captain Herbert G. Sparrow, USN, commander of the U. S. Cruiser, "Tacoma," and four radio men were the last to leave this vessel wrecked off Vera Cruz recently—and, at the end, four of them were dead and the other injured. Old naval traditions obtained, not alone through the action of the gallant skipper, but through the four radio men who stood by with him in an effort to keep radio communication open.

While the details of the accident which killed Captain Sparrow, Radio men Lusser, Herrick and Sivin, and injured Chief J. V. Cooper are not available, Admiral Eberle, chief of operations, says he believes all five men were in the radio shack trying to maintain radiophone communication with the U. S. Consulate on shore, which had been established the preceding day on batteries, as the dynamos were out of action. Then the hurricane struck the old cruiser, whose bow was on a reef, and threshed her unmercifully, washing her with terrific seas and pounding her to pieces.

Either a falling mast or an extremely heavy sea is believed by the admiral to have crushed in the radio shack, formerly the captain's emergency cabin, located on the main deck just below and aft of the bridge. The only dispatch bearing on the death of these four men states: "They all were killed on the main deck on January 21, struck by heavy wreckage and seas."

Naval officers picture the captain, who was an authority on electrical matters and a radio enthusiast, and the radio operators, as crowded around the ship's radio apparatus trying to send a last message to the Vera Cruz Consulate, when the crash came.

Investigations, scheduled as soon as the "Prometheus" reaches Charleston with the survivors, may reveal that the navy has developed a new type of hero—the radio man who remains aboard.

SIMPLEX REFLEX SET

By CARL MASSON

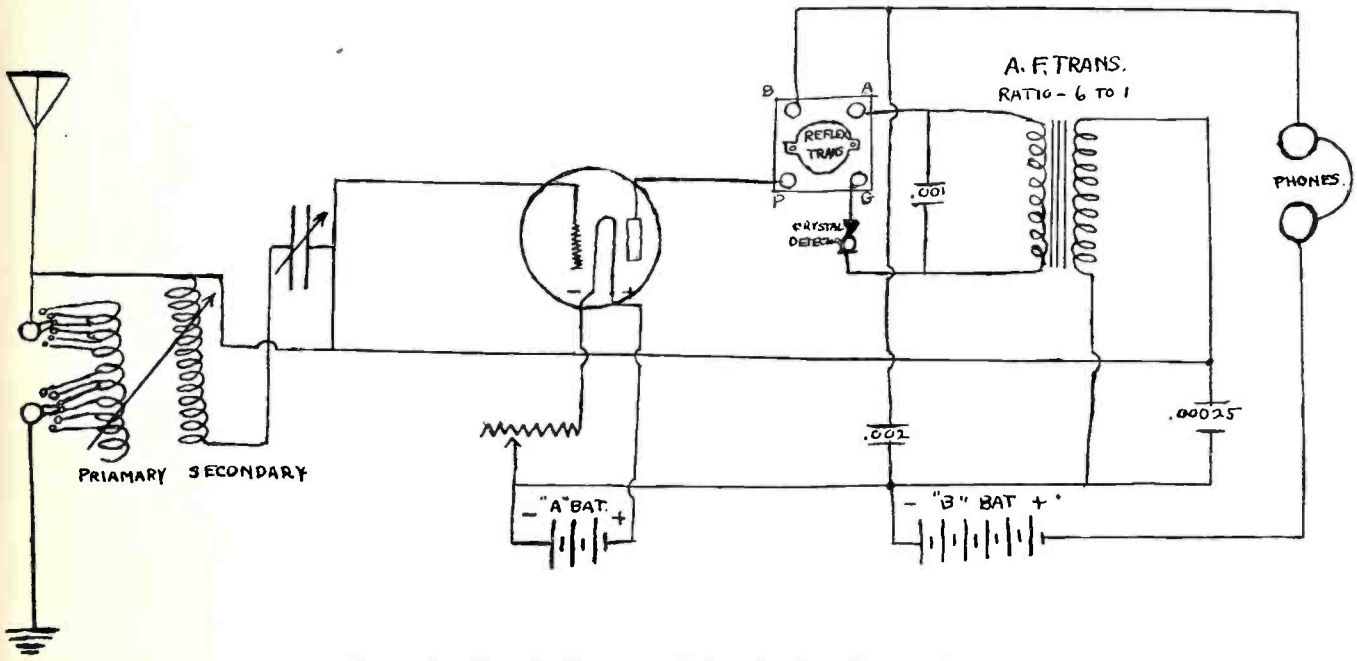


Figure 2—Circuit diagram of the simple reflex receiver.

In spite of the numerous hookups which constantly appear in publication, should we take a census of the various types of sets in use, I feel quite sure that the popularity of the Reflex would be quite evident.

The diagram in Figure 1 shows a one-tube reflex circuit of unusual efficiency in respect to both distance and volume. While this circuit is by no means new but because recently such unusually good results have been secured with it, I believe too little has been said about it.

The panel should measure 7 inches by 12 inches. The general layout is shown in the illustration herewith. Drilling dimensions are omitted, since they would vary according to the type of apparatus used. The variocoupler is mounted to the extreme left. About twelve taps are taken at various intervals and connected to two switches on the panel.

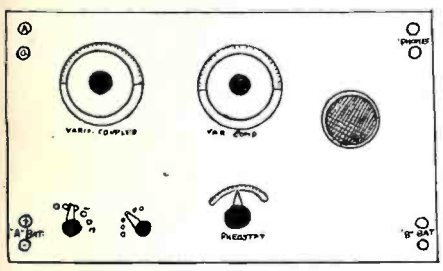


Figure 1—Panel layout of the simple reflex circuit.

The R. F. transformer is of the special type manufactured particularly for use in reflex circuits.

The A. F. transformer may be of any good make, but should have a ratio of six to one. A crystal detector of the fixed type would rid the operator of one more adjustment. The fixed condensers should be of the mica type, with capacities as shown in the circuit. Practically any tube may be used. Very good results have been secured using UV 199. The rheostat of course would depend upon the type of tube. A radio set is no better than its poorest part, therefore when you buy your parts let quality count.

Use bus bar in wiring the set, and if you would have the utmost efficiency, make all connections as short as possible, regardless of appearances from artistic viewpoints. Solder all connections, taking care that all excess flux is removed.

The tuning of this outfit is extremely sharp and selective, but the simple controls make operation quite easy. Judging from the results that users of this outfit report, it is no wonder that it has become so popular. The fact about this circuit, that one tube does triple duty, seems to violate the old adage: "You can't run the mill on the water that has passed."

Wireless Tales

One would scarcely think the sweet song of a canary would in any way affect the prolongation of the incarceration of three of Uncle Sam's sailors in a Japanese prison, but so the tale of an ex-navy operator goes. Three firemen from the good ship, "Orion," got themselves in wrong with the Nagasaki authorities and were detained ashore, although their ship was sailing. Upon the request of his captain, the Orion operator called the flagship to ask that steps be taken to secure the firemen's release and return to the States.

Sparks got his message off, despite the fact that a canary he was bringing home, sang in harmony with the ship's radio wave note. As soon as the operator started to listen in for his O. K. the bird redoubled its efforts in a key which interfered so seriously with the reception of the flagship's answer that it made it impossible to get the message. Spark's couldn't leave his key to put the bird out of the shack, so he threw spare parts and tools in its general direction, without effect. Again he called the flagship; again the dickey bird, now exceedingly unpopular with its temporary owner, began its lusty song. As the ship steamed out to sea, the operator gave up in despair; he couldn't get his answer through the canary's QRM. It developed later that Orion's message was not received correctly, and the unlucky firemen were held in the Japanese "brig," several months, all because of the canary's sweet obligato. The bird finished the voyage in a stateroom, but when delivered to its ultimate owner ashore, although unharmed, it refused to sing again.

United States Accuses Radio Trust

MONOPOLY in the radio apparatus and communication, both domestic and transoceanic, is charged in a complaint issued by the Federal Trade Commission. Efforts to perpetuate the present control beyond the life of existing patents, is likewise charged.

Radio Corporation of America; General Electric Company; American Telephone & Telegraph Company; Western Electric Company, Inc.; Westinghouse Electric & Manufacturing Company; The International Radio Telegraph Company; United Fruit Company; and Wireless Specialty Apparatus Company, are named as respondents and are alleged to have violated the law against unfair competition in trade to the prejudice of the public.

In the language of the complaint "the respondents have combined and conspired for the purpose and with the effect of restraining competition and creating a monopoly in the manufacture, purchase and sale in interstate commerce, of radio devices and apparatus, and other electrical devices and apparatus, and in domestic and transoceanic radio communication and broadcasting."

To attain the present control alleged, the complaint recites that the respondents: (1) acquired collectively, patents covering all devices used in all branches of the art of radio, and pooled these rights to manufacture, use and sell radio devices, and then allotted certain of the rights exclusively to certain respondents; (2) granted to the Radio Corporation of America, the exclusive right to sell the devices controlled and required the Radio Corporation to restrict its purchases to certain respondents; (3) restricted the competition of certain respondents in the fields occupied by other respondents; (4) attempted to restrict the use of apparatus in the radio art manufactured and sold under patents controlled by the respondents; (5) acquired existing essential equipment for transoceanic communication and refused to supply to others necessary equipment for such communication; and also excluding others from the transoceanic field by perferential contracts.

2,000 Patents Involved

From the series of contracts referred to in the complaint it appears that the Radio Corporation of America has the right to use and sell under patents of the various respondents which relate to the radio art. It has also given to various respondents the right to manufacture under these patents. Thus there has been combined in the hands of these corporations patents covering the vital improvements in the vacuum tube used in long distance communications and other important patents or inventions in radio which supplement this central device. Approximately 2,000 patents are involved.

The report of the federal trade commission on the radio industry states that the gross income of the Radio corporation in 1922 was $14,830,856 and that its capital stock on Dec. 31, 1922, was $33,440,033. The holdings of the several respondents in the Radio Corporation of America are given as follows: General Electric company, 620,800 preferred, 1,876,000 common; Westinghouse Electric and Manufacturing Company, 1,000,000 preferred, 1,000,000 common; American Telephone and Telegraph company, 400,000 preferred, no common; United Fruit company, 200,000 preferred, 160,000 common.

It is further stated that up until 1922, the Radio Corporation had an absolute monopoly in the manufacture of vacuum tubes and for the first nine months of 1923 sold 5,509,487 tubes. During the same period the only other concern having the right to make and sell tubes, sold 94,100 tubes.

In the communication field, while the Radio Corporation has some competition in ship-to-shore communication, it has a practical monopoly in transoceanic service. It controls all the high power stations in this country except those owned by the United States government. Agreements of an exclusive character have been entered into with the following countries or with other concerns in control of the situation in those countries, namely, Norway, Germany, France, Poland Sweden, Netherlands, South America, Japan and China. Arrangements have also been made with the land telegraph companies in this country whereby messages will be received at the offices of the Western Union and Postal Telegraph companies.

WILSON FUNERAL

When former President Woodrow Wilson's funeral service was held in Mt. Alban's Cathedral, Washington, D. C., radio transmitted the sermon to the whole country. Photo shows the microphone on the pulpit.

The Contracts

A summary of the contracts between the respondents as recited in the complaint is: First, the organization of the Radio Corporation of America in 1919, under the supervision of the General Electric Company, which company received large holdings in the stock of the Radio Corporation for capital supplied and for its service in connection with the acquisition of the American Marconi Company. An agreement entered into between these companies granted to the Radio Corporation an exclusive license to use and sell apparatus under patents of the General Electric Company until 1945; and the Radio Corporation granted to the General Electric Company the exclusive right to sell through the Radio Corporation of America only, the corporation agreeing to purchase from the General Electric Company all radio devices which the General Electric Company could supply. Subsequently this arrangement was extended to include the Westinghouse Electric & Manufacturing Company, the business of the Radio Corporation being apportioned between the General Electric Company and the Westinghouse Company; sixty per cent to the General Electric and forty per cent to the Westinghouse Company.

Meanwhile in July, 1920, the General Electric Company, and the American Telephone and Telegraph Company, made an arrangement for mutual licensing on radio patents owned by each and providing for traffic relations. The terms of this agreement were extended to the Radio Corporation of America and the Western Electric Company and thereafter to the Westinghouse Company.

The Radio Corporation in March, 1921, made an agreement with the United Fruit Company, which operated a number of long distance radio stations in Central and South America by which licenses under radio patents of the Radio Corporation and of the United Fruit Company and its subsidiary the Wireless Specialty Apparatus Company, were exchanged, and arrangements made for the exchange of traffic facilities, and the definition of their respective fields adopted between the Radio Corporation and the United Fruit Company. Provisions of the agreements between the Radio Corporation of America, the General Electric Company, the American Telephone and Telegraph Company and the Western Electric Company were extended to the United Fruit Company.

Pick-ups and Hook-ups by our Readers

SOME time ago I made it a point to call upon the Editor of RADIO AGE, with the object of finding out how much space he was going to allot for the Pickups by Readers Department, in this issue of RADIO AGE.

Upon entering the Editor's office I was told to take a chair and to wait patiently for a few moments inasmuch as the Editor was rather busy, but would see me shortly.

"He's probably pondering over some deep and important editorial problem or advertising policy," I mused as I took a chair, depositing a stack of Dial Twister letters on a nearby table. "I suppose it takes much thought and deliberation to decide just what department to emphasize to make a first class radio book such as RADIO AGE is."

After a short wait, I was told to step into the Editor's den and I'll bet you can't guess what the Editor was pondering over!

He had a February RADIO AGE opened to the page which had a heading over it, "Pickups by Readers," and was comparing the list of stations heard on his receiver with one of the letters and lists submitted by a Dial Twister!

"You know," he said, "I've got one of the best types of receivers on the market. I've got all the batteries and accessories pepped up to the nth degree. I've sat up until the wee hours of the morning, until I've gotten a taste in my mouth like a blacksmith's apron; but I'll be hanged if I can beat that record submitted by one of these Dumbell Twisters or whatever you call them!"

"Ha!" I laughed, "You're only one of the many, many fellows who are doing the same thing, trying to beat a record or list of some Dial Twister." And feeling sure that he would kick the Pickups by Readers section out of his magazine forever because he couldn't beat one particular Dial Twister record, I added, "Do you think that you can use about a page and one-half of these (dashing down a pile of Dial Twister letters on his desk) in the March issue?"

"For the love of barb-wire antennas and oscillating circuit receivers—are all those letters from Pickup fans?" he asked.

"That's what they are nothin' but," I answered quickly.

The Editor pondered deeply for a few moments, puffing vigorously on a black cigar, and then turning back to his record comparing in the Pickups section of the preceding RADIO AGE he muttered:

"Ummmm! If the fans like 'em as well as I do, they must get a pretty big kick out of them!"

And looking up he decided:

"Let 'em run freely. Understand? If you've got enough of them let 'em run freely. And by the way, when you've finished compiling them and got them in copy form, I want to be the first one to read that copy—I get just as big a kick out of them as a nigger does reading ghost stories ten minutes before bedtime. Don't slam the door as you go out."

And so I'm letting 'em run freely, to the extent of a couple of pages or so.

THE PICKUPS EDITOR.

DIAL TWISTERS

Name	Address	Circuit
John Sabiston, Jr.	Bay Shore, L. I., N. Y.	Atwater-Kent
Curtis Springer	1224 N. Olney St.	Single Circuit
Kenneth Fischer	1219 N. Olney St.	Single Circuit
Both of the above TWISTERS live in Indianapolis, Ind.		
Russel R. Thomas	227 Laurier Av., W., Ottawa, Ontario, Can.	Haynes
Frank P. Oberst	Racine, Wisconsin	Single Circuit
Richard Jones	300 N. Warner Av., Bay City, Mich., Corrected from last month	
George S. Everhart	4214 Ruckle St., Indianapolis, Ind.	Eliminator
Charles E. Rogers	4409 N. Lincoln St., Chicago, Ill.	Eliminator
H. S. Frederickson	406 Howard St., Charles City, Ia.	Ultra-Audion
Joe Hafert	1323 Woodbine Pl., Ft. Wayne, Ind.	Reinartz
Wilson B. Lemberger	2037 Osborn St., Burlington, Ia.	Zenith
H. A. Englebaugh	1328 Winona St., Chicago, Ill.	Eliminator Crystal
G. S. Baird	32 Maltbie Av., Sheffern, N. Y.	Erla-Tripiex
Frank W. Smith	2306 Edward St., St. Joseph, Mo.	Reinartz
Max M. Barnhi er	Mt. Morris, Ill.	First Tube
H. J. Boyenga	Greene, Ia.	Reinartz
J. H. Jones	Crestwood, Ky.	Cockaday
Francis Tye	607 N. 8th Av., Maywood, Ill.	Rosenbloom
A. W. North	61 N. Lincoln Av., Fond du Lac, Wis.	First Tube

John Sabiston, Jr., of Bay Shore, Long Island, wants to start out this month by hanging a bakelite crepe on the lists of Curtis Springer, Kenneth Fischer and his neighbor John Bennett of Rockville Centre, Long Island, N. Y., and submits the following to substantiate his claim:

RADIO AGE,

Gentlemen:

I am a regular subscriber to your magazine, and I take great pleasure in reading the Pickup Page. I notice the excellent pickups of Curtis Springer, Kenneth Fischer and my close neighbor John Bennett of Rockville Centre, and want to say that while I think their records are good, I feel that I have a list that will equal if not surpass them all.

I have an Atwater-Kent three tube set that I wouldn't sell for all the sets on the market. Getting down to business, here is my list of stations heard from January first to February ninth, practically all of them on a loudspeaker. As one would say when playing dice: "Read them and weep!"

KDKA, KFKX, KOB, KOP, KSD, KYW, PWX, WAAF, WAAW, WBAH, WBAP, WBT, WBS, WBAU, WBZ, WCAE, WCAP, WCBD, WCX, WDAR, WDAF, WDAP, WDAY, WDT, WEAF, WEAN, WFAA, WFAY, WFI, WGI, WGR, WGY, WHAM, WHAS, WHAZ, WHB, WHN, WIP, WJAR, WJAX, WJAZ, WJZ, WJY, WKAQ, WLAG, WLW, WMAF, WMAQ, WNAC, WOS, WOAW, WOC, WOO, WOR, WPAB, WPAH, WRC, WSAD, WSB, WTAS, WTAM, WSAI, WWJ, WQAM, WCAD, WMAK, WCAL, WSY, WIAD, WFAB, WCE, WHAA, NPG, NRE, CFCA, KGO, WMC, WBL, 6KW, WHK, KFAF, CKCK, CKAC, CHCB, CHYC, CFCF, CJCN.

Besides this I got a complete test from station 9BM of Canada, on the night of January 8, from 12:15 to 1:36 a. m. On this test they broadcast on the following wave lengths: 400, 300, 350, 450 500,550, 341, and I was waiting for them every time they came on. What do you consider this?

I am a great radio bug, and I would sit up till five a. m. if they broadcast that long.

I trust that you will give my record due consideration, and hope expectantly to see my name on the Dial Twisters list for next month. What say?

Very sincerely yours,

JOHN SABISTON, JR.

Bay Shore, Long Island, N. Y.

All we've got to say is—wait till the Editor reads that one! That's what we would call a record for consistent work, Johnny, and you've certainly made the DT list.

However, judging from the appearances of this correspondence you'll have one extra bakelite crepe to hang on

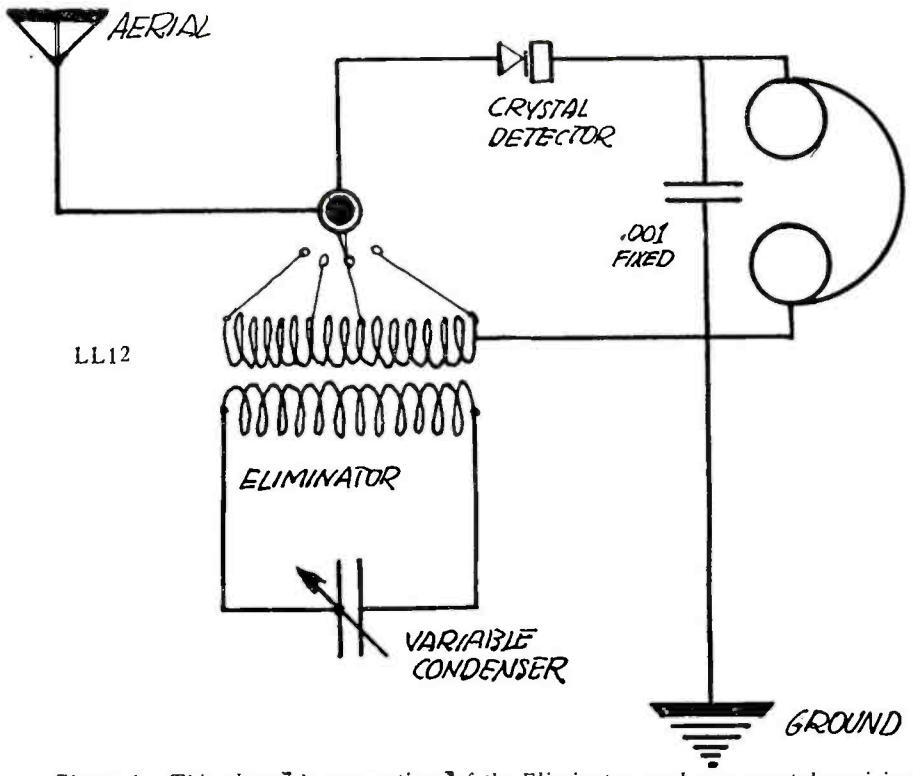


Figure 1. This shows the connections of the Eliminator used as a crystal receiving set tuner, with which Mr. Englebaugh claims such unusual results. L1 is the primary of the Eliminator, and consists of from 8 to 12 turns of No. 24 or 26 DCC wire; L2 is the secondary, consisting of about 42 turns of the same size wire, which is shunted by a condenser of either 23 or 42 plates. The size of wire is not important. The primary is wound directly over the secondary, being separated by a layer of empire cloth or writing paper. Full details of the original Eliminator were published in the January, 1924, issue.

your own record, because, because—well just read this:

RADIO AGE,
Gentlemen:

We are very much interested in your Pickups Page, and have a record which we think will put us nearer the top in the DT list.

