SEPTEMBER 1924

RADIO AGE

The Magazine of the Hour

WITH WHICH IS COMBINED

Radio Topics

Price 25 Cents

In This Issue

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Accurate Isometric and Circuit Diagrams

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RADIO AGE

The Magazine of the Hour
Established March, 1922
WITH WHICH IS COMBINED
Radio Topics

Volume 3 *September, 1924* *Number 9*

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A Chat With the Editor

RADIO AGE is off on its Fall drive. Beginning with this issue we are presenting an excellent group of technical and feature articles that are sure to emphasize this magazine's pre-eminent position as a practical help to constructors of receiving sets.

The first and most important of these consists of the RADIO AGE fac-simile blueprints — **printed in blue** and presented in such a way that they may be used as actual working drawings the same as any other blueprint.

To make this blueprint feature complete, we asked Mr. Rathbun to draw isometric and hookup diagrams for two world-beating circuits.

He did it with an improved "Baby Heterodyne" and an aperiodic variometer set. Mr. Rathbun's first "Baby Het" took the country by storm. This improved model will be no less popular, for it incorporates the latest ideas in simple and efficient set construction.

The aperiodic variometer hookup will meet the demands of fans who want something a little more complicated and yet easy to construct. These hookups, clearly illustrated with attractive blueprints, will be found in RADIO AGE'S new blueprint section, which begins in this issue on page 29 and runs through to page 36.

Four pages are devoted to the blueprints and four to the explanatory articles. Readers who wish may utilize the center pages consisting of from 29 to 36 and keep them for working aids and ready reference.

This blueprint feature is only a sample of what RADIO AGE has in store for this Fall and Winter. An abundance of the kind of technical articles that made RADIO AGE "The Magazine of the Hour" is in store for fans who are eager to start constructing sets again.

Keep a close watch on RADIO AGE, and if you let our hookups be your guide you will be assured of a successful Radio Winter.

Frederick Smith

—Editor, RADIO AGE

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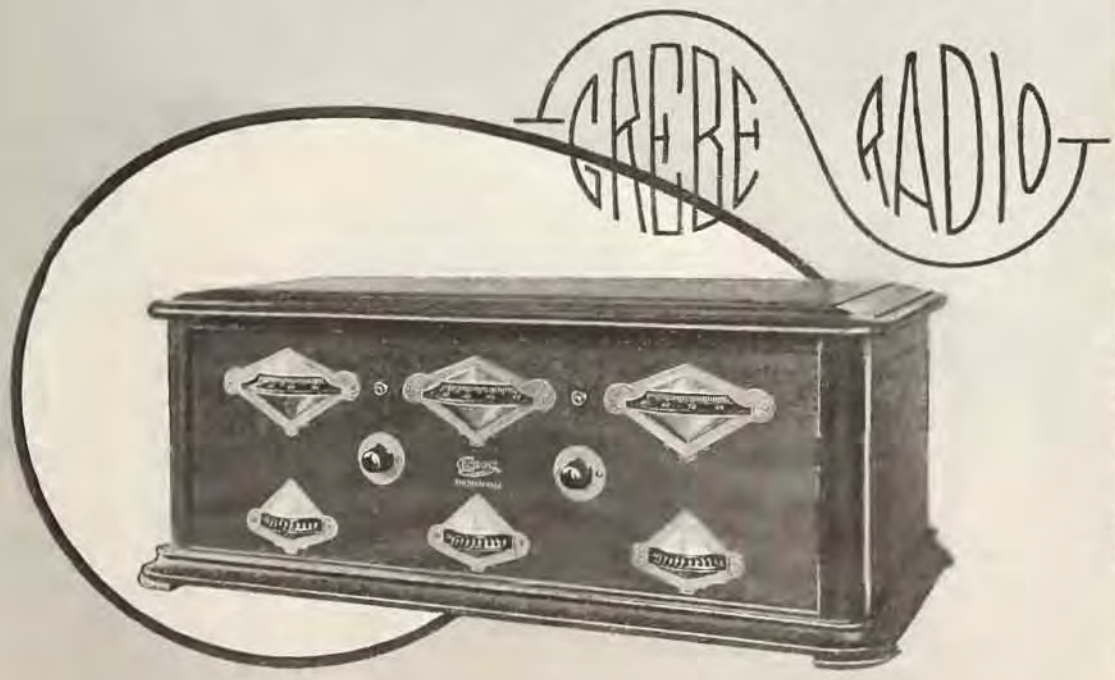