On Saturday night (our friends don't state what Saturday) using a three tube single circuit set, we made a little record for a single night. Fifty-eight all told! The list is: WHAS, WSB, KDKA, BI6, BI4, WJAK, 9ESI, WBZ, WCAE, WDAP, WDAF, WWJ, 9WE, 9VC, WJAR, WGY, WPAB, WEAF, WCK, WLAX, WCBD, WOS, WTAQ, WOC, WRC, WHN, KFSB, WDI, WGR, WMC, KSD, KYW, WOAW, WDAR, WBAV, KFKB, WSAH, WJAZ, WBAP, KHJ, 5ST, WTAS, KFKX, 1XU, WLAG WIAI, 9XAT, WHAA, KFAE, 9QI, KFSG, KFI, 5ZG, 9ANY, KGW, WAAW WTAM and also Kalia, Cuba.

The Cuban station said they had no call letters yet. They broadcast on 360 meters.

Since December twenty-seventh 1923 to February eighth, 1924, we have heard all told *two hundred four* different stations, most of the time only using two tubes. Try to beat that!

(Here is where the joke comes in—read the names carefully, and then laugh! —[The Editor.)

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

Mr. Sabiston—If you'll take our advice, don't try to beat that. These kids get the wooden ohm-saw for the month. Your letter came just in time DT's and what a timely defense you present yourselves with!

Now we are all, without doubt, interested in that Haynes circuit published in the December, 1923, issue of RADIO AGE, and we have a lot of letters of fans who want addresses of other DT's that are getting results so that they can compare records. Here's a letter that puts the Haynes on the Dial Twister's list:

RADIO AGE,
Gentlemen:

I am writing to let you know of the success I have had with your Haynes DX hookup as published in the December, 1923, issue of RADIO AGE. With detector and one stage of audio frequency amplification with a Canadian tube as a detector and a WD 12 as amplifier, I have heard as many as thirty-two stations in a single night on a loud speaker unit consisting of a Baldwin type C phone with a table talker, which by the way is home-made.

Most of these stations are around the 1000 mile mark. Last Thursday night (January 31) I picked up WKAQ, San Juan, P. R. on the loud speaker and held him for three quarters of an hour! Tonight (February 7) I went after him again and got him right off the bat on the same place on the dials. I have a list here that says that WKAQ is silent on Thursday nights, but that can't be so, as several of my friends with larger sets picked him up also.

I log all my stations and never find them to vary over five degrees of the vernier. I intend to add two more stages of audio, and if the police allow me I will be tuned in every night. And as Jack Nelson of Willy Dapp (WDAP) says, "That's that!" Very truly yours,

RUSSELL R. THOMAS.

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227 Laurier Avenue West,
Ottawa, Ontario, Canada.

Mr. Thomas wants to know if two stages of radio frequency can be added to the Haynes, and wants to know if we have a diagram. Frankly we tell you that as yet we have no diagram that has been actually tested out to give results, but feel quite sure that it could be added to the Haynes much in the same way as to the Reinartz, with the exception that the tickler coil would probably have to be changed a little. Are there any experimenters who can help him out? We would suggest that you add the push-pull amplifier as described in January instead of the radio frequency as you will then be blessed with greater volume and still retain the benefits of a straight regenerative circuit. To tell the truth, we are not inclined to recommend radio frequency with highly regenerative circuits due to the fact that it is quite a problem for the average dial twister to engineer his set to get the best results. And if you don't use radio frequency in the right way, you wont get much satisfaction.

And as the barber says, "Next!"

RADIO AGE,
Gentlemen:

After reading some of the letters of the February Pickups Page, I decided to write and let you know what my single tube single circuit set is doing.

On a good night I have no trouble tuning in from thirty to forty stations and hear them with surprising volume and clearness. Among those I have heard are KHJ, KPO, KFDL, WFAA, WDAT, WDAJ, WJAR, CKAC, WEAF, WIP, WSB, KDKA, WSY, WCAP, WOR, WMC, KSD, WCAE, WHAS, WHAM, WHN, KFKX, WOAW, WWJ, KOP, WBZ and others.

On December twenty-eighth I tuned in forty-eight stations and all together I have heard 111 different stations. I am using a WD 12 tube on my set.

To RADIO AGE, "The Magazine of the Minute" (not hour) I wish good luck.

Very truly yours,
FRANK P. OBERST,
Racine, Wisconsin.

We note, Frank, that you are only using one tube, and are pleased to say that you have results almost equal to the record established by Ken Fischer and Curt Springer in this issue, who, while they have a hot record, honestly state that they use two and three tubes. There is one thing sure and that is, Mr. Sabiston can't nail that bakelite crepe on your record. HI!

By the way, fellows, I suppose many of you had orders in for the RADIO AGE ANNUAL that big fat book full of the latest dope and circuits and had to

wait quite a while before your orders were shipped. We wonder if you felt this way about it:

RADIO AGE,
Gentlemen:

I received your card acknowledging my dollar saying that the book would be sent me as soon as it came off the press! For the LUVAMIKE has the press busted? When do you think I wanted to build the set? I'd like to have it before I die of old age.

Let me hear from you soon—don't keep me in this awful suspense.

Respectfully,
L. A. CASS,
6446 Ellis Ave., Chicago, Ill.

Mr. Cass has no doubt built his set by now and is enjoying the comprehensive contents of the Annual, but that doesn't stop us from making the remark that Dial Twisters are probably the most impatient people in the world. As the indulgent mother said to her son, who was crying because the theatre he had just been rescued from caught fire, just as the play in progress was nearing the climax: "Patience, Alfonso, patience! They will resume the play as soon as the theatre is rebuilt!"

And seeing that we are inclined to print a few kicks this month, we also print this one:

RADIO AGE,
Gentlemen:

My list appeared in your February number but due to some error on your part my name on the Dial Twisters list was followed by "Milwaukee, Wisconsin." I wish to thank you for placing me on the list and also ask you if you will please correct this error.

Since writing you I have added many stations to my list and want to add the following over 1000 miles: WNAD, KGW, KLX, WDAH, the first being 1000 miles away, the second 2100, the third 2300 and the last only 1700!

Please do not think me a "limelight bug" but I would like to see a record held by anyone on a single tube set that beats mine. If you can find just a little corner in your excellent department will you please give my correct address and state that I will gladly give all data and hookup of my set to anyone writing me. I would like to see everyone in the U. S. A. get just as good results as I am on my set. And everyone can, too.

I think that your Dial Twisters' idea is a splendid one; it makes you feel pretty good to see your name on a list like that after working into the small hours of the morning to get up a list. I am not able to decide an appropriate compliment for RADIO AGE.

Thanking you for publishing my list, I am, Yours very truly,
RICHARD JONES.

P. S. After writing this I read the lists by the youngsters in their "teens." Well, as far as that goes I'm only seventeen but like everyone else (although they don't like to admit it) I enjoy the bedtime stories too, especially if they come from a station two or three thousand miles from here.

And now Mr. Printer, please put this address in italics. If we know what's what, Mr. Jones is going to be swamped with letters because I have already had a number of requests for his address: *Richard Jones, 300 North Warner Avenue, Bay City, Michigan.*

Also, Dick, RADIO AGE lives at 500 North Dearborn St., Chicago, Ill., and not at Mount Morris, Ill. Mount Morris is only the place where RADIO AGE is printed. (That last remark has all the earmarks of a comeback, eh, wot?)

Due to the fact that "Variety is the spice of life," we won't let this whole department be filled with kicks, so we're going to print a couple of renditions entitled, "Of all my wife's relations, I love myself the best."

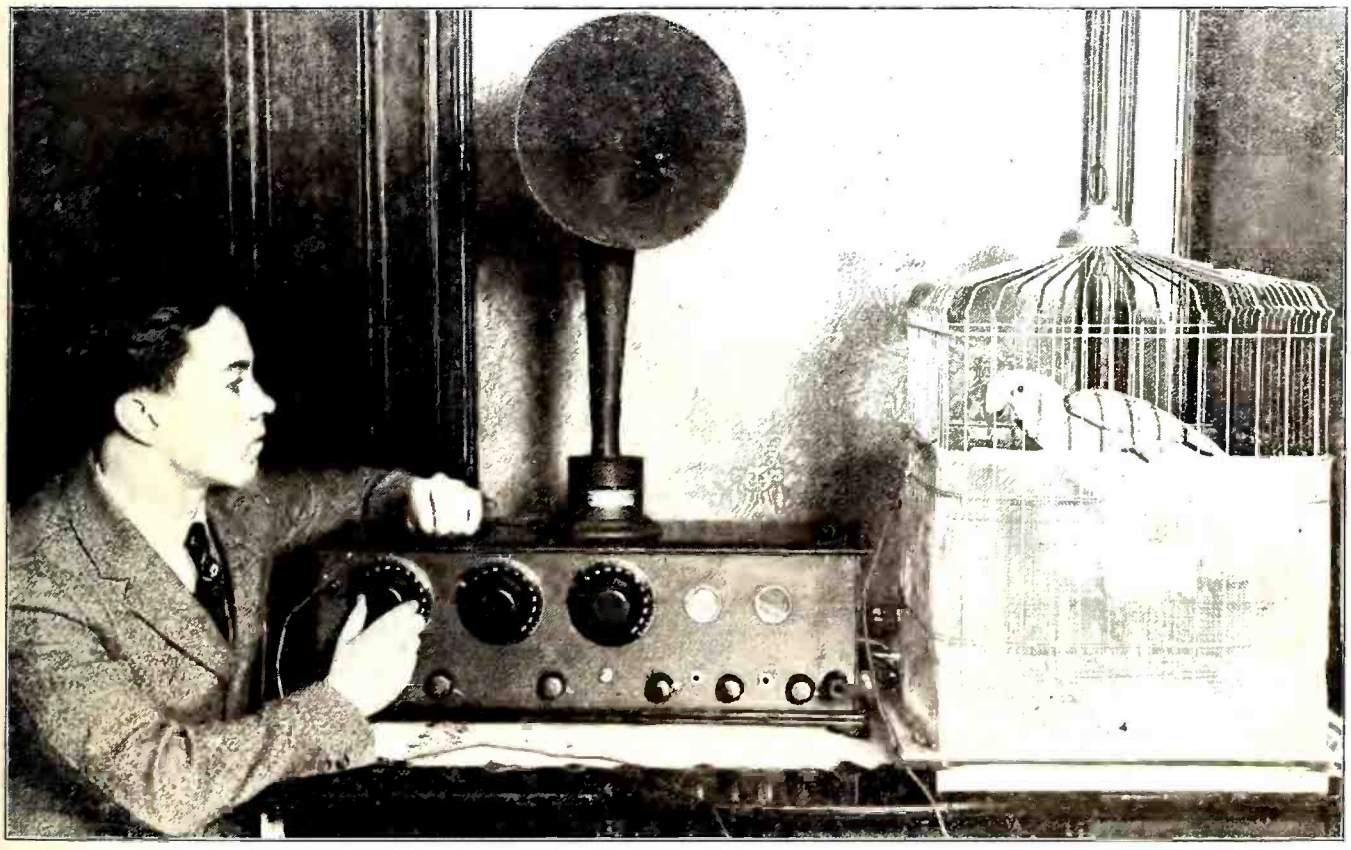
RADIO AGE,
Gentlemen:

Tried out your eliminator as described in January, 1924, of RADIO AGE. It works fine. It certainly is an aid in tuning. Tell the fellows that they might get better results by winding it with number 18 SCC wire.

Last night my variocoupler went on the bum. I disconnected the coupler and used the eliminator as a fixed tuner, the 8 turns as primary and the 40 turns as secondary. It worked better than any coupler I have ever used. IT BROUGHT IN KHJ ON THE LOUD SPEAKER!

Yours truly,
GEORGE S. EVERHART.
4214 Ruckle St., Indianapolis, Ind.

This is RADIO AGE broadcasting;



A CAGE ANTENNA

A new type of radio enthusiast has made his appearance in Robert McAffee's home on West End Ave., N. Y. He is none other than the family's pet parrot, "Jake." He is so interested in radio that he calls out all local and distant stations by heart. He is also so familiar with the voices of the various radio announcers that he is constantly imitating them. He wants to do his part so he permits his cage to be used as an aerial.

stand by one moment. Our next number will be a barber-shop rendition of the parody on "You Can Take Me Away from Dixie," etc., entitled "I can tune out stations in Chicago, For interference I don't give a rap. 'Cause in series with my antenna, I've got a RADIO AGE WAVE TRAP," sung by Chas. E. Rogers, accompanied by the Pickups Editor on a squealing, howling, oscillating and yowling ten tube neutrodyne. Let's go!

RADIO AGE,
Gentlemen:

Broadcasting advertising pays. Had it not been for WJAZ the Edgewater Beach Station announcing one Sunday night that your RADIO AGE contained some very interesting hookups along the wave trap line for eliminating stations not desired, I would not have thought of buying one of your magazines; but upon hearing this in the air, I at once went to three or four stores to purchase one; and you can rest assured that I will not miss a single copy from now on, as your book is without question the best of its kind on the market to-day as far as radio is concerned; and as soon as some of my subscriptions are up on some of the other magazines I intend to be a yearly subscriber for yours.

I constructed the wave trap on page 5 of your January issue and tried it out last night while the opera was on from KYW and WDAP, the Board of Trade Station and the Daily News WMAQ, and must compliment you on your information. Between the hours of 7:30 p. m. and 10 p. m. this wave trap cut out the Chicago stations and I was able to pick up WHAS, Louisville, Ky.; WTAS, Elgin, Ill.; WGY, Schenectady, New York; WHB, Kansas City, Mo.; KDKA, East Pittsburgh, Pa.; WDAF, Kansas City, Mo.; KSD, St. Louis, Mo.; WOR, Newark, New Jersey; WJAX, Cleveland, Ohio, and WEAF, New York City, New York. I think this is a very good record for a one tube set with the assistance of your wavetrap. I intend to construct the last-mentioned trap and see if that will render me any better service than the first-mentioned one, although I am more than pleased with the results, and want to thank you for being able to receive such good and valuable information for such a small cost as twenty-five cents, the price of your magazine.

Yours truly,
CHARLES E. ROGERS,
4409 N. Lincoln St., Chicago, Ill.

Knowing how hard it is to tune out Chicago stations when trying to get a DX program, we are putting Mr. Rogers name on the DT list, as it is a real accomplishment. Maybe not from a standpoint of distance or consistent work but for doing something that was formerly claimed that only a superheterodyne with a special oscillator could do. Good work, Mr. Rogers.

At last we have a fellow who has apparently got a list that compares with Ken Fischer and Curt Springer's records, in respect to the number of stations heard. He only misses their single night record by eight stations, but beats their aggregate number by a considerable figure.

RADIO AGE,
Gentlemen:

I am a constant reader of RADIO AGE and so I'm naturally interested in the Pickups Department.

I have noticed for some time, the records of BCL's from all over the country, but as yet I've seen nothing that beats mine! Therefore I think I'll "tell the world" about my record. Beat it if you can!

I have a home-made detector, and two step using the ultra Audion hookup. My antenna is a plain single wire about 90 feet long, strung between two trees.

My total number of stations to date is 251, with an aggregate Mileage (i. e. from my set to each station) of 169,111 miles. This includes stations from Canada, Mexico, Cuba, and Porto Rico.

Last night, January 25, I played a game of radio golf, or in other words, I tried to see how many different stations I could get in one evening. I put on the Baldwins at just 6:45, and when I quit at 10:45, I had a list of 50 different stations that I had heard during that four hour period.

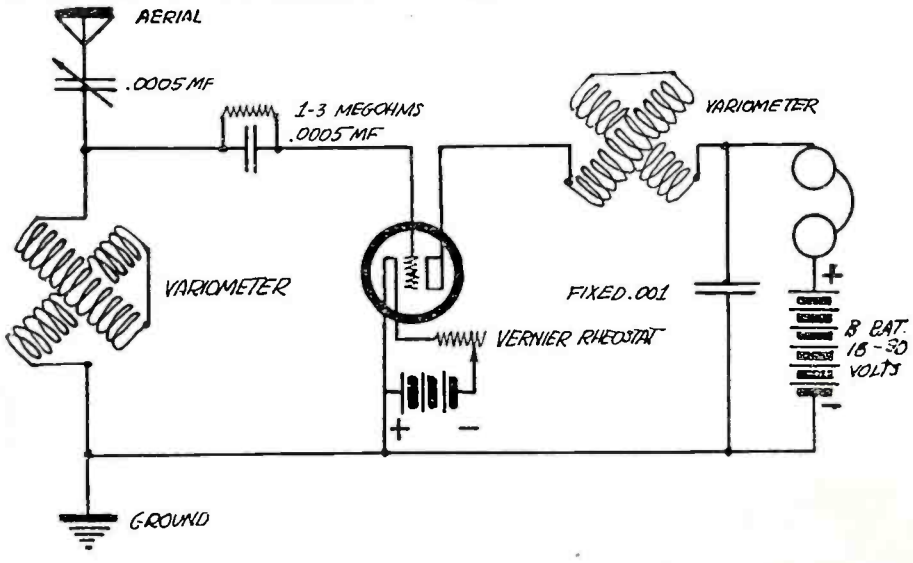


Figure 2. A simple single circuit regenerative set, with which one of the DT's gets such good results. Fellows having trouble with the Rosenbloom might give this one a twirl.

Here is the list. If any one doubts it, I have the exact time of hearing each station, to prove it:

*1 WAAN, Columbia, Mo.
*2 WJAK, Greentown, Ind.
3 WGY, Schenectady, N. Y.
4 KDKA, Pittsburgh, Penn.
5 WDAP, Chicago, Ill.
6 WHAS, Louisville, Ky.
7 WCK, St. Louis, Mo.
8 KFKB, Milford, Kans.
9 WHB, Kansas City, Mo.
10 WOAW, Omaha, Neb.
11 WMAQ, Chicago, Ill.
12 KYW, Chicago, Ill.
13 WCAE, Pittsburgh, Pa.
14 WBAP, Ft. Worth, Tex.
15 WRC, Washington, D. C.
16 WHA, Madison, Wis.
17 WSB, Atlanta, Ga.
18 WOC, Davenport, Iowa.
19 WMC, Memphis, Tenn.
20 WEAF, New York City.
21 WLAG, Minneapolis, Minn.
22 WJAR, Providence, R. I.
23 WBAV, Columbus, Ohio.
24 WJAD, Waco, Texas.
25 WCAL, Northfield, Minn.
26 KLZ, Denver, Col.
27 WTAS, Elgin, Ill.
28 WCBD, Zion, Ill.
*29 CHYC, Montreal, Canada.
30 WDAR, Philadelphia, Pa.
31 WOS, Jefferson City, Mo.
32 KHJ, Los Angeles, Calif.
33 WJY, New York City.
34 WDAF, Kansas City, Mo.
35 CKAC, Calgary, Canada.
36 CKCK, Regina, Canada.
37 WFAA, Dallas, Tex.
38 WOO, Philadelphia, Pa.
39 WJZ, New York City.
40 KFAF, Denver, Colo.
41 KFAE, Pullman, Wash.
42 WNAD, Norman, Okla.
43 KFDY, Brookings, S. D.
*44 KQV, Pittsburgh, Pa.
45 WJAZ, Chicago, Ill.
46 KFI, Los Angeles, Calif.
47 KFEL, Denver, Colo.
48 WJAQ, Topeka, Kan.
49 KGW, Portland, Oregon.
*50 *CYL, Mexico City, Mexico.*

(The star means new station.)

Well—can any one beat it? If they can let's hear 'em broadcast.

Yours very truly,
H. S. FREDERICKSON,
406 Howard Street,
Charles City, Iowa.

The editor will wear warts on his fingers when he tries to beat that one. In the meantime, Mr. Sabiston still has an extra bakelite crepe that he is trying to get rid of at 66 3-4 per cent off. HI!

And here's a fellow who gallantly defends the Reinartz!

RADIO AGE,
Gentlemen:

I have not heard much from Reinartz owners, therefore I am sending in my list of stations for the month of January. I put my set together December 31, set it up on January 1, and the stations I have received since then are as follows: KDKA, WGY, WOC, WFAA, WLW, WHAS, WGR, WCAD, KFKX, WJAX, WMAK, WTAS, WDAP, WHD, WOS,

WLAG, WLAX, WSAI, WDAF, KYW, WBZ, WHAZ, WPAM, WCAL, KLZ, WMC, WSB, WNAD, WJAZ, WCK, WWJ, WRW, CFCA, WOAW, WBAP, WTAM, WOAI, WCAM, WCBD, WOR, WPQB, WBBD, WEAM, WMAQ, WJAD, KFKB, 9AMJ, 9AFY, 9ALW, 9AFA. The last four are amateur radio telephone stations.

I think my little one-tube Reinartz makes a close stab for the record this month. All fifty of the stations came in very clearly. Would like to hear from some of the other Reinartz bugs. Write.

Respectfully,
JOE HAFERT.

1323 Woodbine Place, Fort Wayne, Ind.

By golly, if you could catch fifty stations in the first month you had your set up, you are a pretty apt learner in the matter of learning to tune, and we are putting your name on the DT list. Usually it takes about a month or two before a fellow learns to get his first DX station.

And here's another fellow who makes the grade of Dial Twister because his work for one evening is commendable.

RADIO AGE,
Gentlemen:

I am submitting the following list of stations as logged by me on November 26, 1923, using a Zenith detector and two-stage audio frequency amplifier. Homemade.

I believe that this list entitles me to membership in your much prized "Order of Dial Twisters."

WCX, Detroit, Mich., KDKA, East Pittsburgh, Pa., WBZ, Springfield, Mass., WCAE, Pittsburgh, Pa., WLAG, Minneapolis, Minn., WOO, Philadelphia, Pa., WWS, Detroit, Mich., WEAF, New York City, N. Y., WBAP, Ft. Worth, Texas, WDAF, Kansas City, Mo., WHAZ, Troy, N. Y., WAAW, Omaha, Nebr., WPAH, Waupaca, Wis., KFKB, Milford, Kan., WSB, Atlanta, Ga., WOC, Davenport, Iowa, KSD, St. Louis, Mo., WTAS, Elgin, Ill., WLW, Cincinnati, Ohio, WGR, Buffalo, N. Y., WRK, Hamilton, Ohio, WCBD, Zion, Ill., WBAV, Columbus, Ohio, WMC, Memphis, Tenn., WOS, Jefferson City, Mo., WDAR, Philadelphia, Pa., WOR, Newark, N. J., KFI, Los Angeles, Calif., WSZ, New York City, N. Y., WBAH, Minneapolis, Minn., KFKX, Hastings, Nebr., WOAW, Omaha, Nebr., WRC, Washington, D. C., CFCN, Calgary, Canada, KPO, San Francisco, Calif., 8XJ, Cleveland, Ohio, KFDL, Denver, Colo.

These stations total about 23,150 miles and were logged between the hours of six p. m., and twelve-thirty a. m.

Respectfully,
WILSON B. LEMBERGER,
2037 Osborn Street, Burlington, Ia.

Now you will probably wonder why that deserves the title of DT. The secret that Wilson is only fourteen years old, and any youngster who will have patience to sit at a radio set for six hours to listen for DX ought to get the credit he should have. ATTA' BOY, Wilson!

And while we have been gloating over tube records, we have probably been mentally reproached for not giving some thought to the crystal bugs, but don't convict us that way. Here's a kink for the crystal bugs that will no doubt receive the welcome and grateful thanks of many fans who are not so fortunate as to possess a tube set:

RADIO SCHOOL FOR WOMEN

The first radio school for women has opened at the Bedford Y. M. C. A., Brooklyn, New York. It is the first school of its kind. Photo shows J. S. Peterson, the instructor, explaining the intricacies of the vacuum tube to his pupils.

RADIO AGE,
Gentlemen:

Yours of January 28 received; in reply will say that the purpose of my previous letter was to have you publish this crystal innovation as a follow up on your eliminator. There is really nothing that I have done to improve on your idea, as I only stuck in a crystal detector and phone jack and ran the wires right through to the phones. Since writing my previous letter I have been fortunate enough to get DX on this hookup.

Monday night I heard a speech at KDKA, East Pittsburgh, Pa., and incidentally, might mention that a friend to whom I gave this hookup got WWJ of Detroit, Mich., on it. It is a very sensitive hookup and works very fine with the crystal and you still can use it as a wave trap for your tube set if you happen to have one.

I realize what a trial the people have when WJAZ or one of the other local stations of Chicago starts operating and I think there are a good many fans who are looking for a good efficient crystal hookup, and this is it.

I am not much on drawing, but will do the best I can, so I enclose herewith a sketch of the idea.

Yours very truly,
H. A. ENGLEBAUGH,
1328 Winona Street, Chicago, Ill.

P. S. I have used both No. 24 and 22 DCC for the eight turns but they work about the same.—H. A. E.

Eureka! Perhaps this is what thousands of fans who can only afford a crystal set are looking for. To Mr. Englebaugh the entire credit goes—we never dreamed that the eliminator could be used that way. The eliminator was described in the January 1924 issue of RADIO AGE as an interference preventer, and since then, we have received fifty-seven different varieties of uses for the unit. The whole secret lies in the way you construct the unit; if you make it carelessly and use poorly designed parts, you can't possibly expect results, and any fans who try out this unusual use of the eliminator should bear this in mind. Mr. Englebaugh would be pleased to hear from fans who construct this trick receiver. A diagram of the whole smear is shown in Figure 1.

Reflex fans probably will find the following letter of interest.

RADIO AGE,
Gentlemen:

While looking through the Pickups page, I have been tempted to write the results I have obtained from my homemade Erla 3 tube Reflex. I use an indoor aerial strung between two rooms, and

the following is a partial list of the stations I have succeeded in hearing clearly and loudly. This does not mean I had to nearly bust an eardrum to listen. Those with the mark were heard on the loud speaker, which is a Morrison Phonograph Unit attached to a Clear Tone horn.

KDKA, KYW, PWX, WAAN, WAAT, WBAN, WCAE, WCAL, WACM, WCAP, WCBD, WDAF, WADP, WDAR, WEAF, WFAA, WFAB, WFI, WGR, WGY, WHAS, WHAZ, WHN, WIP, WJAX, WJAZ, WJY, WJZ, WLAG, WOAG, WOAP, WOC, WOR, WOS, WBAM, WSDX, WOAZ, WRC, WRW, WSAI, WSB, WTAM, WTAS, CHYC. Local stations not mentioned but have all been heard.

I have not seen any reflex circuit featured with a list like this one, and would like to hear what the other reflex fans say.

Yours for radio,
G. S. BAIRD,
32 Maltbie Avenue, Suffern, N. Y.

That's a nice little list, isn't it? You've got to give credit to Mr. Baird—we know how hard it is to make a reflex do its darndest. You fellows who are having trouble might give Mr. Baird a ring—perhaps he can give you some valuable suggestions.

RADIO AGE,
Gentlemen:

It seems as if the Reinartz bugs have been falling behind of late with their reports, so thought I'd boost it a bit. About one month ago, I built a set for a friend of mine who had never operated a set and had only listened a few times. The first time I tuned in with the set I heard Havana, Cuba, Los Angeles, Calif., San Francisco, Calif., and Portland, Ore., together with Calgary, Canada, and New York City. It was by far the loudest set I'd ever heard. Announcements and music from Kansas City and Omaha came in so loud that it could be heard across the room. We had no loudspeaker, but we hung the phones on the wall and still heard the signals. Later one stage of audio frequency amplification was added. The set was delivered Christmas eve and to date his record is as follows: WKAQ, KGW, KPO, PWX, KFI, KHJ, CFCN, CFCA, KFAF, KFKX, WAAW, WOAW, KFKB, WNAD, WFAA, WBAP, WOAI, WPAM, WOQ, WDAF, WHB, WOS, KSD, WOC, WEQU, WLAG, WBAH, KYW, WJAZ, WMAQ, WDAP, WTAS, WCBD, WMC, WHAS, WSY, WLW, WSAI, WTAM, WJAX, WCX, WWJ, WCAE, KDKA, WOO, WGR, WGY, WEAF, WOR, WCAP and WSB.

Not a large list, only fifty-one stations, but pretty good for a newcomer. Wonder if any Kopprasch or Cockaday, "fiends" can report as good. The hookup is a slight modification of the standard Reinartz using two taps in the grid circuit and none in the plate or antenna. Other than these slight changes it is standard.

Very truly yours,
FRANK W. SMITH,
2306 Edward Street, St. Joseph, Mo.

Good work, Mr. Smith. The reason your friend gets such good results is due to the fact that when you omitted the taps on the coils you unconsciously cut down many losses, and lowered the entire resistance of the circuit. We'll bet that the tuner is a peach for selectivity, too. It is a far wiser plan to make your coils of sufficient size to suit the wave desired and to use a sufficiently large condenser than it is to use a tapped coil and a smaller condenser. The losses incurred in the taps and dead ends of the coils, while not of appreciable notice in signal strength, will when removed increase the general effectiveness of the set as a whole.

FRENCH GENIUS

Latest portrait of General Gustave Ferrie, the man who has developed radio in France during and since the war. He is head of all the military radio stations in France. He controls the Eiffel Tower post as well as many other stations.

Here's a letter from the town where RADIO AGE is printed:

RADIO AGE,
Gentlemen:

This is to let you know that I have with the little "First Tube Set" and a one-stage amplifier pulled down through my antenna almost every station of importance from New York City to San Francisco, Calif. Here is a partial list of them: KDKA, KFAF, KFFZ, KFI, KHJ, KLZ, KPO, KYW, WEAF, WCAE, WCAP, WCBD, WCX, WWJ, WDAP, WEAH, WEAS, WGY, WHA, WHAN, WHB, WIAB, WIAO, WJAZ, WLAG, WHAS, WLW, WMAI, WMC, WOAG, WPAB, WPAC, WPAD, WSB, WSY, WTAM, WTAS and many others which I failed to put down when I heard them.

It might be of interest to you that I have made five of these little receivers, and they always worked the first time I hook them in.

Yours very truly,
MAX M. BARNHIZER,
Mount Morris, Ill.

The little "first tube set" mentioned above was described in detail in the October, 1923, issue of RADIO AGE, and we have been getting lists that look like the call book on it ever since. RADIO AGE has a staunch bunch of boosters out in Mount Morris, who are employed in the plant where RADIO AGE is printed. Among them are H. V. Biery, Grover Hammet, W. I. Prugh and many others. And believe me, Mt. Morris is certainly radio nuts. They've got a fifty-piece brass band that broadcasts from WOC every once in awhile, and telephone interference and everything. Hot town, that.

Here's a little letter which will make some of the fellows with super-heterodynes look like they have a glass arm:

RADIO AGE,
Gentlemen:

Why all this fuss? There is no use talking, the Reinartz is by far the best receiver! (Ha! How do you like that DT's?—The Ed.)

Come on, you Reinartz fellows—they aren't going to pull the wool over our EARS. This one ought to help testify to that. Here is a list of stations heard in two and one-half hours time: WWJ, WSB, KSD, WCAE, CKCK, WHB, WFI, WLAP, WGY, KDKA, WSAI, WHN, WFAN, KHJ, WMAW, WJZ, WBAP, WCX, WOAW, WBAV, WCAI, WJAN, WLW, WDAP, KFKB, and in addition to these mentioned I hear PWX, Havana, Cuba, Portland, Ore., Calgary, Can., San Diego, Calif., San Francisco and lots of others.

Only a Reinartz will do this. They've got to show me.

Yours very truly,
H. J. BOYENGA,
Greene, Ia.

And that's that! All we're going to do now is to brace ourselves for the flock of letters which will come in in answer to this one telling Mr. Boyenga where to get off. It looks like he started something. That's a good list—only two and a half hour's listening and twenty-five stations; you know some of these fellows think that they've nailed a record when they pull in twenty-five in a week.

The following ought to be of interest to Lloyd E. Foltz, a fan who for the past several issues has been the target of much "razzing." Also to the users of Cockaday sets.

RADIO AGE,
Gentlemen:

If you can spare the room in your Pickups section of the most valuable radio periodical published (Thank You —The Ed.) please print the following

and I'll try and help Lloyd E. Foltz defend the Cockaday DX title.

The following stations were heard on a Type C Baldwin Loud Speaker with two stage of audio, the circuit, of course, being a Cockaday. All were heard loud and clear with enough volume to fill a good-sized bungalow!

WLAQ, 360; WTAM, 390; WWJ, 517; WJAZ, 448; WGI, 360; WGR, 319; WEAF, 492; Wcap, 469; WSD, 546; PWX, 400; WRC, 469; WOC, 484; WCAE, 462; WSB, 429; WFAM, 360; WHN, 360; WCK, 360; WJAR, 360; CFCA, WSY, 360; WIAD, 360; KDKA, 326; WOI, 360 (this station has a radius of only 200 miles); WPAH, 360; WFAA, 476; WOS, 441; WCAL, 360; WOAI, 385; WJAX, 390; WSAI, 309; KYW, 536; WLW, 309; WMAK, 360; WHA, 360; WCAE, 462; WJAD, 360; WOAN, 360; and KFKX, 286.

You will notice that WOI of Ames, Iowa, has a radius of only 200 miles, but in spite of this fact I have heard them both clearly and loudly. I gave the meter wave length of the different stations for the reason that some of the fans don't seem to think that this circuit is capable of going from the lowest to the highest waves. I think that the foregoing will most clearly demonstrate this point. There is only ten meters difference between my local station WHAS and WTAM, Cleveland, Ohio, and I have repeatedly listened to an entire concert from WTAM while Louisville was going full blast.

Only five meters between WHAS and WOR at Newark, N. J., and I have also heard an entire concert from WOR, while Louisville was on with no interference from Louisville whatever.

Any RADIO AGE reader desiring information on this set may get same gratis by writing me at Crestwood, Ky. I want to see the Cockaday bunch at the top.

Here's hoping that I have contributed at least two or three good points for the Cockaday and a good many more for the RADIO AGE.

Very truly yours,
J. H. JONES,
Crestwood, Ky.

The Cockaday fans will probably welcome that letter, Mr. Jones, and will especially feel that it bears weight when we tell them that Mr. Jones is an old friend of RADIO AGE, and has been visiting the Pickups section before. It seems that Mr. Jones has at various times been a Reinartz fan, an Erla bug but this is the second letter we have had from him with reference to the Cockaday.

RADIO AGE,
Gentlemen:

Purchased my first copy of RADIO AGE, January, 1924, and am much interested in the Pickups page. I would like to give you a slant at my list heard on a two-variometer single circuit set with detector only. The following are the stations heard since August, 1923. The amateur are all phone. If the list is too long, cut out the ones closer than 500 miles.

PWX, at Havana, Cuba, was tuned in at about 7:30 one evening through powerful interference created by WDAP.

I have heard KFI and KHJ several times, one time when my antenna lead in was lying on the roof.

I use a UV 199 tube, 22 1-2 volts on the plate and an aerial of one wire about ninety feet long, including lead in. Have tuned in as many as twenty-eight stations in one evening, with KFI the farthest. I am leaving out several amateur stations which I have heard but in spite of that, my list totals 103 stations. I am enclosing a copy of my hookup, which I think will be of interest to fans. (We are showing the hookup in Figure 2.) The list is as follows: KYW, WDAP, WMAQ, WPAD, WAAF, WTAS, WCBD, WOAW, WLW, KDKA, WMC, WLAG, WGY, WDAF, WSB, WHB, WSAI, WGR, WHAS, WWJ, WOC, WCAE, WFAA, WBAP, WBAV, WJAX, WDAR, WOO, WOS, WHAZ, WJY, KSD, WIAS, WCX, KFJK, WOR, WTAM, KOP, WBAH, WEAF, WCAP, KFDY, WIP, WHA, WEAH, WCK, WMAK, KFKB, WMAY, WSY, WAA, WHAM, CFAC, CFCN, CKCE, WRC, WPAH, PWX, 9CE, WRAD, WWAE, KFJL, KFKX, WEAS, WMAH, KLZ, KHJ, WBZ, WNAV, CKCK, KFDL, KFI, WIAO, 5LJ, 2BXL, 9DNI, 9BRX, 9BRN, 9CNN, 9ASH, 9GB, 9JC, 9CJX, WCAL, KFIX, WABT, WEAN.

Yours very truly,
FRANCIS TYE.
607 N. Eighth Avenue, Maywood, Ill.

Next time you send in a list, tear out the broadcast stations pages from some old RADIO AGE, and with a pencil indicate "leave this and this out, I've heard all the others." HI! That's a nice list, and will probably show the fellows who contemplate building the Rosenbloom circuit what it can do.

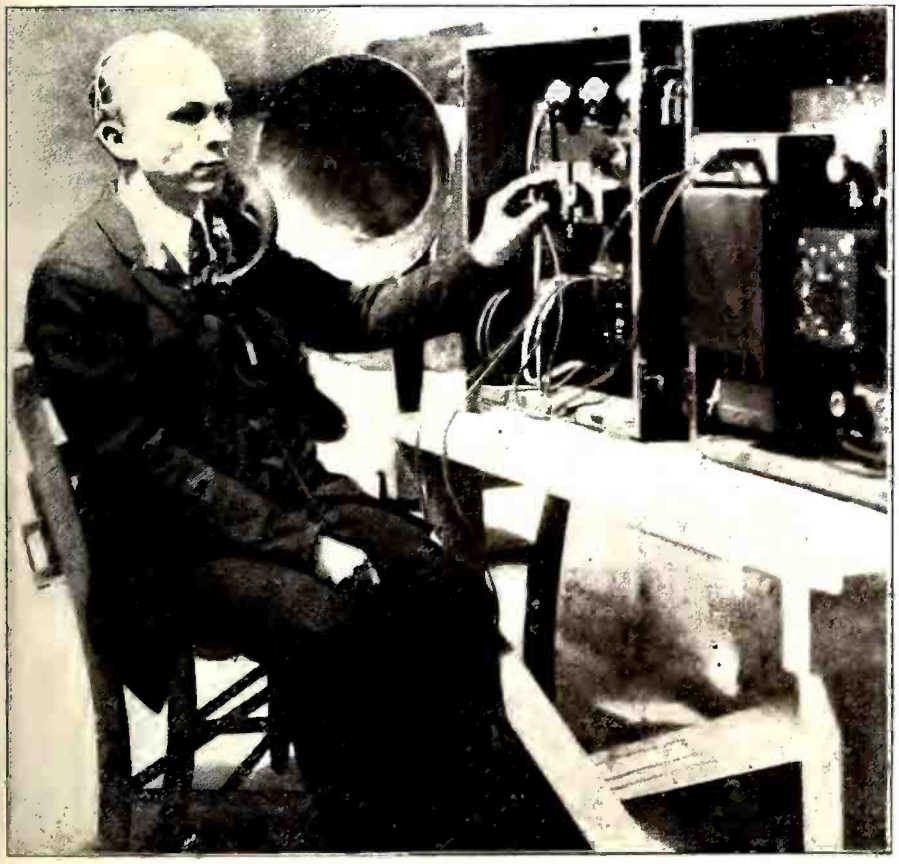
RADIO AGE,
Gentlemen:

Have been trying several hookups but have not had much success and as I had the parts I thought I would try your first tube set as described in the January issue of RADIO AGE. Got it wired up at about 8:45 p. m., and up to 10:30 p. m., I got the following twelve stations which I think is some good work for one and three-quarters hours. I am using a C 299 tube and they all come like a house afire. It sure is some hookup. Stations were received as I am listing them: WCAE, WCBD, KDKA, WOAW, OMAHA, WPAH, WLW, WHB, WHAZ, WDAR, WGR, KFKF, and KFKB.

Would recommend the circuit to anyone having trouble with their sets, as this one sure gives the satisfaction.

Yours truly,
A. W. NORTH,
61 N. Lincoln Avenue, Fond du Lac, Wis.

Now this is the part that gets us; a fellow will monkey around, mortgage his house and sell his car to get money enough for a ten tube super-heterodyne—and then when he can't get it to work goes and tries out a circuit of the type mentioned. By jimminy, it's not the kind of circuit that counts, it's the make of the set. The secret of that little "First Tube" circuit lies in the fact that



HISTORIC BROADCAST

Photo shows John Hammond in crypt below Bethlehem Chapel operating radio equipment by which the nation heard Ex-President Wilson's funeral services.

it has so few parts that you can't help but construct it with few losses. On the other hand, when you improve on a circuit, add taps, more condensers and more fancy coils you usually increase the resistance and losses in the circuit and the result is a bum set. If you take our advice, make a simple little tuner, learn how to keep the losses down and enjoy a variety of stations that you couldn't get with a poorly built ten tube super-heterodyne. Frankly, we say from personal experience in the game that if you find that an amateur takes more than two hours to wire up and make a circuit it really calls for an investigation. The general rule is to slam the thing together and then give it a test, and when it doesn't work—classify it as a failure. That's the thing that won't jibe with a large receiver, and it really takes weeks and often months before you get all the parts working in proper unison, because there are so many of them. With the little "First Tube" circuit the whole thing is based upon a few major pieces of apparatus, and it is almost impossible to fail with it. We don't mean to reflect on Mr. North's former sets or anything like that—we just feel that his letter is typical of many ill advised fans, who think that the only way you can get DX is to add more tubes, power and spend more money on a larger set, when the real solution of their problem lies in reconstructing their original set with the intention of cutting out losses when they do so.

Well, fellows, I guess that's about enough for this issue. True to our word, we've been running them pretty freely, and rather than crowd out some good feature, we'd better quit.

Before we do so the Pickups Editor wants to extend his thanks to the fans who sent in their letters but whose letters are not published, due to lack of space.

By the way, it looks like the Editor has been putting his two cents here and there, and I suppose he has read them pretty thoroughly.

S'long! See you next month.

Ship-Shore Record

All records were broken for commercial 600 meter continuous wave transmission when Operator M. A. Obradovic, of the S. S. "West Nilus," while ninety-five miles north of Wellington, New Zealand, copied a number of messages direct from WIM, the Radio Corporation of America station at Chatham on the Massachusetts coast. The distance is 9,300 miles and perfect reception obtained in broad daylight.

Operator M. A. Obradovic, whose reception has been checked and confirmed, sent a letter to marine superintendent at Chatham on December 23, in which he reported the history-making achievement. The letter reached the United States more than fifty days after it was mailed in New Zealand.

Washington Show

Washington, D. C.—Washington's radio dealers with the co-operation of officials of the federal government will stage in Convention Hall here the week of March 19 to 26, one of the most pretentious radio expositions ever held in the United States.

With the array of exhibits that have featured radio shows in other cities, augmented by special government displays, some of which have never been on public view, Washington's first radio show is destined to attract nation-wide attention.

The Department of Commerce which has supervision and control over all of America's activities in the field of radio; the Bureau of Standards, the government's famous experimental laboratory, and other federal agencies interested directly or indirectly with radio and its development, will take an active and leading part in making the radio exposition in the nation's capital an epoch in radio history.