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RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

How Careful Mounting Will Bring

IMPROVED RECEPTION

By FRANK D. PEARNE

IN A RECENT issue of RADIO AGE we gave some of the reasons for poor reception, and the object of this article is to make plain to the layman just what takes place in the circuit when the coils and condensers are active, so that he may be better able to decide just how to mount the different parts of his set in such a way as to avoid as much as possible the interference and consequent losses occasioned in many of the sets in use today.

In the first place, it is necessary that he understand perfectly just how energy is passed from one coil to another without any electrical connection between them, or in other words, by induction. As explained before, when a current of electricity flows through a conductor, such a conductor is surrounded by invisible lines of force which are whirling about it either in one direction or the other.

The direction in which they whirl will of course depend upon the direction in which the current is flowing, and the number of lines and the distance they reach from the conductor will depend upon the amount of current flowing. Just how this would look if the lines were visible, is shown at "2" in Figure 1.

IF THE current flows along the conductor in the direction from the observer, then the lines would whirl in the direction in which the hands of a clock would move, and if it was flowing toward the observer, they would whirl in an anti-clockwise direction. Now if this conductor is wound up into a coil as shown at "1" in Figure 3, the lines will arrange themselves as shown in this diagram. Some of them will continue to whirl about each turn, but most of them will join forces with the adjacent turns, resulting in a magnetic field as shown at "1," Figure 3.

Now as this whirling magnetic field advances in an outward direction and encounters another conductor as shown in Figure 1, and this conductor is forming a complete circuit of some kind, it offers a resistance to the lines passing through it and the lines bend, objecting to passing through it; but nevertheless the lines are forced out by new lines emanating from the original source and regardless of the resistance so offered, they bend around the conductor so far that they finally snap across it on the opposite side as shown at A, B, C and D, in Figure 1.

If the direction in which the lines are whirling is traced as they bend around this conductor, until they eventually snap across on the other side, it will be seen that the lines have been made to whirl in a complete circle about the conductor resulting in the whirling magnetic field shown at "2" in Figure 1. Thus a magnetic field has been produced around it and a current will flow in this conductor, although it has no electrical connection whatever with the coil or conductor which is producing the magnetic field. This explains the question so often asked as to how the signals can pass from one circuit to another when there is no visible connection between them.

If this conductor is so located that it is out of the range of the advancing lines, then of course no current is set up in it and likewise it will be noted that the closer it is placed to the original source of the lines, the more of them will whirl about it and the more energy will be passed to it.

IF THIS conductor, however, is wound into the form of a coil or loop, as shown in Figure 2, which represents the lines cutting through a loop of a conductor which has been cut in two for simplicity, it will be seen that if this loop is placed at right angles to the loops or turns which are producing the magnetic field, then the lines cut through both sides of the loop in the same direction, setting up opposing currents in both sides and resulting in one neutralizing the other. No current is produced, so long as the same number of lines cut through each side. Apparently, if one desires to so mount a coil in the receiving set, so that it will not be inductively connected to another coil, the best method is to set it

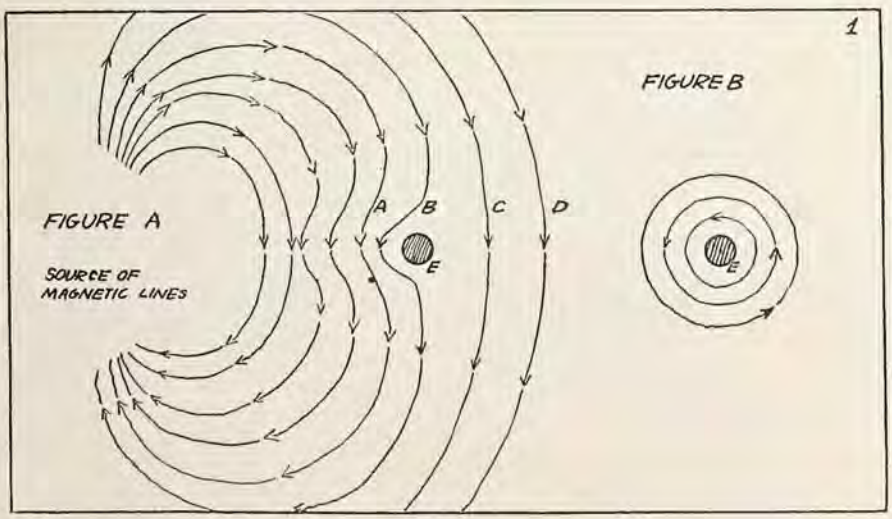


Figure 1. Showing how the whirling lines of magnetic force are made to cut through a conductor.