The fighting arm of the government—the army, navy and marine corps—also will be represented at the show with exhibits of historical value. The navy has planned to exhibit a replica of the 300 watt radio transmitting station on the giant dirigible, "Shenandoah," which kept the navy department in constant communication with the big ship during her sensational gale-driven flight up the Atlantic coast in January. The army, which proudly boasts that its radio engineers are at least two years in advance of the radio wizards employed by the leading manufacturers of radio products in the development of improved apparatus, has promised an exhibit to prove its claim.

Officials of the government departments, including President Coolidge, the chief executive, and members of his cabinet, are expected to take an important part in the elaborate and unique entertainment features of the show, tentative arrangements for which already have been made.

Radio in the Movies

A praiseworthy bit of co-operation with the radio industry has just been released by Kinograms news weekly in the shape of "Behind the Scenes of a Broadcasting Station."

E. F. McDonald, Jr., of the Zenith-Edgewater Beach Hotel Broadcasting Station, WJAZ, and Ray L. Hall, head of the Kinograms news weekly chanced to meet one day on the stage of Selwyn theatre in New York.

"Radio speaking, I am rather well acquainted with WJAZ," said Mr. Hall.

"It has often entertained me in my home in New York state. I have never seen the station, however. Often wondered what it looked like."

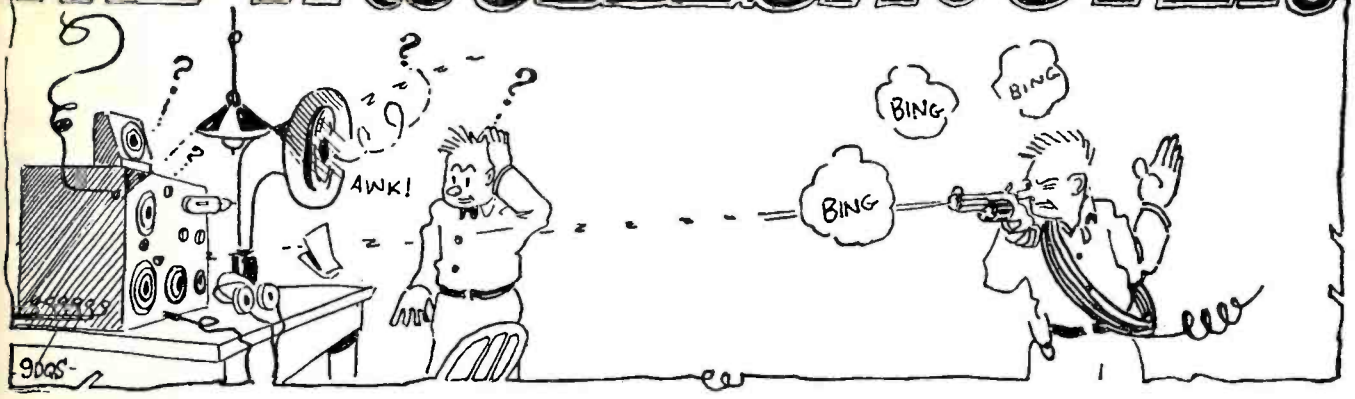
Said Mr. McDonald, "I shall be glad to arrange that not only you see it, but all of your big family of Kinogram fans the country over."

That was the starter of the film.

Next to seeing the station with one's own eyes, the picture is the closest to a full realization of the beauty of the crystal studio; the complexities of the operating and motor rooms; the gaiety of the guests in the marine dining room; the eager faces of the famous Oriole orchestra; and all that happens when the artist stands in front of the microphone and sings to his eight million or more WJAZ listeners.

Movie audiences are introduced to the grand opera stars: Florence Macbeth, Angelo Minghetti, Virgilio Lazzari, Mary Fabian and Myrna Sharlow of the Chicago Civic Opera Company in periodic flashes of the crystal studio. We are shown how the concert is put on the ether at the very moment it is being received in the different parts of the country; in a play spot of a metropolitan section in the east, vast throngs of skaters are entertained with the very same concert by means of the Zenith radio sets conveniently placed in different parts of the lagoon.

THE TROUBLESHOOTER



E. S. M., Detroit, Mich.

Question: Your February issue came today, and first of all I must compliment you on its contents and general appearance. I am a reader of several radio publications, but this RADIO AGE takes the cake. It's a King Bee—don't let it slip. Now I have a little kick coming. I want to know why the author of that code article didn't give us more code Q signals while he was at it. I got interested in the stuff and have been talking it to the wife ever since, till she's nearly dazy. Let's have some more Q signals as soon as possible.

Answer: I am printing elsewhere in this department a complete list of Q signals as are used by the transmitting operators in the course of the regular wireless conversations. I might add that now, due to the fact that international amateur communication is becoming more and more common, the various nations are adopting a form of calling which will enable listeners to identify foreign amateur stations. Thus an American amateur calling a French "ham" would call F8AB F8AB F8AB U9DQS U9DQS U9DQS, etc. The F would classify him as French and the U preceding the American call identifies the last station as United States. The same applies to Canadian who sign "C," the British "G," and Australian "A." Sometimes the Australian sign "Aussie" and then their call. For full details on this code work, those interested should see the November and December issues of RADIO AGE, and to keep pace with amateur code developments, it is advised that readers refer to the amateur code journal QST at Hartford, Connecticut, a periodical which specializes in advanced amateur transmitting and receiving problems.

J. W. H., Topeka, Kans.

Question: I want to thank you for your January article in the RADIO AGE on the Junior Heterodyne. That is an article a great many have been looking for, particularly us fellows that are in the game with a shoe string and an oat meal can. Beg pardon if I pull a boner, but is not your tickler circuit short circuted on socket VI plate post? Having recently built a 5-tube Neutrodyne, using ice cream containers to build the transformers on, I would like to record the result for your information and advice. The transformers are wired 15 turns on primary with 60 turns on secondary, tapped at 15th turn for neutrodons. Am using Bremler-Tully .0005 MF vernier variable condensers, 19 plates on rotor and 2 on vernier. The result is that all balancing is done on the 0 to 55 divisions of the condenser dials, which are 100 division dials. Cannot separate stations on this space to good advantage. St. Louis balances on 55 55 55 and Cincinnati on 8 8 8 degree settings on the dials. Hastings, Nebr., KFKX comes in on about half of the three verniers, that is a 286 meter station. There are a good many stations down around the wave that Hastings operates on, and I would like to bring them in. My friends have made transformers 13 and 54, 14 and 56, and mine is 15 and 60 windings. They advise me to cut plates off of these condensers in order to spread the range over 100 divisions of my dials. The scrap is heated at times, as I cannot see it that way. It seems to me that I should not destroy the condenser capacity. Now I don't want to bind you down with a lot of red tape and ask you to sign on the dotted line. I know that each technical engineer

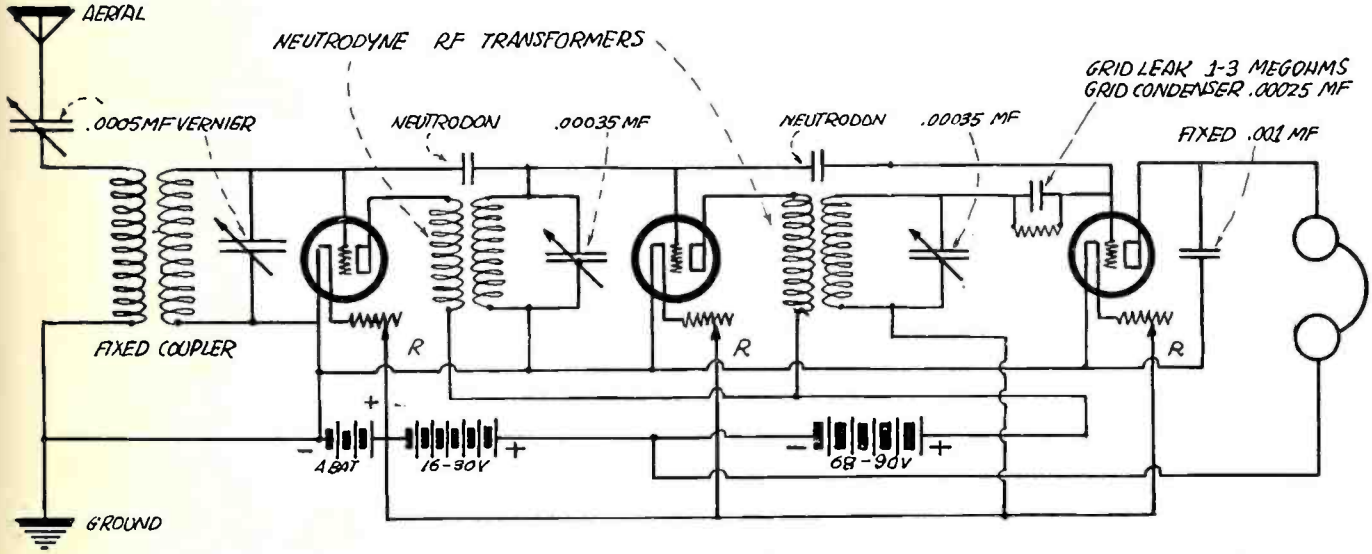


Figure 1. A hookup diagram of a three tube neutrodyne. The transformers are made according to the instructions outlined in the accompanying answer. The fixed coupler is constructed according to the directions given in the October, 1923, RADIO AGE, and consists of eight turns of No. 28 DCC wire on a three and one-quarter inch tube. The secondary consists of fifty turns of the same size wire wound on the same tube, with a separation of about one inch between the windings. No taps are taken off the fixed coupler. The condensers across the secondaries of the Neutrodyne transformers are 17 plates.

INTERNATIONAL RADIOTELEGRAPHIC CONVENTION

List of Abbreviations to Be Used in Radio Communication

Abbreviation	Question	Answer or Notice
PRB	Do you wish to communicate by means of the International Signal Code?	I wish to communicate by means of the International Signal Code.
QRA	What ship or coast station is that?	This is.....
QRB	What is your distance?.....	My distance is.....
QRC	What is your true bearing?.....	My true bearing is.....degrees.
QRD	Where are you bound for?.....	I am bound for.....
QRF	Where are you bound from?.....	I am bound from.....
QRG	What line do you belong to?.....	I belong to the.....Line.
QRH	What is your wave length in meters?	My wave length is.....meters.
QRJ	How many words have you to send?..	I have .....words to send.
QRK	How do you receive me?.....	I am receiving well.
QRL	Are you receiving badly? Shall I send 20?..... . . . — . for adjustment?.....	I am receiving badly. Please send 20. . . . — . for adjustment.
QRM	Are you being interfered with?.....	I am being interfered with.
QRN	Are the atmospherics strong?	Atmospherics are very strong.
QRO	Shall I increase power?.....	Increase power.
QRP	Shall I decrease power?.....	Decrease power.
QRQ	Shall I send faster?.....	Send faster.
QRS	Shall I send slower?.....	Send slower.
QRT	Shall I stop sending?.....	Stop sending.
QRU		I have nothing for you.
QRV	Are you ready?.....	I am ready. All right now.
QRW	Are you busy?.....	I am busy (or: I am busy with.....). Please do not interfere.
QRX	Shall I stand by?.....	Stand by. I will call you when required.
QRY	When will be my turn?.....	Your turn will be No.....
QRZ	Are my signals weak?.....	Your signals are weak.
QSA	Are my signals strong?.....	Your signals are strong.
QSB	{ Is my tone bad?..... { Is my spark bad?.....	The tone is bad. The spark is bad.
QSC	Is my spacing bad?.....	Your spacing is bad.
QSD	What is your time?.....	My time is.....
QSF	Is transmission to be in alternate order or in series?	Transmission will be in alternate order.
QSG	.....	Transmission will be in series of 5 messages.
QSH	.....	Transmission will be in series of 10 messages.
QSJ	What rate shall I collect for?.....	Collect.....
QSK	Is the last radiogram cancelled?.....	The last radiogram is cancelled.
QSL	Did you get my receipt?.....	Please acknowledge.
QSM	What is your true course?.....	My true course is.....degrees.
QSN	Are you in communication with land?.....	I am not in communication with land.
QSO	Are you in communication with any ship or station (or: with.....)?	I am in communication with..... (through.....)
QSP	Shall I inform.....that you are calling him?	Inform.....that I am calling him.
QSQ	Is.....calling me?.....	You are being called by.....
QSR	Will you forward the radiogram?.....	I will forward the radiogram.
QST	Have you received the general call?....	General call to all stations.
QSU	Please call me when you have finished (or: at.....o'clock)?.....	Will call when I have finished.
*QSV	Is public correspondence being handled?.....	Public correspondence is being handled. Please do not interfere.
QSW	Shall I increase my spark frequency?	Increase your spark frequency.
QSX	Shall I decrease my spark frequency?	Decrease your spark frequency
QSY	Shall I send on a wave length of..... .....meters?.....	Let us change to the wave length of..... meters.
QSZ	.....	Send each word twice. I have difficulty in receiving you.
QTA	.....	Repeat the last radiogram.
QTC	Have you anything to transmit?.....	I have something to transmit.
QTE	What is my true bearing?.....	Your true bearing is .....degrees from.....
QTF	What is my position?.....	Your position is.....latitude..... longitude.

*Public correspondence is any radio work, official or private, handled on commercial wave lengths.

When an abbreviation is followed by a mark of interrogation, it refers to the question indicated for that abbreviation.

has his own special ratio for these transformers. I am disposed to make new transformers in hopes that my set will be better, and would appreciate a few words from you with regard to ratios.

Answer: First of all I want to tell you that as far as beginners in the radio game are concerned, I am not in favor of recommending neutrodyne receivers to novices—the balancing of the tubes requires quite a knowledge of radio principles and tube characteristics, and inasmuch as no two tubes are exactly the same with respect to capacity, it is a pretty hard thing for the novice to balance a neutrodyne receiver properly. Of the many neutrodynes I have seen in possession of broadcast listeners, I find that very few of the fellows know enough about them to get the best results. However, with respect to your transformers, the general rule is to wind the ratios of these coils about 4 to 1. This is greatly dependent upon the type of tube used, and for UV 201A, WD 11 and UV 199, I would recommend a ratio of primary on a 3-inch (diameter) tube wound with about 15 turns of No. 26 DCC wire, and the secondary on a 3 1-2-inch (diameter) tube wound with 50 turns of No. 26 DCC. This ratio is a matter of experiment, and the results obtained are a matter of the type of tube used. Also hand wound coils vary a great deal, and no definite number can be given, outside of this general specification. A tap at the 15th turn of the secondary for the connection of the neutrodon is recommended. Often this is not necessary, the neutrodon being connected directly to one side of the parallel circuit as shown in Figure 1. The condenser across the secondary should be a 17 plate. When the tap is added, the connections are made as in Figure 2. For those interested in Neutrodyne circuits we would say that the most advantageous method of adjusting the neutrodon is to proceed in the following manner. It is assumed that two stages of neutrodyne radio frequency amplification are used. First, place a piece of cardboard in the tube socket of the first radio frequency stage so that the tube does not make contact with any of the connectors of the tube socket. Light the second tube and detector (if an amplifier is used do not use it; or closer adjustments may be obtained with the detector alone.) Select some strong local station, and if no station is in your immediate vicinity, set up a temporary wavemeter as a source of oscillations using a small buzzer as the source of your power. Here is where the delicate adjustment lies. Vary the capacity of the neutrodon of the first radio frequency amplifier tube until no signal is heard whatever from either the station or wavemeter, whichever you may be using. Keep the wavemeter at a distance of about six feet from the set. If the signal fails to disappear, try a larger neutrodon. A good one may be constructed according to instructions printed in January, 1924, RADIO AGE. The neutrodon must be absolutely correctly adjusted or the set will give only indifferent results. When the first stage has been properly balanced, proceed in the same manner with the second stage. During this adjustment the first stage of radio frequency should be on. Don't make these adjustments in a haphazard manner—if you do the set won't work properly. It will only get local stations, will howl and give poor results. The adjustment of the neutrodons together with the careful construction of the set is the secret of the Neutrodyne circuit. The trouble with J. W. H.'s receiver is quite apparent. The condensers and coils which he is using are too large for the 300 meter stations. In any case where it is desired to lower the wave length of a circuit, it is advisable to decrease both the capacity and inductance of the circuit respectively. In your case would recommend that you wind your transformers according to the ratios mentioned, and decrease the size of your condenser. This would enable you to tune with the entire condenser, making use of the whole dial scale of degrees. The additional 45 degrees that you mention as now inactive are not in use and are only dead timber, only serving to make the tuning of the receiver more critical.

C. T. S., Warren, Pa.

Question: I have built the Haynes circuit using the 180 degree variocoupler as shown in your hookup published in the December RADIO AGE, but find that in

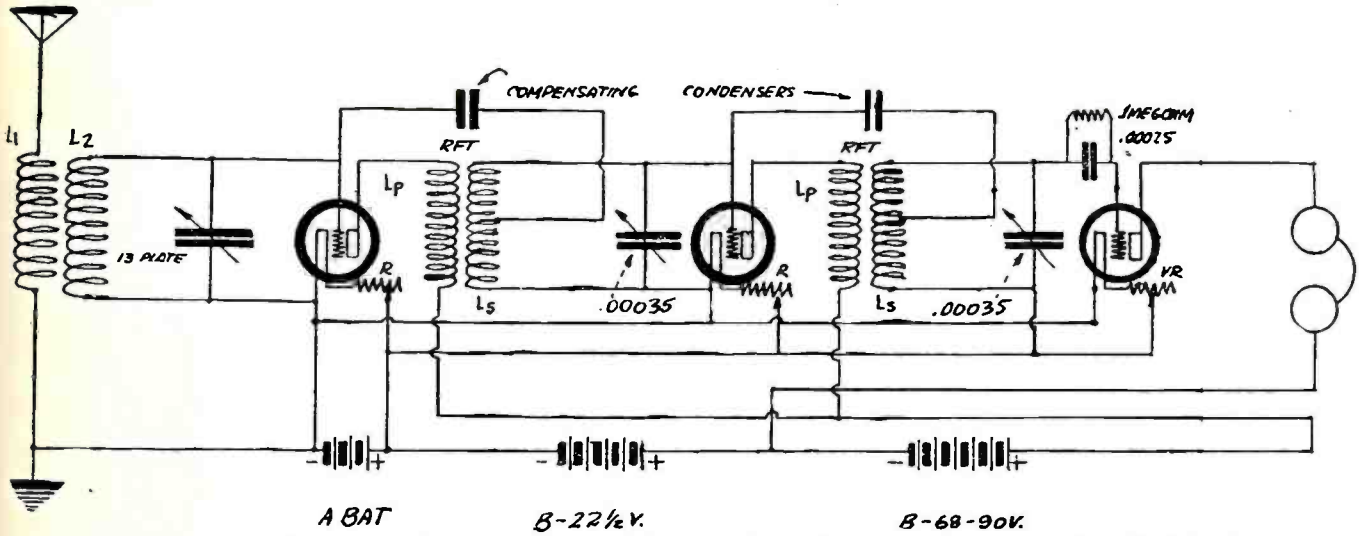


Figure 2. Another diagram of the Neutrodyne, with taps taken off the transformers as described in the accompanying question showing how the connections are made when this method of connecting the compensation condensers is used.

order to tune in, the position of the rotor is very critical, and the tube spills over all too easily. I am using No. 18 wire on the stator and No. 20 on the rotor with a 23 plate condenser and with a UV 199 tube. It seems that the 23 plate condenser works better than the 11 plate in the circuit. Would like to have you answer the following questions on the above circuit. Would you advise using No. 20 wire on the stator or taking off some of the No. 18 wire to make the circuit balance more easily? Is the Haynes considered a single circuit? Is it as selective as the Cockaday circuit? Can the variocoupler be purchased complete? What is the diameter of the rotor and stator? Please furnish hookup for this circuit using push-pull amplification with UV 199 tubes. Will I have as loud a reception with push-pull transformers as I get with the 10:1 and 3:1 transformers?

Answer: Would not advise that you disturb the winding of the stator coil, as this probably is not at fault. You might rewind the rotor with some of the No. 18 wire, and experiment a little with the exact number of turns. The action you describe suggests too large a tickler coil, and it would probably be a wise thing to cut down on the number of turns. It also might be attributed to too high a plate voltage on the detector bulb. With the U. V 199's, a plate voltage of anywhere from 18 to 45 volts is often possible and necessary in the matter of getting the best results out of the circuit. Increase the size of your grid leak, and the circuit will not be so finicky. The Haynes is a modified single circuit, but because it has two permutations for tuning it would probably be better to classify it as a two circuit tuner. If properly operated and constructed it is about equal with the Cockaday for selectivity. This however is dependent upon the operator, and careful handling is the only way it can be brought to comparison with the Cockaday. Ordinarily, the Cockaday is considered super-selective. The variocoupler can be purchased from the Haynes-Griffin Co., of New York. completely made up. The diameter of the rotor and stator are not very important, but in any case if the diameter of the stator exceeds 3 3-4 inches, the number of turns on both coils should be decreased. The amplifier described in the January issue of RADIO AGE, being a push-pull circuit is connected up by placing the input of the first push-pull transformer to the output (phone connections) of the detector. Your reception will be louder and clearer due to the fact that your tubes are only working half the time, and higher plate voltage can be applied.

H. L. C., Joliet, Ill.

Question: I would like to ask a question concerning my receiver on which I am having trouble with an alternating current hum. My antenna is close to a power line and three big transformers. Would another wire alongside of my present antenna grounded at both ends reduce the hum? What would you suggest?

Answer: The grounded wire you speak of would only detract from the effectiveness of your receiver, and lower the effective height of your antenna as a whole. If you can't run your antenna at right angles to the source of the interference, would advise that you erect a pole of as high an altitude as you can, and run the aerial up and down (vertically) in the air. The effectiveness of your set would increase materially, and it would also be at right angles to all the wires which run parallel to the earth.