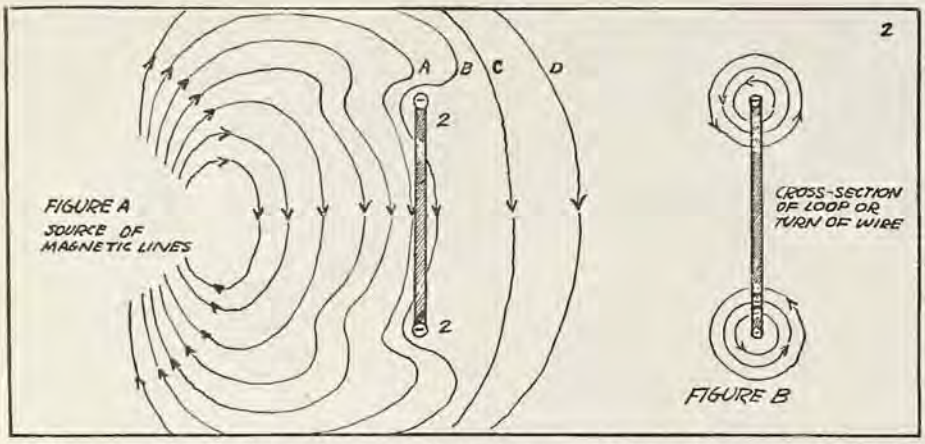


Figure 2. Showing how a loop or coil of wire set at right angles to an excited coil has opposing currents set up in each side, resulting in the neutralization of the current in the loop. This is what happens when your variocoupler is set at zero.

at exact right angles to it, but it must also be remembered that if it is not exactly at right angles, one side will be cut by a few more lines than the other and the result will be that the current in one side will be a little more than that in the other and a current which is equal to the difference between the two will flow.

This naturally will cause interference in the operation of the set which may be very slight, but it is interference just the same and the greater the angle of mounting diverges from an exact right angle, the greater will be the interference. This neutralizing effect is shown at "2" in Figure 2. If two coils which are not intended to be inductively connected are mounted as in Figure 3, care should be taken to mount them far enough apart so that the lines produced in one of them cannot reach the other, or, as shown in the diagram, some of the lines will cut through one side of the coil but will not reach the other side; or some might cut through both sides. But the side nearest the source would be affected more than the distant side, and in either case undesired currents would be produced and interference and losses would occur.

It must be remembered that because of the power required to force these lines past or through a conductor, as is usually stated, much of the energy is used up in this useless and harmful work. The only way to prevent such losses in a case of this type of mounting is to so locate the coils that they are beyond the range of the magnetic field.

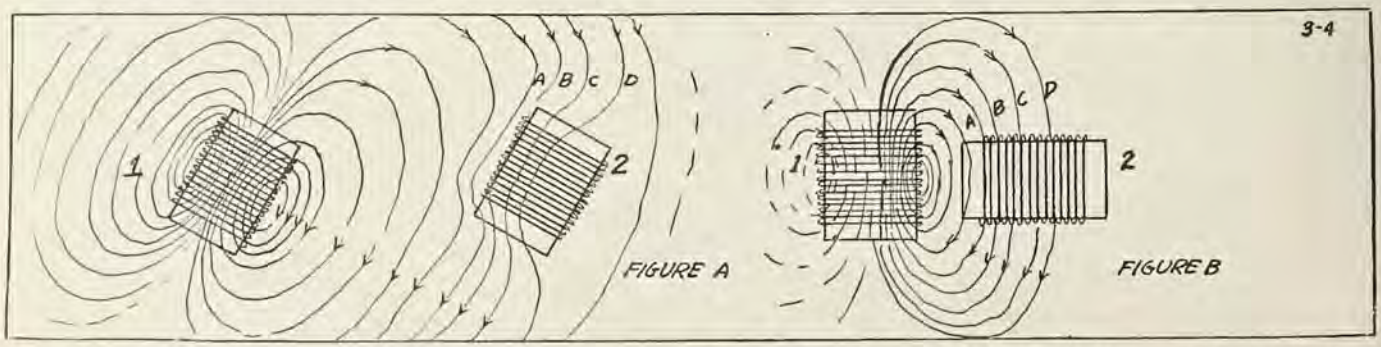
FIGURE 4 shows the ideal method of mounting two coils which are not inductively connected, but because of the danger of not getting them at exact right angles, it is best to keep them separated as far as possible and still consistent with short connecting wires. In this diagram the arrows shown at "2" explain the direction of the opposing currents set up in the two sides of the coil when set at an exact right angle to the coil "1," which is the original source of the magnetic field. Very often, however, it is necessary that certain coils be inductively connected to others and in such a case it is necessary to mount them in such a way that all the lines possible are made to cut through them, in which case they should bear the relationship shown in Figure 5.

Here we have one coil placed in inductive relation to the other. This is usually called a "coupling" of the two. It will be noticed that the winding of one is parallel to the other and a close inspection of this arrangement will show that the lines of force from the original source so cut through the turns of the coil "2" that they apparently whirl around them in opposite directions, but by carefully tracing them out in all positions it will be found that if the wire were laid out straight and parallel to the other, the lines would all be whirling in the same direction and consequently the maximum current would be developed in it. If the coils are separated some distance, it would be called a loose coupling and if they were close together, or one was wound on top of the other, it would be a tight coupling. If the coil "2" should be tilted slightly with one side higher than the other, more lines would affect one side than the other. This also would tend to give a looser coupling.

This method of changing the coupling is used in the standard variocoupler which is so arranged that coil "2" is mounted on a shaft and is placed inside of coil "1." Then by turning the shaft, the turns of coil "2" may be made to be parallel to those of coil "1" or may be turned at right angles to them. It is obvious that any position between these two extremes may also be obtained. It is this clever idea which makes it possible to get such a fine adjustment when a variocoupler is used in a set.

OTHER methods of producing a variable coupling have been devised, one of the best being the use of two flat coils, such as the honey-comb and spider web type. These are usually mounted in such a way that they are either close together with the turns parallel to each other, or by means of a hinged mounting, one coil may be swung away from the other until the turns are at right angles. Either of these methods is very efficient, so far as efficiency in a radio set is concerned, and it is often a question as to which is the best. Naturally the honey-comb and spider web coils are better than the straight coil wound upon a tube, because they are so designed that their distributed capacity is less than that of the flat straight winding, and their magnetic fields are more concentrated, which would appear to make less danger from stray fields. But it is hard to determine just how far these stray fields will wander.

From this description of the action of the magnetic lines, the reader will observe that the most important thing to remember in the construction of his receiving set is to so arrange the apparatus that he is sure that no interference due to stray magnetic fields is taking place. The visible defects are easily seen and remedied, but the invisible troubles are very seldom corrected, simply because one is not aware of their presence; but if they are recognized and guarded against as carefully as the visible defects, then the results obtained will more than pay for the extra trouble and thought used to



Figures 3 and 4. Figure A shows how magnetic lines from coil 1 cut through turns of coil 2 if they are placed too close together. This is important in neutrodyne and other radio frequency receivers. Figure B shows how losses are brought about when coils are properly placed at right angles. The lines from coil 1 cut through the coil 2 in the same manner as that of Figure 2, and no current is produced in coil 2.

eliminate them.

Now, how about the mounting of condensers in relation to the position of the coils? Here is another invisible problem. As stated in the August issue of RADIO AGE, stray magnetic fields which come in contact with any metal objects will also cause considerable loss of energy. Rapidly alternating currents will send out lines of force from a coil, which whirl first in one direction and then another. When such lines pass through a metal object, such as the plates of a condenser or a shield, they set up eddy currents in them. Just what this means is shown in Figure 6. Eddy currents derive their name from the fact that they arrange themselves in circular form similar to the circles appearing on the surface of the water, when several stones are dropped into it. They are sometimes spoken of as Faucault currents and are a source of loss of energy in any alternating current apparatus.