J. F. M., Chicago, Ill.

Question: Will you kindly give me a sketch showing how we can both get results without interfering with one another on the following tangle: My four wire antenna was up about 2 years and a party moved in down stairs and put one wire over mine and the result is that I cannot get outside stations.

Answer: The same goes for you JFM; run your antenna straight up and down in the air on a single pole as high as you can afford. Your antenna will still be at right angles to your friend's, and you have the advantage of more effective working antenna, the whole thing being a sort of a lead in without a flat top giving a strong sharp signal as described by Mr. Pearne in the February issue in his articel on antenna analogy.

F. M. H., San Diego, Cal.

Question: We are troubled very greatly with interference from a powerful arc station (call being NPL) here around San Diego, and I would appreciate it if you would inform me as to whether it would be advisable to use a wave trap with the little "First Tube" receiver in this locality. This station makes life miserable around here for radio fans, and if this little set described in your article cannot tune out any of this interference it would be practically useless. What would you advise?

Answer: We have read with considerable concern of the powerful arc interference created by NPL, and understand that the San Diego Radio Club has created a movement to put a stop to the "mush" created by the interfering arc of this station. With reference to the circuit you mention, we wish to say that if it is carefully constructed of good apparatus it will tune about as closely as any two circuit set devised. While not over selective, it will give admirable results where interference is not too strong. If the interference you speak of is particularly violent, we would certainly recommend the addition of a wave filter as described in January, 1924, and would recommend that you use a 43 plate condenser instead of a 23 plate to cover the wave of NPL inasmuch as we know that they transmit on a higher wave than the broadcasting stations. We want to be frank with you and say this in defense of the receiver. Arc interference is composed of so called "harmonics" which occur at various waves with varying intensity. If one of these harmonics of any considerable audibility happens to be on the wave you desire to listen on, no set can tune them out. It is entirely a matter of how frequent these harmonics are, and where they occur that will judge whether you will be able to shut them out.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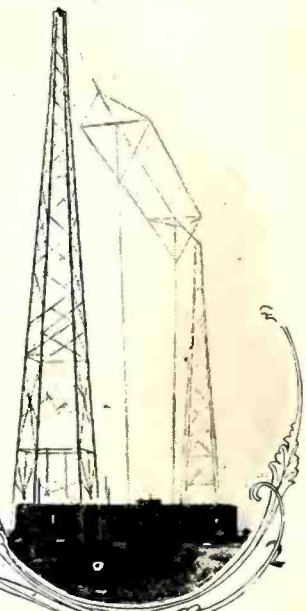
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SUNSET STATION

Above is the studio of the New General Electric broadcasting station, KGO, at Oakland, Calif. At the right is a glimpse of the antennae. Below is the station building and the operating room. The portraits are those of Martin P. Rice, director of broadcasting for the General Electric Company at Oakland, Denver and Schenectady, and J. A. Cranston, Pacific coast manager of the General Electric Co.

What the Broadcasters are Doing

KFKX, The Repeating Broadcasting Station

By D. G. Little and F. Falknor, Radio Engineers, Westinghouse Electric and Manufacturing Company

From the Electrical Journal, January, 1924

ON NOVEMBER 22, 1923, there was put into operation the latest type of radio broadcasting station—a type which presages a great advance in the art of broadcasting radio programs. The repeating of programs which are originally presented in Pittsburgh, makes available to more distant listeners the high quality of program which is obtainable only in the larger cities. While experiments along this line have been carried on for some time, KFKX is the first station to seriously attempt a service of relaying or repeating regularly a previously announced radio program, broadcast from a distant station.

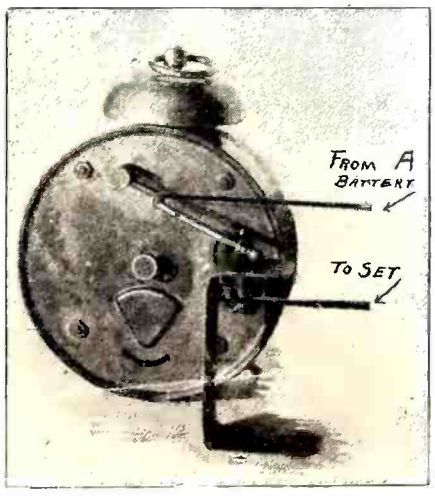
It has long been desirable to interconnect broadcasting stations in various parts of the country, so that national events could be enjoyed by the nation as a whole instead of by only those in a small area. At least two solutions of the problem are to-day in use to some extent. One is the use of long-distance telephone lines and the other the use of a primary broadcasting wave or frequency. This primary frequency must necessarily be selected in a band where atmospherics and existing radio stations interfere the least. It is also highly desirable to have this carrier frequency more independent of intensity fluctuations due to change from daylight to darkness than generally is the case in the series of frequencies now used for broadcasting. From an interference standpoint, frequencies at least as high as 3,000 kilocycles are obviously the best.

The high frequencies have many advantages for such purposes. One of the most important of these is that "fading," which is so annoying at the usual frequencies, is reduced at the higher frequency to the point where its effects are negligible. The elimination of fading is one of the first essentials of successful repeating by radio. The 3,200 kilocycle waves seem to carry almost, if not quite, as well during the daytime as at night, thus meeting another requirement of successful repeating. High-frequency transmission is also exceptionally free from static interference. While special equipment is necessary both for the transmitting and receiving of programs at this high frequency, there is no particular difficulty involved in designing equipment which will give the highest type of service.

Not an Experiment

While the first of this type to establish regular service, Station KFKX is by no means an experimental station. The repeating of programs at high frequency from Station KDKA has been carried on in an experimental manner by the Westinghouse Company for some time.

In June, 1922, it was decided to conduct preliminary tests on a large scale by repeating, at Cleveland, Ohio, signals transmitted from East Pittsburgh, Pa. Station KDKA was equipped to transmit at frequencies near 3;000 kilocycles while the Cleveland station's equipment consisted of a receiver for this frequency, and an 803 kilocycle transmitter. This apparatus was completely installed and ready for actual tests about September 1. Tests conducted between these two points, from September, 1922, until January, 1923, indicated that the use of a very high frequency as a primary carrier in a repeating system was not only highly desirable but entirely possible from a practical standpoint.



Station KYW, Chicago, broadcasts news bulletins at half-hour intervals throughout the day and night. Paul C. Kahn, 3222 Carroll Ave., Chicago, has invented an alarm clock device that automatically "brings in" the station. The clock is timed with the station time and the alarm is set for the half hour. When the alarm sounds the lever attached to the alarm wind comes down and completes the circuit. When the announcer signs off the clock is again set for the next period.

In July, 1923, it was decided to attempt repeating over a greater distance, with the object of transmitting the programs of KDKA to the Pacific coast. A series of tests was made between KDKA at East Pittsburgh and points intermediate between St. Louis, Mo. and Denver, Colo., to determine the maximum distance from KDKA that the secondary transmitter could be located. After the completion of this investigation, it was decided that the point in question was roughly near the center of the boundary line between Nebraska and Kansas.

Near Center of United States

The locating of a city or town having the desired facilities for power and suitable space available was next necessary. The city of Hastings, Nebraska, seemed to meet all necessary requirements, and arrangements were made to locate the equipment at that place. Hastings is located almost ideally for the purpose of repeating programs from Pittsburgh so that they may be heard with ordinary receiving equipment throughout all the middle west and can be heard on the Pacific coast with less elaborate equipment than is necessary to receive directly from KDKA.

The new station is very close to the center of the United States. The country around Hastings is level and the particular location is relatively free from static and other radio interferences. The nearest broadcasting station of 500 watts or more is at Omaha, Nebr., a distance of 142 miles. Hastings is almost 1,000 miles from Pittsburgh and 1,200 miles from Los Angeles. Under

CANADIANS IN CONFERENCE

Recent session of prominent radio men and officials of the Department of Commerce at which 450 meter wave length for ship and shore communication was discussed and suggestions made for an allotment for another wave length. Photo shows Canadian radio men who were present at the conference. Left to right—C. P. Edwards, director of department of Marine and Fisheries; W. A. Rusch, Supt. of Canadian Government Radio service; J. H. Thompson and H. M. Short, general manager of the Marconi Wireless Telegraph Company of Canada.

ordinary conditions its programs should be heard at any point west of Pittsburgh. The opening program was received on loud speakers at Washington, D. C., about 1,100 miles and New York City, over 1,200 miles from Hastings.

Although designed primarily for repeating programs from KDKA, a complete studio is provided at Hastings where local programs will be given at regular intervals. The first program on the night of November 22, was given partly from Hastings and partly from East Pittsburgh. The principal address delivered in the studio at East Pittsburgh was received with loud speakers at a convention in session at Salt Lake City, Utah, 700 miles distant from Hastings and 1,700 miles from Pittsburgh. Reports from this convention and from other western points, as well as from New York and Washington, indicate that this first program was heard clearly over a wide range of territory.

When a program from East Pittsburgh is to be repeated at Hastings, KDKA transmits on its regular frequency of 920 kilocycles (326 meters) and at the same time sends out the same program on a carrier frequency of 3,200 kilocycles (94 meters). The 3,200 kilocycle wave is picked up at Hastings and the output from this receiver is used to control the radio transmitter at Hastings. In this manner programs from East Pittsburgh are rebroadcast with practically no time lag from KFXX at a frequency of 1,050 kilocycles (286 meters). Provision is also made at Hastings for repeating the signals at a second high frequency to a third more distant repeating station, when this becomes desirable.

Local Interference

The initial step, after Hastings had been selected as the location of the new station, was the installation of experimental equipment for both receiving and broadcasting. The problem of rebroadcasting or radio-repeating was then undertaken. As most of the major problems had already been worked out at Cleveland, the difficulties to be overcome at Hastings were mostly of a detail nature.

The most troublesome and perplexing of all details soon proved to be that of local interference caused by leaky power lines and the operation of electrotherapeutic apparatus by physicians and hospitals. Most of this equipment is based on resonant circuit principle and, because of the high decrement and overabundance of harmonics generally found, causes a constant band of interference from about 300 to at least 3,750 kilocycles. By experiment it was found that in the case of some of the above mentioned apparatus the radius of this area of interference was at least a half mile. Since it was impossible to remove this interference, the receiving equipment used to pick up the Pittsburgh signal was moved out of the city and placed about one mile north of the local transmitter.

In the new receiving location, it was found that the received speech level was satisfactory for repeating at all times except between 8 a. m. and 4 p. m. central standard time. Various primary carrier wave frequencies between 3,448 and 3,000 kilocycles were used in order to determine the most suitable one. Above 3,333 kilocycles it was found that the signal was maximum about 7 p. m., central standard time, and would fall to about ten per cent strength before 8 p. m. At 3,000 kilocycles the signal strength increased until about 11 p. m. and then remained approximately constant until about 4 a. m. From this data one would naturally assume that at some frequency between these two hours the strength of signal should remain constant at all hours. In fact, it so happened in all cases observed that slightly above 3,333 kilocycles the signal was relatively weak at all times although it apparently maintained a constant level from at least 4 p. m. to 9 p. m.

All of these effects on signal strength were also observed in Cleveland, Ohio, during January, 1923. No opportunity to corroborate the Cleveland observations was afforded, however, until the establishing of the Hastings station. It is of interest to note that the two sets of observations were taken after ten month's lapse of time, at different periods of the year, and with entirely different receiving and transmitting equipment. Since the most of the repeating was to take place in the evening, a frequency was selected near 3,200 kilocycles.

Antenna

The antenna is of cage construction, there being two cages of eight No. 12 copper wires each, on 1.5 inch diameter spacers. The cage length is 35 feet. These are swung tightly between ten foot cross arms at the tops of two fifty-four foot wooden poles, as shown in Fig. 6. The down lead is a 1.5 inch diameter copper tube rigidly supported on porcelain insulators from one of the poles. The antenna ammeter and additional loading inductances are connected in series with the down lead part way up the pole. An insulated counterpoise is supported on stakes a short distance from the ground and there is also an experimental counterpoise similar in construction to the antenna between the lower cross arms and the poles.

Studio

In addition to the repeating apparatus installed at Hastings, a local studio is also provided in the business section of Hastings. The room used is about fifteen by twenty feet. The floor and walls of this room are suitably padded to reduce sound reflection to a minimum. A complete condenser microphone system has been installed and used exclusively. A novel feature of this studio equipment is that "back to back" amplifiers are used entirely. The studio and station, separated nearly one mile, are connected by several telephone circuits, over which orders are sent to and from the studio and the program speech sent to the station.

Cost is Low

Tests that have been conducted up to the present time show that while constructional difficulties naturally increase at these high frequencies, the results obtained are most encouraging. The costs of construction, maintenance,

and operation of a high-frequency system of radio repeating is far below that of wire lines. The performance is also infinitely better from the standpoint of distortion of the audio signal transmitted. Contrary to the condition on wire lines, the speech frequencies suffer the same attenuation throughout the limits of audibility, thereby greatly improving the quality of transmission. There are two apparent advantages to wire transmission, in that the number of channels open to use has practically no limit, and that attenuation is constant at all times of day. In answer to the first advantage it may be said that assuming 3,000 cycles per second as the necessary wave band for radio use, 1,000 channels are available between 6,000 and 3,000 kilocycles. This is ample for the needs of this continent. Tests also show that it is possible to use carrier frequencies having satisfactory characteristics for daylight use.

Phonograph Stations

WABU, the new Victor talking machine broadcasting station at Camden, N. J., will soon give the public an opportunity to hear phonograph records in the making. That is, radio fans will be permitted to hear original records before they are released. When famous vocalists or musicians are about to perform for the reproduction on master phonograph records in the studio, a microphone will be placed alongside the recording apparatus and as the artist renders his piece for record the radio fans will hear it over the air.

The Columbia Graphophone Company, through co-operation of the A. T. & T. Company and station WEAF, will also start broadcasting new records soon.

This system is likened to "first nights" at operas and theatrical productions, seats at which are always sold at a premium or distributed to the elite and members of the press. By means of radio broadcasting, fans will now be permitted to hear new records before they are put on the market. It is a unique feature, welcomed by all receiver owners who await the advent with pleasant anticipation.

Schools Use Radio

For the first time in the history of education active use of radio broadcasting on an extensive and permanent basis as an educational aid was inaugurated on February 18, when the Board of Education of the city of New York, acting with the co-operation of the Radio Corporation of America, broadcast through station WJZ the first of the daily educational radio programs which have been scheduled.

These programs, arranged by the newly created radio committee of the Board of Education, are broadcast from 2 to 2:30 o'clock on every school day. A special and permanent broadcasting apparatus is to be installed in the office of Dr. William L. Ettinger, superintendent of schools, and the programs on every Tuesday afternoon will be broadcast by WJZ directly from there. On all other school days the programs will be given at the studio of station WJZ at Broadcast Central, Aeolian building.

The programs are designed primarily to acquaint the people with the work of the schools, educate the public as to education.

SON OF GREAT COMPOSER

Siegfried Wagner, son of the great German composer, Richard Wagner, speaking from Station WJZ, when thousands of radio listeners heard his appeal for $200,000 which will enable him to resume the musical festivals at Bayreuth, which were originated by his father.

More Stations

The limits of "Radio Land" are being extended so rapidly on both land and sea, and so many fans are asking for aid in identifying stations outside our borders, we are listing hereafter the neighboring foreign broadcasting stations.

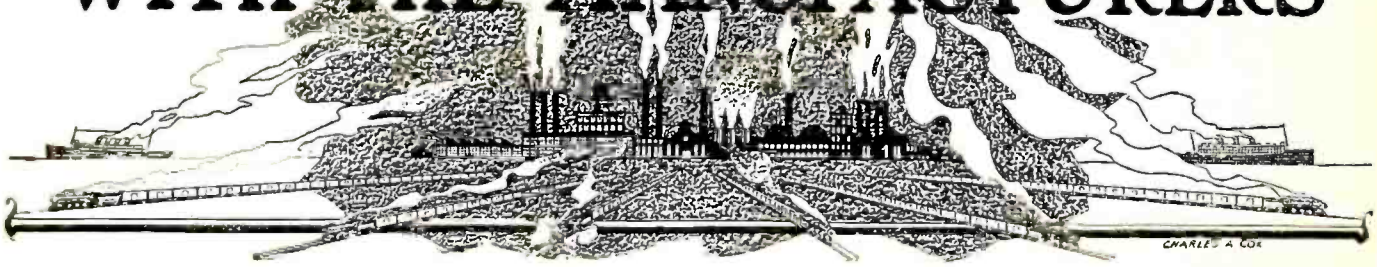
In Canada, for example, there are now thirty-six stations broadcasting, many of which are heard in the states. They all are identified by their initial call letter "C," assigned to the dominion by the International Bureau at Berne.

Cuba has thirty-one stations which broadcast, eighteen of them situated in Havana. Except for well-known PWX, these stations all have initial numbers instead of letters, and are in consequence sometimes confused with American amateur stations, which also start with the district numbers.

With the licensing of KFNG, at Coldwater, Miss., on January 18, every state in the union had one or more broadcasters, it was learned at the Bureau of Navigation, Department of Commerce. This is not the first time, however, that each state has been listed; last year a broadcasting station opened up in Corinth, Miss., which completed the roster, but this station later dropped out, leaving one of the forty-eight states unrepresented.

During January, twenty-seven new broadcasting stations started operation and twenty signed off for the last time, the Department of Commerce states. Broadcasting gained seven stations, and on February 1, stood at 554 stations.

WITH THE MANUFACTURERS



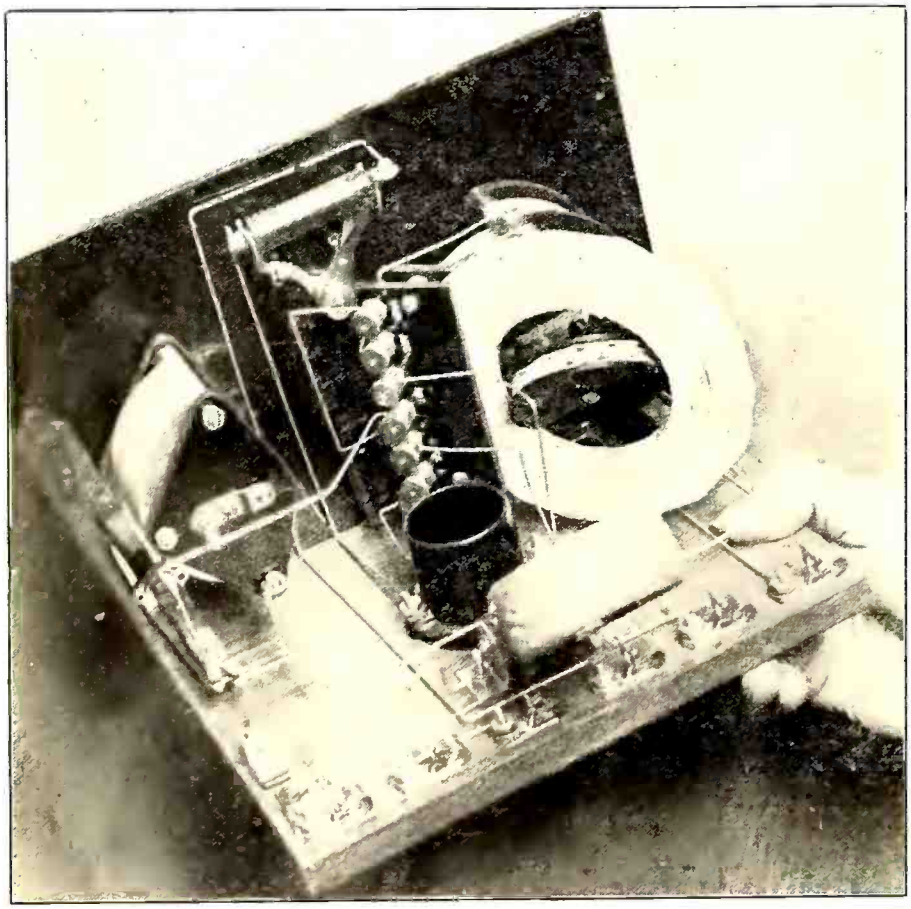
Summer Business

The danger of permitting radio to become a seasonal business is pointed out in a recent speech by David Sarnoff, vice-president and general manager of the Radio Corporation. Since the radio combine has more at stake than any other individual or collective interest, Mr. Sarnoff's advice should carry weight. He said:

"I think one of the dangers to the radio manufacturer at this time, and of course ultimately to the distributor, is the thought which is in the mind of a great many distributors, apparently, that radio is a desirable thing because it offers an opportunity for sales during a period of the year when other lines of merchandise do not move readily, and I think that the distributor and the dealer today, more than any one else, are making radio a seasonable business. There is not the slightest excuse, in my opinion, for having a seasonable business in radio. It has been amply demonstrated that people will use radio in the summer, when you give them sets at the right prices, in the right way and with the proper convenience.

"What are the dangers of a seasonable business? The season only lasts a few months, and it takes two or three months to get up steam. You are losing momentum as you are going downhill, and you have a valley in the curve when you are doing nothing, and you force new patterns, new designs, because you want to start off at the beginning of the season with a new line of merchandise. When you find yourself at the end of the season with an old line of merchandise you want to give it away to get rid of it. You don't want it on the shelves. That is true of the cloak and suit business. If you get into that kind of business, however, neither the manufacturer nor the distributor is going to be happy. The manufacturer has got to keep his factory running all the year. round. He has to have quantity production, so as to reduce prices. He has to carry on consistent and insistent national advertising. He has to have an inventory and the like.

"Therefore, unless there is a very good natural reason over which you have no control, for creating a seasonable business—you can't sell overcoats in the summer—I say you are heading for trouble if you do create such business merely because it happens to fit in with your situation at the time. You must avoid that in every way possible."