Naturally, a solid piece of metal is a very good conductor of electricity, and as these currents are set up in the metal itself, the resistance offered to them is very low. It is also known that the pressure which forces the current through the metal is very low, but because of this extremely low resistance, the very feeble pressure generated as the lines cut back and forth through the metal is able to force considerable current around in the circular form shown in Figure 6. In cases where a strong magnetic field cuts through a sheet of metal, it often happens that the current produced in the form of eddies is strong enough to heat the metal so hot that it cannot be touched safely by the hand.

THE currents used in radio reception, however, are not strong enough to produce eddy currents of sufficient strength to heat the metal condenser plates to such a degree that the heat can be noticed, but in a small way the same action takes place with these feeble currents, resulting in a dissipation of much needed energy.

Figure 7 shows how the lines cut through the metal plates of a variable condenser mounted across the end of a coil, which is enough to show that this is not a good method of mounting it. Here the lines naturally have to do considerable work in passing through the metal and in so doing not only do they waste energy in setting up the unnecessary eddy currents, but the resistance of the coil itself to the rapidly alternating current will be considerably increased, which will in turn cut down the current flowing through it. Condensers are not very often mounted in this way, although sometimes in order to save space on the panel, they are mounted inside of the coil. When this is done, the same condition exists and the lines are made to cut through the plates.

If mounted along the side of the coil, it will be seen that the plates will not be directly in the path of the lines, but even then some of them will pass through the plates, and while it is not a good way to mount them, it is better than the method shown in Figure 7. They should

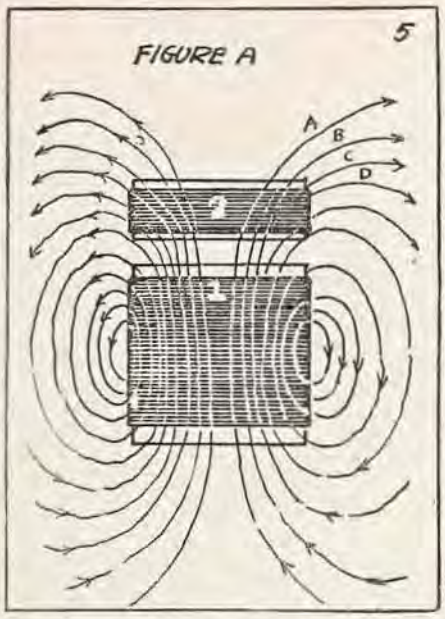


Figure 5. Showing how in this case all lines enter from the inside and pass out, producing maximum current in coil 2 by induction. This is the effect you obtain when your variocoupler is set at maximum.

really be mounted some distance from the coils if the best results are to be expected, and should be so located and in such a position that none of the lines from the stray magnetic fields can cut through the plates.

There are many fans who will dispute this theory in regard to mounting the condenser inside of the coil. They will say that they notice no bad effects from so doing, but it must be remembered that any one of these little things explained herein will not make any great appreciable difference in the action of the set, but a number of them in combination will make the greatest difference in the world. This article is written for the careful fan who wants to get the best possible results from his receiver and is willing to go to a little trouble to carefully lay out his work so as to avoid every unnecessary loss.

There are many sets in use today, the owners of which very proudly state what marvelous results they are getting, but who do not know that they could far exceed their present reception if they would only pay some attention to the little things which are invisible, but which at the same time are absorbing much of the energy of the set.

A NOTICEABLE improvement in body capacity effects may be made by mounting the coils and condensers a few inches away from the panel. A support may be made on which to brace the apparatus.

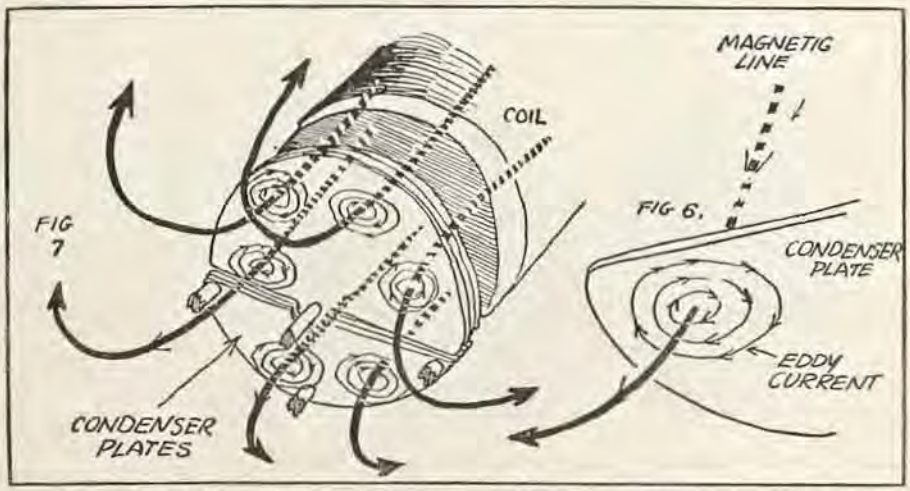
However, one should not forget that when a piece of insulation is under the influence of an oscillating current, the molecules moving back and forth tend to absorb the energy with each reversal of the current. As a result, it has been seen—the energy that was absorbed is totally lost, as far as radio reception is concerned. A small extension will be necessary to run the condenser shaft through the panel, the same applying to the rotor of a coil.

This will do away with the popular but not practical method of shielding the entire set by a sheet of copper or tinfoil.

A number of prominent manufacturers ground all the rotors of coils, condensers and switch shafts or any other part of the set that comes in contact with the hand while manipulating the controls. The transformers should be mounted at right angles to each other and not too close together, unless shielded

Body capacity is usually confined to the tuning controls, the effect being noticed when the hand is removed from the knob of the condenser or coil. Body capacity is usually noticed on distant stations and not so much on local stations. The average listener experiences the most body capacity in the grid circuit. However, it is noticed in many other parts of the circuit exclusive of the grid.

On some sets the effect may even be noticed on the phones when the hands are brought in close proximity to them or if your head is near the set. This, however, is not so noticeable on the regular three circuit tuner as on the Ultra-Audion.



Figures 6 and 7. "A" shows the losses by eddy currents when a condenser is mounted on the end of a coil. The lines of force as indicated in Figure B show the eddy current set up when the line cuts through the plate, which wastes power.

A Complete Radio Set on a Dial

By BERT WHITMAN

THERE are now about seven radio stations in Chicago that broadcast news reports, market reports, musical concerts and operas every day. All of these can be heard by any one who wishes to tune in accordingly.

Aside from using receivers of standard make, it is possible to home-construct a receiver, the simplicity of which involves only scant knowledge of radio. The set I am going to describe will be very efficient, providing you do not live in Pittsburg or some other point distant from Chicago and expect to hear all the Chicago stations.

A top view of the "Dial Crystal Receiver" showing the arrangement of the taps, binding posts and illustrating the manner in which the vernier knob of the condenser dial is used as the switch knob to vary the inductance.

A radio outfit is usually made up of an aerial to catch the incoming waves and also to catch waves that come in through the ground that are sent out by a broadcasting station. A coil is used so the listener can listen to one station at a time, thus avoiding two or more stations coming in at once, which would only result in a mass of noises. A crystal detector is used to change the waves, thus effecting the magnets in the phones; producing the sound which reaches the listening fan.

I will now proceed with the details of constructing this odd receiver. The entire set is made on an ordinary three-inch hard rubber dial. For the cabinet for the dial I used a discarded back of a dry cell case from a bicycle light. Where the numerals are marked off, drill a hole large enough for the taps to fit through, at the 10, 20, 30, 40, etc. Where the knob is to turn on a dial, in the middle equal with the shaft, drill a hole clear through. Use this for the switch-arm. The knob on the switch can be easily secured by using the top of a hard rubber binding post; for the shaft, use the shaft of an old rheostat; and for the arm of the switch-lever, you may use the arm of a rheostat. This shaft must go all the way through so it will hold on the crystal detector and the back of the battery case together with the dial. The pointer of this same old rheostat can be used to point out the taps from the switch-lever on the front of the dial.

Also drill four holes opposite of the taps and buy four plates marked aerial, ground phones, and another marked "phones." Place in the binding post where you just drilled the holes and put on the plates wherever desired.