NEW "LONG-45"

Another new circuit has appeared in the radio field. Using but one tube, it works on a loop aerial. It is really a new type of regenerative circuit construction, using a special type variable inductance and other parts.

Distortionless Amplifier

Continuing their work of improvement of radio station WBZ in Springfield, Westinghouse engineers are putting in the latest devices and apparatus developed for better broadcasting of all types. The most recent addition to the excellent equipment of this New England station is a voice amplifier of entirely new design which reproduces and magnifies the sound impulses without distortion before they are "fed" to the station's transmitter.

Radio Exports Grow

Radio exports for the year 1923, totaled $3,448,112, compared with $2,897,799 last year, according to Department of Commerce statistics. While the shipments of radio apparatus form only about five per cent of the total value of all electrical exports, which in 1923 passed the $72,000,000 mark, radio exports increased about seven per cent out of a total gain of $9,000,000. December radio exports totaled $335,308, compared with $381,827 for November and $270,061 in October.

Cockaday Coil

The Precision Coil Company, Inc., is the exclusive manufacturer of the Authorized Cockaday Coil. It is authorized by him and each coil bears the word "approved" above his signature. It is wound on hard rubber tubes (one eighth inch wall) with No. 18 double silk covered magnet wire. All terminals have copper soldering tabs and are located to give shortest leads possible to the condensers. Nickeled fittings give the coil a finished appearance. There is no shellac, paint

Your Radio Problems Solved for 30 Cents in Stamps

IF YOU are constructing a receiving set, and you need help in the way of clear diagrams and full detailed descriptions you may have it by return mail.

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 of several issues already has been exhausted.

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.

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.

January, 1923

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

May, 1923

—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz 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.

September, 1923

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

October, 1923

—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.

February, 1924

—How to make a battery charger.
—Improved Reinartz Circuit.
—Interference rejectors
—Single Tube Heterodyne.
—How antenna functions.
—Adding two audio stages to selective receiver which began as a crystal set.
—Superdyne receiver.

RADIO AGE, Inc.

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

or varnish on the coil. The manufacturer claims for it: High dielectric strength, low moisture absorption, maximum sensitivity, minimum capacity effect, low leakage, high selectivity. The price is $5.50.

The Teledyne

A new four-tube radio receiving set, to be known as the Teledyne and employing engineering features which overcome radiation, generally credited as the worst form of radio "interference," is announced by Bowden Washington, chief engineer of the Cutting & Washington Radio Corporation.

The receiver, according to Washington, has the following advantages over the conventional double circuit set:

1. Will not transmit.
2. Increased volume.
3. Greatly increased range.
4. Somewhat increased selectivity over the best conventional double circuit sets.

"It has for some time been evident that the customary 'transmitting' regenerative set was becoming a grave menace to the future of radio and yet this principle which so greatly increases volume and range could not be discarded," said Washington.

"Experiments made in view of overcoming this problem of radiation led to the perfection of the Teledyne, a set which takes advantage of this previously known method in the radio art of securing volume, range and selectivity but does not throw wave impulses into the air and annoy neighboring sets.

"The first stage of the Teledyne circuit operates in the following manner:

"It is well-known that when a resonant circuit, consisting of an inductance and a capacity in parallel is placed in series with the plate circuit of a vacuum tube, the grid circuit of which is also resonated to the same frequency, the resonant plate circuit will produce oscillations and somewhat off this resonant point, 'negative resistance' or regeneration. If this circuit is coupled with the plate circuit with sufficiently close coupling

the same phenomena will occur. If, however, the coupling is at a certain critical value regeneration can be produced without possibility of oscillation. This latter value is that used in the Teledyne.

"The antenna circuit consists of the usual inductance but of two values, tuned by a series condenser, which, by the way, operates a cam switch choosing either of these inductance values over the two available 180 degree scales, with the grid-filament input leads across this inductance.

"The plate circuit of the first stage is coupled, at the critical value mentioned heretofore to the grid inductance of the detector, which latter is tuned by the usual variable condenser. The adjustment of this condenser resonates the detector grid circuit and at the same time regenerates the radio-frequency amplifier, thereby increasing its response by lowering the antenna resistance.

"The antenna inductance which is also the grid inductance of the radio-frequency amplifier is carefully mounted at minimum coupling position with the detector grid inductance. This is necessary in order to prevent parasitic feed back causing oscillation of the first tube and, incidentally, as the detector is the only tube which can be over regenerated and oscillate, this minimum coupling position prevents these oscillations from getting into the antenna circuit.

"The tuning of this set is extremely simple and either of two methods may be employed. First, the regeneration of the detector may be left low and the antenna condenser and detector grid circuit tuning condenser may be handled in a manner resembling the tuning of a one-stage neutrodyne. The second method is similar to the usual manner of handling a two circuit regenerative receiver i. e., oscillate the detector, turn its condenser until a heterodyne note appears, tune the antenna until it is loudest and reduce the regeneration. The difference is that the heterodyne note does not go out on the air and become a pest for several blocks in all directions.

"Owing to the double use of regeneration this receiver with four tubes is more sensitive than the conventional five-tube neutrodyne.

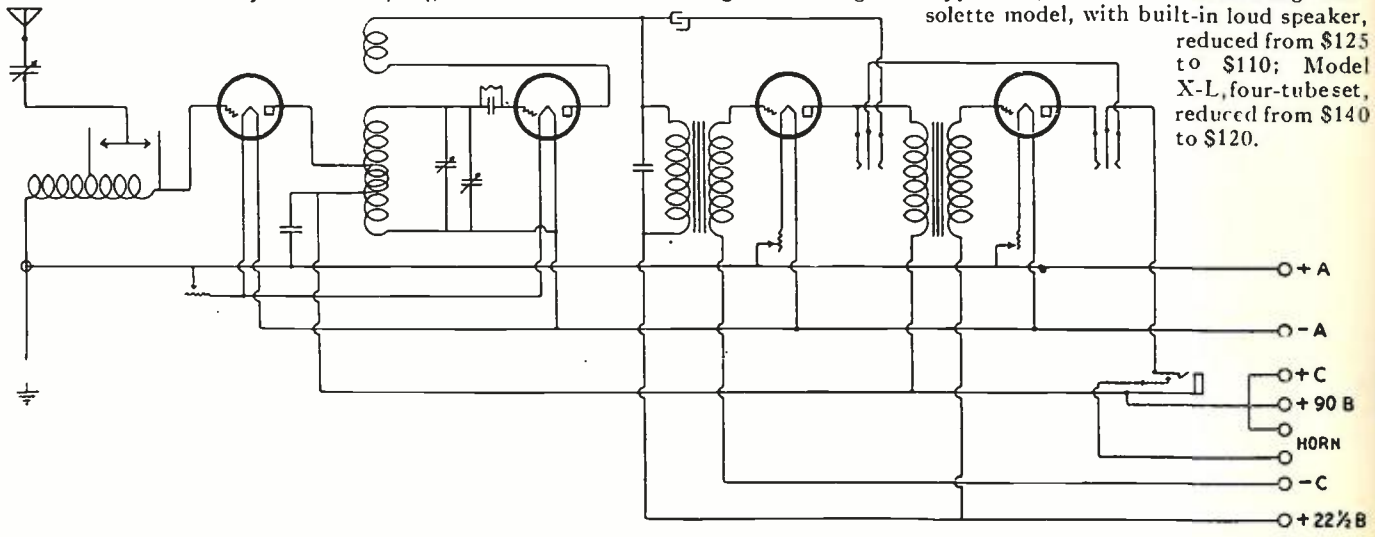
"It is of course extremely simple with the neutrodyne to tune a station once logged, as it is with this set, but it is somewhat more difficult to pick up new stations. Hunting for new stations with the Teledyne is as simple as with the old-fashioned single circuit receiver but without its drawbacks.

Crosley Lowers Prices

The Crosley Radio Corporation announces that greatly increased production makes possible the reduction of prices on the various complete sets manufactured by the big Cincinnati company. The Crosley Company makes more receivers than any other organization in the world and its announcement will be of general interest to the trade and to the radio public.

A new two-tube receiver is offered consisting of Armstrong regenerative detector and one stage of audio frequency amplification, giving loud speaker volume on local stations at all times and on distant stations under fair receiving conditions. The instrument, known as the Crosley Model 51, sells at $18.50.

Reductions on other Crosley sets are as follows: Type V, single tube regenerative, reduced from $20 to $16; two stage audio frequency amplifier to match the Type V, reduced from $20 to $18; Model VI, two tube receiver, reduced from $30 to $24; Type 3-B, three-tube Armstrong regenerative in mahogany cabinet, reduced from $50 to $42; Model X-J, four-tube receiver, reduced from $65 to $55; Type 3-C, three-tube Armstrong consolette model, with built-in loud speaker, reduced from $125 to $110; Model X-L, four-tube set, reduced from $140 to $120.



TELEDYNE DIAGRAM

Wiring diagram of the Teledyne, four-tube receiver which Cutting & Washington offer with the announcement that it will not transmit and that it has good range, volume and selectivity.

Hongkong Listens In

The urge to broadcast and listen in has reached Hongkong, China, where a few foreigners interested in radio got together about eight months ago and formed the Hongkong Radio Society, membership in which now numbers over a hundred, Consul Webber reports to the Department of Commerce. Today there are over 500 listeners in but it is estimated that this number will be doubled within a year's time.

So far there are only two broadcasting stations in Hongkong, the consul states; one, a 100-watt American set, operated by the local telephone company which transmits phonograph music for an hour each evening; the other, a ten-watt Canadian set is operated by the Radio Communication Company, Ltd.

WLAG Record

Minneapolis, Minn.—Another American radio broadcasting record was recorded when a letter was received by the Cutting & Washington station, WLAG, from Mrs. Charlotte Jorgenson, Kragero, Norway, saying that the writer and her husband had been listening regularly to WLAG concerts.

The letter, addressed to Mrs. A. H. Dieseth, Minneapolis, a neighbor of Mrs. Jorgenson when the latter lived in Minneapolis, said Mrs. Jorgenson heard Hazel Dieseth, a daughter of Mrs. Dieseth, sing on a WLAG program and recognized her voice and name.

It is approximately 5,176 miles from Minneapolis to Kragero, Norway.

Radio exports for the year 1923 totaled $3,448,112, compared with $2,897,799 last year, according to Department of Commerce statistics.

CLASSIFIED ADVERTISEMENTS

Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 15th of month for succeeding month's issue.

HELP WANTED

U. S. Government Positions. $100 to $250 month. Quick increase. Become Railway Mail Clerks—City Mail Carriers—Postoffice Clerks. Income Tax Auditors. Steady work. No strikes—no layoffs. Pleasant, interesting. Short hours. Paid vacation. Influence unnecessary. Schedule examination places—free. Men-women, 18 up. Write immediately. Franklin Institute, Dept. G, 114, Rochester, N. Y.

FREE HOOKUP

Sixty-thousand miles on Home-made Receiver. Twenty-six hundred mile range. Hundred-station log and Hookup free. Spencer Roach, 2905 Columbia Avenue, Philadelphia, Pa.

BOOKS

If you have not bought your Reinartz Book, fully illustrated with hook-ups and clear description of how to make this popular circuit, send $2.50 in money order or currency and we will send you the booklet "Reinartz Radio" and place you on the subscription list of Radio Age for one year. Address Radio Age, 500 N Dearborn Street, Chicago, Ill.

RADIO CALL CARDS printed TO ORDER. Red call, black printing. 100, $1.75; 200, $2.75, prepaid. Color changes 35c extra. Government postals 1c extra each card. LETTERHEADS 8 1-2x5 1-2 AND ENVELOPES, 100 EACH, $2.25; 200 EACH, $3.25. ARRL emblem used on cards or stationery if requested. Send TODAY. Department 62C, Radio Printers, Mendota, Illinois.

RADIO ODDS AND ENDS

No. 14 square tinned bus wire— 2 ft. lengths—64 feet for $1.00. $1.20 set of 8 lettered binding posts—60c. Spaghetti—3 ft. lengths, red, yellow, green or black—7 lengths—21 ft.—$1.00. 50 assorted brass screws, nuts, washers, lugs, etc.—50c. All four items prepaid return mail—$3.00. Redio list for stamp—none free. Kladag Radio Laboratories, Kent, Ohio.

FOR RENT—Factory with wood working machinery and power installed, suitable for making Redio Cabinets. Also office and show room if desired. William H. Gardner, 7326 Roosevelt Road, Forest Park, Ill.

Acme Charger

The Acme battery charger for radio A and B, also automobile batteries has recently been brought out on the market. The capacities that these battery chargers are built in are two ampere and five ampere sizes with an attachment on both sizes to charge up to and including 36 B type cells

The construction and design is unique, and the operating characteristics are such that Radio A batteries can be charged while set is in operation.

These battery chargers are being manufactured by The Acme Electric and Manufacturing Company, Cleveland, Ohio.

Selectoformer

The need of variocouplers, switches, taps, etc., is largely done away with by the Selectoformer just designed by the Electrical Research Laboratories of Chicago. The manufacturers announce that it permits of greater selectivity in practically any tuning unit now using a variocoupler, except in one-tube reflex sets. It requires no adjustment and has for its main object the coupling of the antenna to the receiver without causing a broadening of signals.

The antenna circuit is never tuned to resonance with any particular incoming signal and coupling of signal to the receiver is only sufficient to excite the receiver at the wave length to which it is tuned, without adding the resistance of the antenna circuit to the secondary circuit, which always causes a broadening and loss of signals.

With the usual variocoupler it is possible to reduce the inductive coupling between the primary and the secondary to a very low value, but capacitive coupling exists which allows as full a coupling as if the total inductive coupling were maximum. The inductive and capacitive coupling between the primary and secondary circuits is always fixed at a very low value by the selectoformer. With other fixed couplers, reducing the coupling reduces the volume of signals.

The Selectoformer, due to its particular design, reduces the resistance of the secondary circuit and therefore increases the signal volume.

The selectoformer increases the selectivity when substituted for a variocoupler, or loose coupler, and is especially good in the two and three tube reflex sets.

It also makes an excellent wave trap when used with a 23-plate variable condenser and when so used it actually adds to the strength of the incoming signals. It also prevents reradiation from regenerative sets, or others which oscillate, when it is used as an absorbing circuit for such oscillations.

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.

Radio Music Fund

Clarence H. Mackay, Felix M. Warburg, Frederick A. Julliard and A. D. Wilt, Jr., announce that they have constituted themselves a committee to be known as the Radio Music Fund Committee, with the object of raising a fund to be known as the Radio Music Fund for the purpose of broadcasting radio music concerts by the world's greatest artists.

The committee has selected station WEAF, the broadcasting station of the American Telephone and Telegraph Company, 195 Broadway, New York City, to broadcast the proposed concerts because

of the well-known quality of transmission from this station. Concert Management Arthur Judson, manager of eminent artists and of the Philharmonic, Philadelphia and the Cincinnati orchestras, will handle the engagement of artists for these concerts.

The members of the committee, who are already well known for their activities in support of things musical, believe that radio offers a wide and hitherto undeveloped field for stimulating the increasing public interest in good music. The committee hopes through the Radio Music Fund to afford to thousands of people, who for one reason or another are unable to be present at concerts and the opera, the opportunity of hearing by radio, the world's best musical talent.

Prominent broadcasting stations have received hundreds of letters from the radio audience not only expressing appreciation of programs but offering to contribute financially toward the immense cost of maintaining programs. The Radio Music Fund Committee offers the organization through which the radio audience can contribute to the financial support of radio music programs.

The committee has designated Central Union Trust Company of New York to act as depository of the fund. All contributions should be made payable to the Radio Music Fund and sent to Central Union Trust Company of New York, 80 Broadway, New York City, and should be accompanied by the name and address of the contributors. The depository will acknowledge receipt of contributions by postcards

The committee invites contributions to the Radio Music Fund of from one dollar upwards. The fund will be held by Central Union Trust Company of New York subject to the order of the committee and will be expended under the direction of the committee. If, in the opinion of the committee, the contributions received are not sufficient to warrant going ahead with the plan, the committee will notify the bank to that effect and all contributions will be returned as far as possible to the contributors.

All funds contributed will be used for obtaining the service of artists and for direct expenses, and a financial statement will be published or sent to the contributors at the close of the season.

If, after the presentation of radio concerts shall have begun, the committee shall deem it advisable to discontinue such concerts, any balance remaining in the Radio Music Fund may be returned to the contributors or disposed of for musical or educational purposes as may be determined by the committee.

The expense of broadcasting will be borne by the American Telephone and Telegraph Company and aside from incidental expenses in connection with the administration of the fund, the entire contributions of the radio audience will be available for the maintenance of broadcasting programs. When contributions sufficient to warrant it are received, the committee will endeavor to engage the services of prominent artists to appear

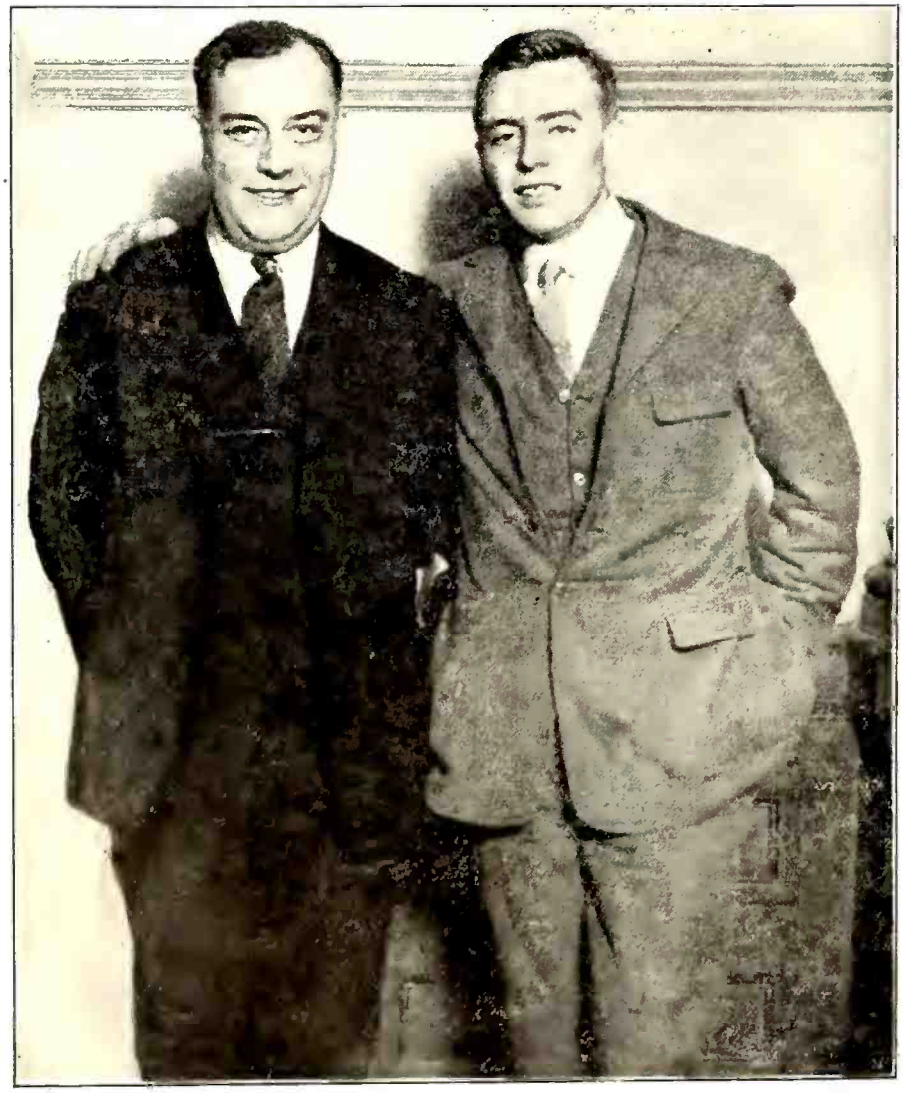
during the remainder of the present season which ends May 1. In the future, if the plan works out successfully, a more definite organization may be effected and the concert season extended over a longer period.

Broadcasters inform RADIO AGE that it is the avowed intention of the American Telephone and Telegraph Company to control broadcasting. It is suggested that one result of the fund plan, as described in the foregoing, would be to introduce the practice of paying performers who now are quite willing to entertain the radio millions without pay. It is pointed out that with such a fund the bigger companies might be able to pay their entertainers and thus make it very difficult for other broadcasters to obtain the services of artists without paying them. Thus the old plan to drive out the independent broadcaster by depriving him of his entertainment and make of broadcasting a virtual monopoly in the hands of the few would be furthered.

Radio Writers Entertained by the Allen-Bradley Company of Milwaukee

THROUGH the courtesy of the Allen-Bradley Company of Milwaukee, a few well known writers of radio articles were invited to inspect the factory where the Bradleystats and Bradleyleaks are manufactured and to attend the meeting of the American Radio Relay League, held in Milwaukee on February 14. The party, which was conducted to the Wisconsin city by Mr. Gohl, Chicago representative of the company, consisted of Mr. David Grimes, of the Sleeper Radio Corporation of New York, Mr. E. T. Flewelling, Mr. Harry J. Marx and Mr. Milo Gurney of the Radio Digest and Mr. Frank D. Pearne of Radio Age. Under the careful guidance of Mr. Gohl the party reached the factory without mishap and spent the entire afternoon inspecting the latest modern methods of manufacturing. This factory is certainly a credit to Milwaukee. Everything used in the construction of their apparatus, with the exception of the porcelain units, are manufactured under one roof, even to the carbon discs used in the resistance units. Up-to-date testing methods and inspections assure one that the finished product is as perfect as human intelligence can make it. Mr. Harry Bradley personally conducted the party through the factory and explained in detail how everything, from the tiny Bradley switches to the gigantic power controllers, are constructed, after which he took the party to the Milwaukee Athletic Club for dinner. At the Club the party was joined by several members of the Allen-Bradley Company, Mr. Bruns of Radio Age and some of the members of the American Radio Relay League. After a splendid supper, the host, Mr. Bradley, finally got the party started for the A. R. R. L. meeting, where they arrived in time to find the hall so crowded that even standing room was at a premium. This large attendance shows the interest which the A. R. R. L. members take in their meetings and speaks well for the future of radio. The meeting was turned over to the visitors, who talked on many subjects pertaining to radio. Mr. Marx gave the first talk, which covered a description of the different types of receiving sets, from the crystal to the king of them all, the super-heterodyne, touching upon the merits of each and explaining their proper application. He was followed by Mr. Flewelling, who gave a splendid discussion on the use of good apparatus and careful construction, clearing up considerable confusion in regard to the reason why some radio enthusiasts get good results, while others fail. Mr. Grimes then took the floor and told of the development of radio, starting with the time when Alexander Graham Bell transmitted the first radio message on a beam of light and stated that at the present day we are still transmitting radio messages on invisible beams of light. Mr. Pearne followed Mr. Grimes with a brief talk on his experience in building the Grimes Inverse Duplex. The next and last speaker was Mr. Milo Gurney, who started in to chastise two offenders who had caused some interference with spark sets and then told what the A. R. R. L. had done to clear up interference of this kind, having finally succeeded in making the air practically clear during the hours of broadcasting. He also explained that most of the code messages heard during these quiet hours were sent out by ships on both the Atlantic and Pacific oceans. The party broke up at the Athletic Club, an hour or so later, all agreeing that it was the end of a perfect day.

The Chairman of the meeting was Edward T. Howell, 9CVI, President of The Milwaukee Radio Amateurs' Club, Inc.



SMILING EXPERTS

Frank D. Pearne, on left, and David W. Grimes as they were snapped at Milwaukee where they attended a radio dinner with other wireless notables as guests of the Milwaukee Radio Club and of the Allen-Bradley Co. Mr. Pearne is Technical Editor of Radio Age and Mr. Grimes is the famous "Inverse Duplex" genius.

Station for Farmers

Sears-Roebuck Agricultural Foundation is building a new broadcasting station which is being erected by the foundation to broadcast agricultural as well as entertainment programs. Samuel R. Guard, is director of the foundation.

The new station will be located on the main building, in Chicago, using the fourteen-story tower for one aerial post. Another post of equal height will be erected on the opposite side of the building. The station, unless other arrangements are made, will have a wave length of 448 meters, and will be the largest made and sold by the Western Electric Company. It will carry a class "B" license, the highest issued by the government. The studio will be located on the eleventh story of the tower, with the operating room on the fourteenth floor. In addition to the main studio, there will be a branch down town in the loop district, with special leased wires through the city to points of advantage for the entertainment features of the program, which will include the best music and theatrical talent. By having the station located in the open district and free from the absorption by all buildings, it is estimated that it will be possible to put more energy in the air than any other station in Chicago.

Theatrical stars will bring the stage to the farmers' parlor, and there will be bedtime stories for the country kiddies. An interpretation of market trends and a current events feature, explaining what is going on in agriculture all over the world will be given, according to Mr. Guard. This new station, which will be the only one in the United States broadcasting exclusive agricultural programs, will be completed early in March. L. P. Dryden will be director of the studio.

Airplane Telephony

By LLOYD JACQUET

While speeding westward at a 120 miles an hour rate, Airmail Pilot Jack Knight, in his radiophone equipped plane, convinced officials of the Post Office Department and engineers of the Westinghouse Electric Company that two-way radio telephone communication between an airship and the field was possible.

Jack Knight left Omaha, bound for North Platte, one of the regular stops on the transcontinental air route, on a test flight early this week. Eugene Sibley, radio traffic supervisor of the United States Airmail Service, was his only passenger. The radio equipment in the plane had been tested previous to his taking off, and found to be in perfect operating condition.

The airmail field at Omaha, which is the headquarters of the superintendent of the western division of the airmail service, had been chosen by General Superintendent Carl F. Egge as the place at which the new one kilowatt Westinghouse radiophone transmitter was to be installed. As Omaha is practically the midpoint on the New York-San Francisco journey, the location of this powerful unit is ideal from a point of centralized communication east and west. It was by means of this specially designed and built set that the officials of the airmail field at Omaha kept in touch with Knight's plane as he was flying to North Platte.

For nearly three hours, that is, the time it took for the pilot to fly between the United States Airmail fields at Omaha and North Platte, signals were exchanged between the speeding airship and the men in the radio room of the Omaha field. A schedule had been worked out, whereby the pilot would "report" to the division superintendent the progress of the plane as it speeded across Nebraska. The voice of the pilot was received clearly, and was received on a loud speaker in the radio room of the field, so that Superintendent D. B. Colyer, special assistant of Postmaster General J. V. Maggee, Mayor J. C. Dahlman, of Omaha, R. L. Davis, radio engineer of the Westinghouse Electric, members of the press, and many others followed the progress of the plane with a map.

When the Post Office Department undertook to transport mail by means of airplanes, the necessity for some means of communication between fields, and between planes and fields was plainly

(*Continued on page 49.*)

RCA Tells Why Tubes Dropped

HEREWITH is published a part of an open letter issued by David Sarnoff, of the Radio Corporation of America. Because of certain facts and conditions well known to the radio industry the drop in the price of vacuum tubes was not surprising but it caused so much interest among tradesmen and buyers of receiver equipment that some space is given to it. The letter follows:

ON January 11, 1924, the Radio Corporation of America reduced the list price of its standard line of receiving radiotrons from $6.50 to $5.00 each. Notice of this reduction was given at the same time by telegraph to all our distributors, and no one was given any advance information or special advantages in connection with this change. The public was informed through suitable advertisements in the leading newspapers of the country on the same day that the lower price became effective.

We have heard from a number of our distributors, who have frankly expressed themselves with regard to this matter, and while some have complimented us on the action taken, there are others who criticised our policy in this particular instance.

The purpose of this communication is to inform our distributors and dealers, with equal frankness, of the circumstances obtaining in this case, which have led to the position taken by the Radio Corporation.

Why was the list price of radiotrons reduced from $6.50 to $5 each?

1. Because the RCA desired to give to the public, as quickly as possible, the benefits of a reduction in price on an article of merchandise which had become standardized in manufacture and on which manufacturing economies on tubes now being produced were made possible through continued and increased public demand for this article.

2. Because the RCA desired to enable its distributing channels to be in a position to offer to the public the best known tube in the world today at a price which would discourage "bootlegging," infringement and unfair trade practices on the part of those whose present activities in the radio market tend to destroy rather than build up public confidence.

3. Because the RCA believes that this decrease in price will bring increased sales and thereby enable more balanced production at the factory, less fluctuations on the market and greater popularity for radio itself; all of which advantages are distributed over the manufacturer, distributor, dealer, consumer and, therefore, over the industry as a whole.

Why did the RCA put this reduction into effect overnight without previous notice?

1. Because it desired to avoid any possibility of individual advantage on the part of one distributor or dealer at the expense of another, which might have resulted from advance notice of the contemplated reduction.

2. Because previous experience on the part of other manufacturers, as well as ourselves, has amply demonstrated the impracticability of avoiding the undesirable effects referred to in the preceding paragraph, except by an instantaneous overnight notice in the case of merchandise having national distribution, as in this case.

3. Because it has been suggested to us from time to time in general discussion and without reference to any particular case, that where a change in price is to be made, the trade generally prefers to have it become effective overnight through simultaneous notification.

What is the financial effect on the jobber and dealer as a result of this price change?

1. While we fully understand that as a bookkeeping proposition the distributor measures his loss on stock in terms of what he would have earned if the price change had not been put into effect, nevertheless it must be recognized that this is not the true measure of actual financial loss. The actual loss is the difference between the price paid for the article and the price at which it is sold, minus the cost of doing business. In this particular case, as a result of the change which went into effect, the jobber will receive in cash fifteen cents less than he paid for the tube he had in stock on January 10, 1924. On the same basis, the dealer will receive thirteen cents more than the actual cost to him for the tube he had in stock on the same date.

Why did not the RCA make an adjustment on jobbers' and dealers stocks of tubes in inventory at date of reduction in price?

1. Because in this particular case the dealer would probably have felt justified in claiming an adjustment on his stock of tubes if an adjustment were made to distributors on their stocks. For the RCA to have adjusted on dealer's and distributor's stock of tubes, would have meant a financial loss to this corporation greater than it feels its distributors and dealers have a right to expect it to assume in view of all the circumstances recited above and in the paragraphs to follow.

2. Because the Radio Corporation of America, in the interest of its distributors and dealers, has always found it necessary itself to carry a large inventory—amounting to several hundred thousand radiotrons—in order that distribution should be prompt, uniform, and satisfactory to the trade and the public. The RCA uncomplainingly carries this heavy investment even in slack periods and now takes a very large loss itself, resulting from the reduction.

Complete Sets

Efforts are being made to standardize radio apparatus and the nomenclature which describes sets and parts. Is it not time all manufacturers and dealers standardized descriptions of sets? When is a set complete? How much more must one expend for tubes, batteries, aerial and for phones?

Just after Christmas, a woman called the Chesapeake & Potomac Telephone Company and asked for aid, explaining that although she knew WCAP was broadcasting, she could not get it on her new set.

The operator inquired if the tubes lit up, whereupon she asked what they were, and being told, said there didn't seem to be any in the set. Further inquiry showed that she had neither tubes, batteries, aerials nor phones, but that the donor of the gift supposed he had presented her a radio receiver ready for operation.

Other examples, such as this, convince of the need of better salesmanship and also of better advertising, for some advertisements are found to be misleading, although probably not intended to be deceptive. The dealer who sold the above set lost the sale of accessories and the purchaser was embarrassed and disappointed when he learned that vital parts were missing from the "set." The word "set" implies that it is a complete entity. An automobile salesman would not sell or advertise a car without a battery, headlights and tires; why should a radio salesman do so? If the set is not complete and ready to operate, why not say: "Without tubes, batteries or phones," as a few agencies do? Complete sets could also be advertised and then the purchaser would know just how much money he would have to spend.

Ship Interference

Amateur radio operators and the broadcasters, it appears, have "laid off" each other as far as interference is concerned, but both are now complaining of the ship interference, supervisors of the Department of Commerce point out. Needless to say, the ships must be permitted to communicate with the shore stations and each other, and while some of them may not have gotten over the idea that the "air" belongs to them, as it did virtually for years, they now claim with some justice that there are not enough channels for their necessary communication.

Ship operators report and supervisors agree that the wavelengths assigned to vessels are not all they should be. The 300 meter wave is not sufficient; the 600 meter wave, used for calling and for distress signals, is always in use, and the 706 meter wave can't possibly serve all the vessels operating. So far as it is known, it is understood that many foreign ships are not yet equipped to use 706 meters, which throws them on the 450 or 600 meter waves. Consequently the ships have to resort to the 450 meter wave assigned them, which is right in the middle of the broadcasting wave band. They are practically forced to use this wavelength for their position reports transmitted between 7 and 11 p. m. daily.

(Continued from page 47)

apparant. In fact, the need of a radio communication circut for such purposes was well appreciated by Second Assistant Postmaster General Paul Henderson as far back as 1919, when the earliest airmail service experiments were performed, using a radio direction finder.

Sence then, many developments have been made by the department, and more recently, tests have been inaugurated between flying planes and fields. In November, 1922, were begun the experiments which culminated in the demonstration held at the Omaha field nearly a year later with gratifying results.

Due to the farsightedness of Second Assistant Postmaster General Henderson, and to the vision of E. B. Mallory, radio manager of the Westinghouse Electric Company, the air service was able to conduct the first satisfactory experiments in communicating between the field and the flying plane.

The problem of communicating between plane and ground is a very peculiar one. Due to the technical limitations of the radio apparatus because of its reduced size and weight, and its operation with reduced antenna facilities and available power, the range of the aerial set is necessarily limited.

To reach the speeding plane from the ground has been equally as difficult. Due to the noise of the engine, local interference picked up by the receiver from the ignition and other electrical circuits of the motor, the use of a comparatively poor antenna system, and the limitations of the equipment in the plane the accomplishment is no small one.

The thousand-watt transmitter which was especially designed and built for the airmail service of the Post Office Department by the Westinghouse Electric Company is the first to be installed at any of the airmail fields. The range of the transmitter is estimated at about 300 to 500 miles daylight, and up to 1,000 miles at night. By means of this transmitter it is possible for the superintendents at the fields to talk to any of their pilots while the plane is in flight between fields, as these are less than 500 miles apart.

Can Radio Be Hooverized?

By CARL H. BUTMAN

COMPLAINTS relating to radio interference are received daily by Secretary of Commerce Hoover, who has become a sort of foster father of the art, now regulated under the 1912 law by his Bureau of Navigation. A recent and unique communication from a fan located on the Florida peninsula, where ship traffic is heard almost constantly, has caused amusement in high official circles. The letter which follows, voices a pathetic appeal from an apostle of Hooverism, and demonstrates the need for definite regulatory laws:

"My dear Sir:

"Help! ! ! ! !

"When you called upon me to conserve, I conserved. When you asked me to sweeten my food with the milk of human kindness, I got indigestion using Florida cane syrup in my coffee. When you asked me to come across, I stepped on the gas. When you asked for help for Near East, I went the limit. When you asked for help for Russia, I sent over a few safety razors and barber shears.

"I have been for you in your every endeavor. I have Hooverized until I didn't know hover who.

"Now *I* want RELIEF.

"I have seven hundred dollars invested in a radio set. It functions perfectly but every program is deadened or the fine passages lost by the damnable interference.

"And this not for one night but every night for a year back, and from any time in the day until I quit in disgust.

"Night after night I try until my patience is exhausted to get a decent reception—and maybe for a minute, sometimes two minutes—a song or music comes in as clear as a bell, and then some deep throated spark begins to shatter the atmosphere and the amplifier takes it up and another station is lost. Some damphool is playing with the keys of his transmitter—or telling some buddy or some other rumrunner that he has a date when on shore with some calico.

"There must be some relief. Were there periods of ten minutes even when one could listen in to lectures, songs or music without interference I would have no complaint. But it is incessant.

"Even when our President spoke his eulogy of Mr. Harding, the code kept jamming the atmosphere and I lost part of the beautiful message. Surely there can be some measure to protect three million radio fans from this insistent interference on every wave length—fellows using old-time sets with a spark as wide as Cumberland Gap that no wave trap can still nor any point on variocouplers, three condensers and four rheostats tune out.

"Dante's Inferno can be no worse than the noises that come to us here in the peninsula of Florida.

"In relief work, in drives, in everything you have accomplished the seemingly impossible—for God's sake let us have relief!

"(From a Florida Fan)."

Mr. Hoover's answer has not been made known, but it is understood that he realizes keenly the need for more authority to regulate radio, both ashore and afloat, even though the voluntary agreement laid down by past radio conferences has modified the radio interference. Legislation defining his duties and setting forth rules and regulations as to amateur, commercial, private and other forms of radio communication is urgently desired by the secretary, as well as additional appropriations and personnel for better and more frequent inspection of stations causing interference.

Chief Radio Supervisor W. D. Terrill, in connection with the recent radio conference on shipping interference, says that coastal stations near New York and most of the shippers have agreed not to use the 450 meter wave but to make greater use of the 600 and 706 meter channels, thus eliminating much spark interference. Other conferences in San Francisco and Seattle, are also reported to have come to practically the same agreement; using the longer wave lengths when off our coasts.

Types of Receivers

By A. K. PHILLIPPI, Radio Engineer, Westinghouse Electric and Manufacturing Company

THE radio columns of the daily papers are filled with questions asking for possible results from certain receiving sets; whether they are good for one hundred miles or a thousand, whether they will get this station or that, and a host of other details. It is evident that a short description of the different types of receivers and what may be expected of each will be appropriate, and will enable many to make a better selection which will more adequately meet the individual's needs.

A radio receiving set is an instrument which, when connected to an antenna, either of the elevated wire or loop type, is capable of converting the high frequency ether or wireless waves into air or sound waves, thus enabling the listener to hear speeches, broadcast programs or telegraphy.

There are many types of radio receivers, varying in sensitivity, selectivity, price and ease of operation.

The crystal receiver is the type most commonly used and the least expensive. This consists of a tuning coil and a crystal detector. Some of these have sharp tuning, or are more selective, while others have broad tuning. Sharp tuning is to be preferred, of course, as it helps to eliminate stations to which one does not wish to listen. The range of the crystal set is small, and on the average it is capable only of receiving signals within a maximum of fifty miles from the broadcasting station; this range depends entirely on the power of the transmitting station, the size of antenna and the sensitivity of crystal. With this type of instrument the music and other programs are almost an exact reproduction of that delivered into the transmitter, as very little distortion occurs. It is used near a broadcasting station and requires a large antenna for best results. Head phones must be used with this set. Receivers of this class are gradually losing their popularity for, as the owner becomes most interested in radio, he feels hampered with only a crystal set and wishes to reach farther out into ether for more distant stations.

Vacuum tube receivers.—The vacuum tube receiver consists of practically the same apparatus as the crystal receiver, except that a vacuum tube is used instead of a crystal for a detector. This set has a distinct advantage over the crystal set in as much as the detector remains adjusted once it is set, while the crystal requires careful adjustment and is easily jarred from a sensitive position. Another advantage of the vacuum set is that it is more sensitive than the crystal. Its sensitivity is, however, still limited, and head phones must be used.

Detector amplifier receivers.—This instrument is one in which the signals are detected by either a crystal or a vacuum tube. The signals are then strengthened by means of one or more stages of vacuum tube amplification, and may be built up to such an extent as to permit the use of a loud speaker.

Regenerative receivers.—By means of the Armstrong or regenerative circuit, amplification and detection with a single tube may be obtained in a receiver, which will give great sensitivity for distant signals. This set differs from others in that a regenerator or tickler coil is used and its function is to build up or amplify the detected signal. By the use of the instrument very weak signals may be heard. This set requires a little more careful adjustment than the other receivers mentioned.

Care should be taken in operating it to use its good qualities and not abuse them. With a little experience the operator will find that when the tickler or regenerator knob is turned to a certain place, the signals received are clear and strong. This is the point of maxi-

Corrected List of U. S., Cuban 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.

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.	244
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	Rhodes Department Store	Seattle, Wash.	270
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 Dist. of Boise City, Boise High School, Boise,	Idaho	270
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
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
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 Musio Store	Baker, Oreg.	360
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tuscon, 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	Bullocks' Hardware & Sporting Goods (Robert G. Bullock)	York, Nebr.	360
KFDV	Gilbrech & Stinson	Fayetteville, Ark.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanics 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.	226
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)	226
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Standford University	Stanford University, Calif.	360
KFGJ	Missouri National Guard. 128th Infantry	St. Louis, Mo.	266
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGV	Heidbreder 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
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oreg.	360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	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
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (H. 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
KFJQ	Valley Radio, Div. of Elect. Constr. Co.	Grand Forks, N. D.	280
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	248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	341
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	Franklinton, 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 Grande 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	249
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.	252
KFNC	Echo Park Evangelistic Ass'n., Inc.	Los Angeles, Calif.	278
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNH	State Teachers College	Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop	Warrensburg, Mo.	234
KFNL	Radio Broadcast Ass'n.	Paso Robles, Calif.	240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Cal.	234
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.	273
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.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple 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
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co.	Los Angeles, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
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	366
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
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.	380
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University o Mfissouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WABA	Lake Forest College	Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence	Harrisburg, Pa.	266
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
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
WARN	Waldo C. Grover	La Crosse, Wis.	244
WARO	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weindg	Dover, Ohio	266
WABQ	Haverford College Radio Club	Haverford, Pa.	261
WARR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WARS	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
WARW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WARZ	Coliseum Place Baptist Church	New Orleans, La.	263
WBAA	Purdue University	West Lafayette, Ind.	360
WRAD	Sterling Electric Co.	Minneapolis, Minn.	360
WRAH	The Dayton Co.	Minneapolis, Minn.	417
WRAN	Wireless Phone Corp.	Paterson, N. J.	244
WRAO	James Millikin University	Decatur, Ill.	360
WRAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Emer & Hopkins Co.	Columbus, Ohio	390

mum regeneration and by going past this point the sound becomes mushy. This mushiness indicates that the maximum regeneration point has been passed and that the receiver is oscillating. This not only destroys the quality of the signal but by radiating from the antenna a certain amount of energy, interferes with the neighbor's proper reception of the signal. This misuse has caused considerable unjust criticism of this type of receiver.

The regenerative loud speaking reciver combines the good qualities of the detector amplifier and the regenerative receiver, making possible the amplification of weaker distant signals to such an extent that the volume furnished is ample to operate a loud speaking device. One of the advantages offered by this instrument is that a small antenna may be used with no appreciable decrease in signal strength and the selectivity is increased, thus making it possible to tune out more easily the interfering stations.

Radio frequency receivers.—As this type of instrument, which is quite new to the majority of radio fans, can be used on a loop or short antenna it has helped fill the need for a set that can be used in a congested district such as in apartment houses or in places where the homes are so close together as to make it almost impossible to erect an antenna.

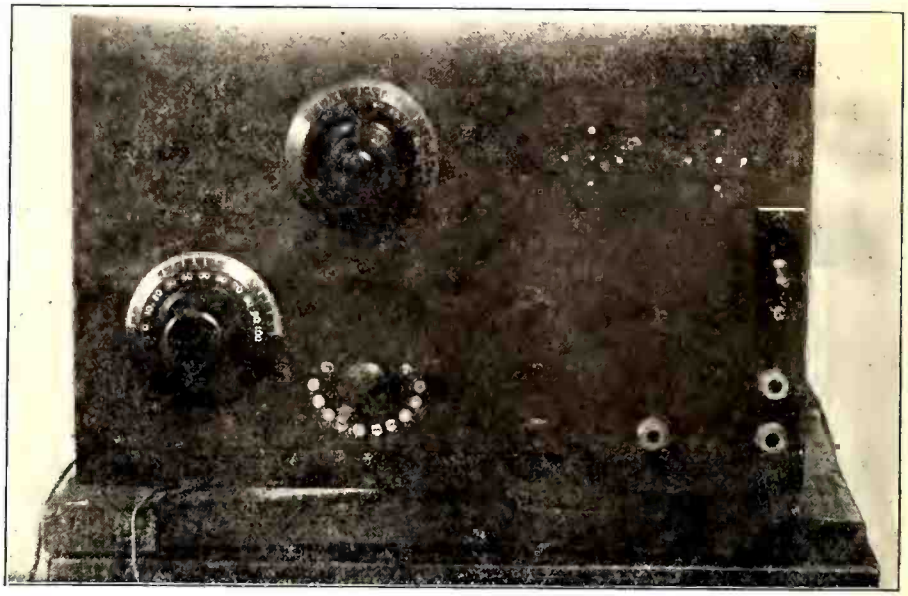
By using radio frequency amplification ahead of the detector tube, the radio waves are amplified before they are detected. Two or more stages of radio frequency are equal to regeneration, which means that to get the same results, one must have more tubes and batteries to operate this type. Instruments of this nature have been designed in cabinets which can be moved about the room with the same ease as a phonograph cabinet.

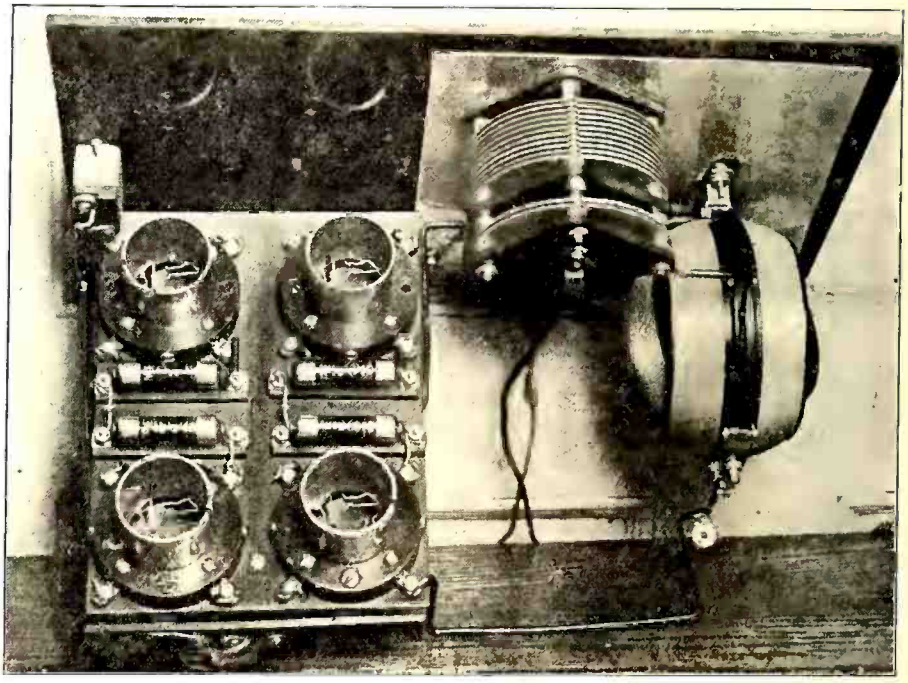
Armstrong's Radio Muffler

THE other day Major Edwin H. Armstrong visited the office of the Chief Supervisor of Radio in Washington. The Major has cut loose from radio for a while and with his wife is en route south in his machine, where he plans a month's vacation and honeymoon in Florida.

Future activities of the major, it is understood, will be devoted to a large extent in remedying interference troubles said to be caused by his famous regenerative circuit. A large amount of the difficulty encountered, it is believed, is due to poor manipulation, but he suggests the use of an additional tube of radio frequency, as a "muffler." Just as in automobiles where excess noises are eliminated by the use of an engine muffler, in the operation of the regenerative sets, a radio muffler can be incorporated. One exception is noted; in the automobile the muffler is placed after the engine, behind it, so to speak, while in a radio set the "muffler" should be put in front or before the regeneration.

No Rheostats





The above photographs picture a method used by a radio fan to eliminate controls for the filaments of the tubes. The cartridge types of resistance are of the proper value to be used instead of rheostats, thereby making the use of four extra controls unnecessary. The circuit is the conventional single circuit using a variocoupler as tuner. The panel view shows how simple the control of this set is. (Kadel & Herbert Photo.)

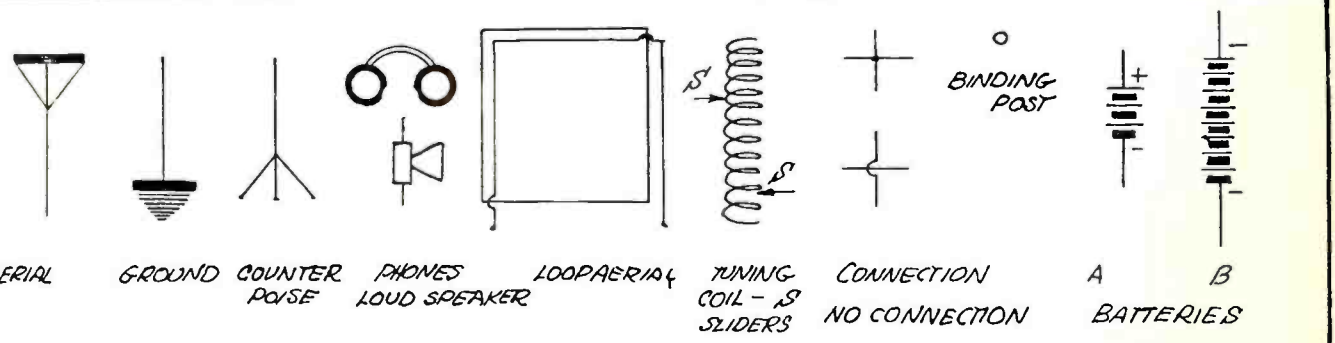
Hints on Transformer Shielding

When the magnetic or electrostatic field of one transformer is so located that it passes into the windings of the adjacent transformer, the first induces currents in the second which cause noises and which forms a by-pass around the amplifying tubes so that all of the energy is not amplified in the tubes. Where possible, the tubes and transformers should be spaced about 5 1-2 inch to 6 inch centers, but where so much room is not available we may have to resort to shielding the tubes and transformers by grounded metal partitions. The shielding, however, is not desirable since it causes losses and usually interferes with the proper arrangement of the wiring.

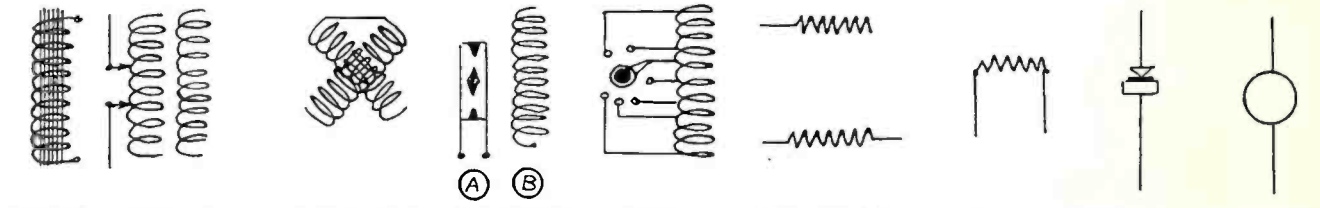
Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laboratories	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBF	Petoskey High School	Petoskey, Mich.	246
WBBF	Georgia School of Technology	Atlanta, Ga.	270
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBBH	J. Irving Belt	Port Huron, Mich.	246
WBBI	The Indianapolis Radio Club	Indianapolis, Ind.	234
WBBJ	Neel Electric Co., P. E. Neal	West Palm Beach, Fla.	258
WBBK	Kaufmann & Baer Co.	Pittsburgh, Pa.	254
WBBM	Frank Atlass Produce Co.	Lincoln, Ill.	226
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBO	Mich. Limestone & Chemical Co.	Rogers, Mich.	250
WBBQ	Frank Crook	Pawtucket, R. I.	252
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	244
WBBT	Lloyd Brothers	Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.	Mommouth, Ill.	224
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
WCAO	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Cylde R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	360
WCAK	Alfred P. Daniel	Houston, Tex.	263
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 Vermont	Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Co.	Milwaukee, Wis.	261
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCM	University of Texas	Austin, Texas	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WOAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurance Martin	Amarillo, Tex.	263
WOAH	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
WDAR	Lit Brothers	Philadelphia, Pa.	395
WOAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Kilburn	New Bedford, Mass.	360
WOAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WOBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDM	Church of the Covenant	Washington, D. C.	234
WDZ	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, Texas	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAF	H. C. Spratley Radio Co.	Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.	Port Arthur, Texas	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.	360
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. Alhright	Altoona, Pa.	261
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, Texas	360
WHAD	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, Texas	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	Heey Stores Co.	Springfield, Mo.	252
WIAJ	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis.	224
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAQ	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
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	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.	250
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
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas	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
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, Texas	360
WLAK	Vermont Farm Machine Corp.	Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.	Tulsa, Okla.	360
WLAP	W. V. Jordon	Louisville, Ky.	360
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
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.	231
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	286
WMAP	Utility Battery Service	Easton, Pa.	246
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAW	Wahpeton Electric Co.	Wahpeton, N. D.	254
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.	360
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, Texas	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	266
WOAD	Friday Battery & Electric Corp.	Sicourney, Iowa	360
WOAE	Midland College	Fremont, Nebr.	360
WOAF	Tyler Commercial College	Tyler, Texas	360
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Texas	385
WOAL	William E. Woods	Webster Groves, Mo.	229
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
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.	360
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 & Telephone Equipment Co.	Columbus, Ohio	286
WPAM	Auerbach & 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, Texas	360
WPAU	Concordia College	Moorbead, 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.	360
WQAC	E. B. Gish	Amarillo, Tex.	360
WQAD	Whitall Electric Co.	Waterbury, Conn.	242
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAH	Brock-Anderson Electrical Engineering Co.	Lexington, Ky.	254
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360

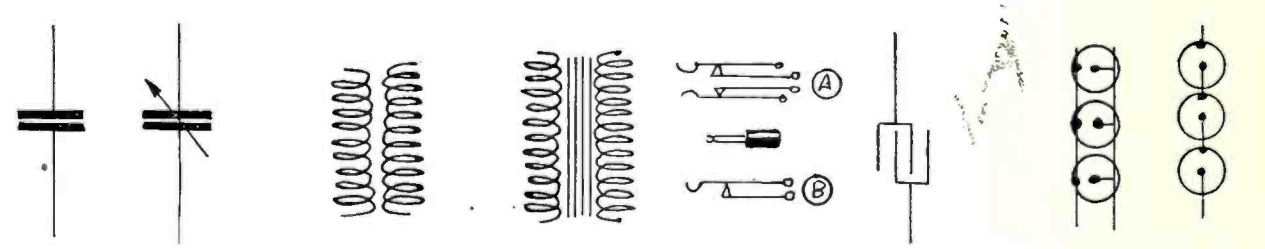
Radio Construction Diagrams



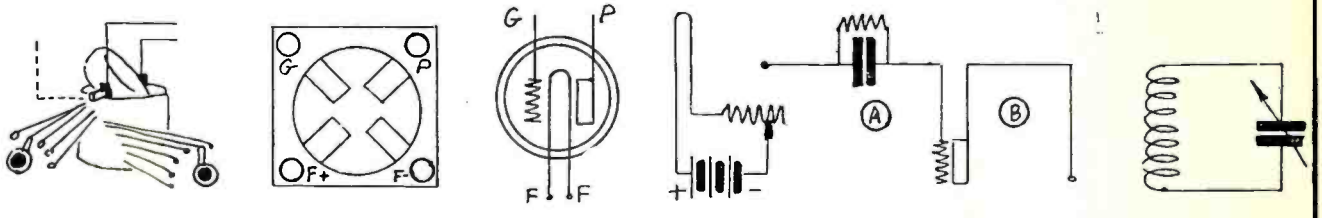
AERIAL GROUND COUNTER POISE PHONES LOUD SPEAKER LOOP AERIAL TUNING COIL – S SLIDERS CONNECTION NO CONNECTION A B BATTERIES



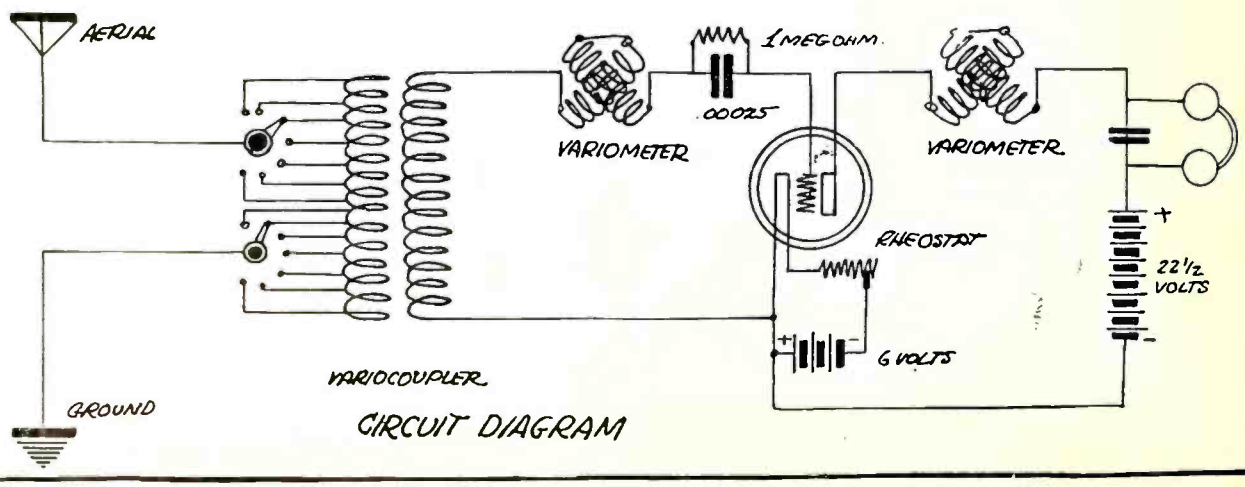
CHOKE COIL VARIO OR LOOSE COUPLER VARIOMETER HONEYCOMB COIL TAPPED COIL RHEOSTAT POTENTIOMETER GRID LEAK CRYSTAL DETECTOR METER



CONDENSER FIXED VARIABLE RADIO FREQUENCY TRANSFORMER AUDIO TRANSFORMER JACKS PLUG CONDENSER AUDIO FREQUENCY CONNECTIONS PARALLEL SERIES



VARIO COUPLER CONNECTIONS TUBE SOCKET CONNECTIONS VACUMN TUBE FILAMENT CIRCUIT A – GRID CIRCUIT B – PLATE CIRCUIT OSCILLATORY CIRCUIT



CIRCUIT DIAGRAM

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAV	Huntington & Guerry (Inc.)	Greenville, S. C.	258
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WRAA	Rice Institute	Houston, Texas	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	242
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, Texas	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, Texas	268
WSAW	John J. Long, Jr.	Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
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.	273
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.	230
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.	220
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.	220
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.	220
WWAC	Sanger Bros.	Waco, Texas	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.	230
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WYAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholic University	Washington, D. C.	236

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta.	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario.	400
CFCF	Marconi Wireless Teleg. Co. of Canada	Montreal, Quebec.	440
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement	Quebec, Quebec.	410
CFCK	Radio Supply Co.	Edmonton, Alberta.	410
CFCL	Contennial Methodist Church	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
CFCO	Seinniemhaack-Dickson (Ltd.)	Bellevue, Quebec.	450
CFCQ	Radio Specialties (Ltd.)	Vancouver, B. C.	450
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCW	The Radio Shop	London, Ont.	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFQC	The Electric Shop (Ltd.)	Sasakatoon, Sashatchewan.	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec.	400
CHAC	Radio Engineers	Halifax, Nova Scotia.	400
CHBC	Albertan Publishing Co.	Calgary, Alberta.	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec.	410
CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	400
CHCL	Vancouver Merchants Exchange	Vancouver, B. C.	440
CHYC	Northern Electric Co.	Montreal, Quebec.	410
CJCA	Edmonton Journal	Edmonton, Alberta.	450
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	420
CJCI	Maritime Radio Corp.	St. John, New Brunswick.	400
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJCX	Percival Wesley Shackleton	Olds, Alberta.	400
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebec.	430
CKCD	Vancouver Dailey Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Pub. Co.	Regina, Saskatchewan.	420
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba.	450

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
2OK	Mario Garcia Velez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	350
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JD	Raul Perez Falcon	Habana	150
2KP	Alvara Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leobaldo V. Figueroa	Colon	360
6KW	Frank H. Jones	Tulnucu	340
6KJ	Frank H. Jones	Tulnucu	275
6CX	Antonio T. Figueroa	Clenfiegos	170
6DW	Eduardo Terry	Clenfiegos	225
6BY	Jose Ganduxe	Clenfuegos	300
6AZ	Valentin Ullivarri	Clenfuegos	200
6EV	Josefa Alverax	Caibarien	225
8AZ	Alfreda Brocks	Stgo. de Cuba	240
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Anduz	Stgo. de Cuba	275
8EV	Eduardo Mateos	Stgo. de Cuba	180

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 other 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 telephoned a message of congratulation. He had not questioned for a moment but that the announcing voice was that of his friend, so perfect was its reproduction.

Warship's Stunt

The Battleship "Colorado" has just accomplished what radio engineers have said was impossible a few years ago. Her radio personnel has succeeded in receiving messages on five different wave lengths while her transmitter was sending dispatches across the continent on another wave length.

This was accomplished by means of a special high-power tube transmitter.

Farm Report

Radio's first big bow to the agricultural interests of the nation was made recently when, in co-operation with the Stockman-Farmer Publishing Company, the Westinghouse Electric & Manufacturing Company opened its third broadcasting studio in Pittsburgh.

It was discovered that there was a general demand for market information and weather reports via radio, farmers realizing that such information would be of vital importance in the conducting of farm operations and particularly in the marketing of farm products. The first of July, 1923, witnessed the opening of a regular market reporting service which was conducted from the offices of the National Stockman and Farmer and broadcast by Station KDKA, the pioneer in the farm field as elsewhere.

The market reporting service developed so rapidly that it was soon found necessary to broadcast three market reports daily. As now constituted these market reports cover the primary activities of seven livestock markets, the principal grain and feed markets of the country, the New York Cotton market, the Boston wool market, the fur market, produce markets and numerous government reports on market and crop conditions. Two weather reports daily were added to the reporting activities of KDKA until the needs of practically every class of farmers in the nation were being filled by the broadcast market service.

The need for a separate broadcasting studio soon arose and following the first few months of experiment the Stockman Farmer Publishing Company erected a well equipped studio in its building and have now perfected arrangements with the Westinghouse Company to give the required market report service.

The interest of the United States Department of Agriculture was aroused by the success of KDKA's market reports and co-operation resulted, the government with its leased wire service helping the broadcasting station, so that market reports from the various centers of the country could be assembled and put on the air. In addition, the United States Weather Bureau with the co-operation of the Western Union Telegraph Company, gave special service on the night weather report so that this report is now broadcast from KDKA just a half-hour after being issued at Washington, D. C.

Since the inception of the market reporting service in 1923, the National Stockman and Farmer has heard from all but nine far western states while the reports have been heard in Canada, Cuba, Jamaica, the Virgin Islands, South America and England.

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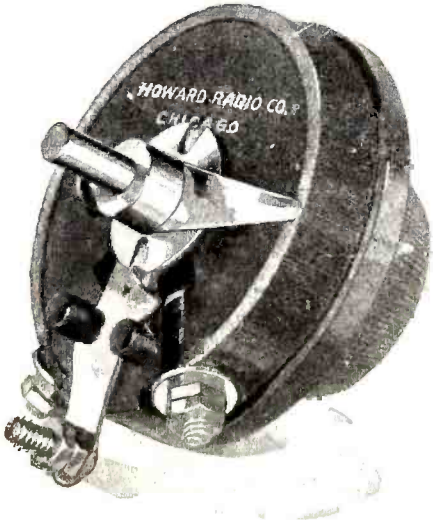

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THE astounding growth of Radio has created thousands of big money opportunities. Millions of dollars were spent during the past year on Radio—and thousands of young men are needed right now to meet the ever increasing demand of work. Never before has there existed so many and such remarkable opportunities for making money in this wonderful, new field.

Men are needed to build, sell and install radio sets—to design, test, repair—as radio engineers and executives—as operators at land stations and on ships traveling the world over—as operators at the hundreds of broadcasting stations. And these are just a few of the wonderful opportunities!

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No matter if you know *nothing* about Radio now, you can quickly become a radio expert, by our marvelous new method of practical instruction—instruction which includes all the material for building the latest up-to-date radio apparatus.

Scores of young men who have taken our course are already earning from $75 to over $200 a week. Merle Wetzel of Chicago Heights, Ill., advanced from lineman to Radio Engineer, increasing his salary 100% *even while taking our course!* Emmett Welch right after finishing his training started earning $300 a month and expenses. Another graduate is now an operator of a broadcasting station PWX of Havana, Cuba, and earns $250 a month. Still another graduate, only 16 years old is averaging $70 a week in a radio store.

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Hardly a week goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer"—"We want men with executive ability in addition to radio knowledge to become our local managers"—"We require the services of several resident demonstrators"—these are just a few small indications of the great variety of opportunities open to our graduates.

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