How It's Done

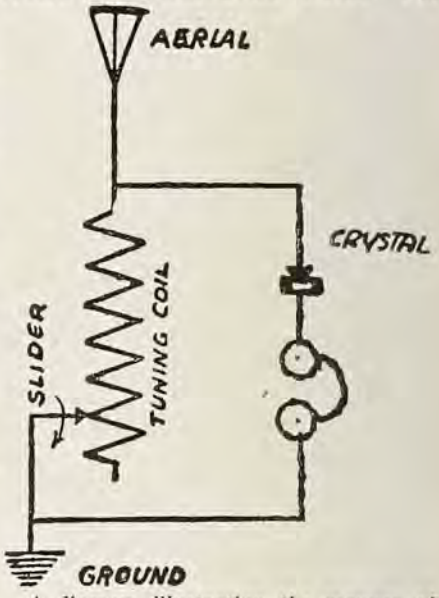
Following are the details for making the coil: Secure a cork 1½ inches at the top. Anchor 10 pins, one-sixteenth of an inch deep, nearly ¼ inch apart, in a straight line all around. Proceed by wrapping twice, the end of the wire securely around the pin you wish to start from. Start winding with No. 22 D. C. C. wire over two pins, under two pins, over two, under two, etc., until having gone around six times, and upon coming to the pin you started from, tap it about one-sixteenth of an inch farther from the same. Take these taps off every six turns and stagger it a little farther than the previous one Continue this until you have as many taps on the coil as you drilled on the dial.

After you have finished this, leave in your pins and give the coil a heavy coat of shellac or any other liquid varnish for coils. After this dries, pull out the pins and slide off the coil. It is advisable to place a small strip of paper on the coil before you place in the pins, so after you shellac the coil and pull out the pins the coil will not stick to the cork. When you have finished this, scrape the insulation off the taps and solder them to the switch points. Solder all connections.

The crystal detector was purchased at a Woolworth radio counter for ten cents, which serves the purpose very satisfactorily. After doing this, wire the set with the same wire you used to wind the coil with. Cover all the connections with spaghetti so it will make the connections more durable.

When this is finished, tighten up the bolt that holds the cabinet (back of the battery case) and the crystal detector and you have the complete receiver all ready to tune in the nearby stations.

To tune and work this set, buy a pair of good phones, about 100 feet of No. 14 copper aerial wire and about 50 feet of No. 14 rubber covered copper wire for your lead in and ground. Rig up your aerial, making it as long as possible. Attach your ground to the radiator. Put your aerial to the aerial post on the set, your ground to the ground post on the set and the phones to the two posts marked "phones."



A diagram illustrating the manner of wiring the various parts of the receiver. A .001 Mfd. condenser connected across the phone posts is often an aid to the detector in getting clearer signals.

Now you are all ready to tune in. Start by moving the switch lever on the first tap and moving the detector about easily on the crystal to find a good spot. If it does not work on the first tap try the second, third, fourth, fifth and so on until you find the sensitive spot of the crystal. When you hear plainly, lay the set on table sideways to make it stay steady or lay the set in an ordinary glass. It will fit right on the top.

A view of the receiver "exploded" to show the manner in which the inductance is mounted. The crystal detector is mounted on case to the right, the mounting posts being visible in the photo.

King of Belgium Honors American Citizen

Dr. L. H. Baekeland, of Yonkers, New York, president of the American Chemical Society and honorary professor of chemical engineering in Columbia University, has just been highly honored by King Albert of Belgium, who made him commander of the Order of Leopold. Doctor Baekeland has already received such distinctions as officer of the Legion of Honor of France and officer of the Crown of Belgium.

Interference: the How and Why of It

Why It Is Impossible to Tune Out Local Stations When DX May Be Eliminated

By HENRY A. WORNER

THE average radio fan quite often is confronted with the problem of coping with interference caused by nearby broadcasting stations, while he is engaged in the interesting and absorbing pastime known as "fishing for DX."

What seems to puzzle him especially is the fact that certain stations are apt to interfere more than others. For instance, he knows that one station allows him sufficient latitude for satisfactory tuning of an out-of-town station broadcasting on a wave length which differs from that of the home station by 15 meters, while another local station operating on a different wave length entirely prevents the reception of a moderately distant station, whose wave length differs from that of the interfering station by as much as 17 meters.

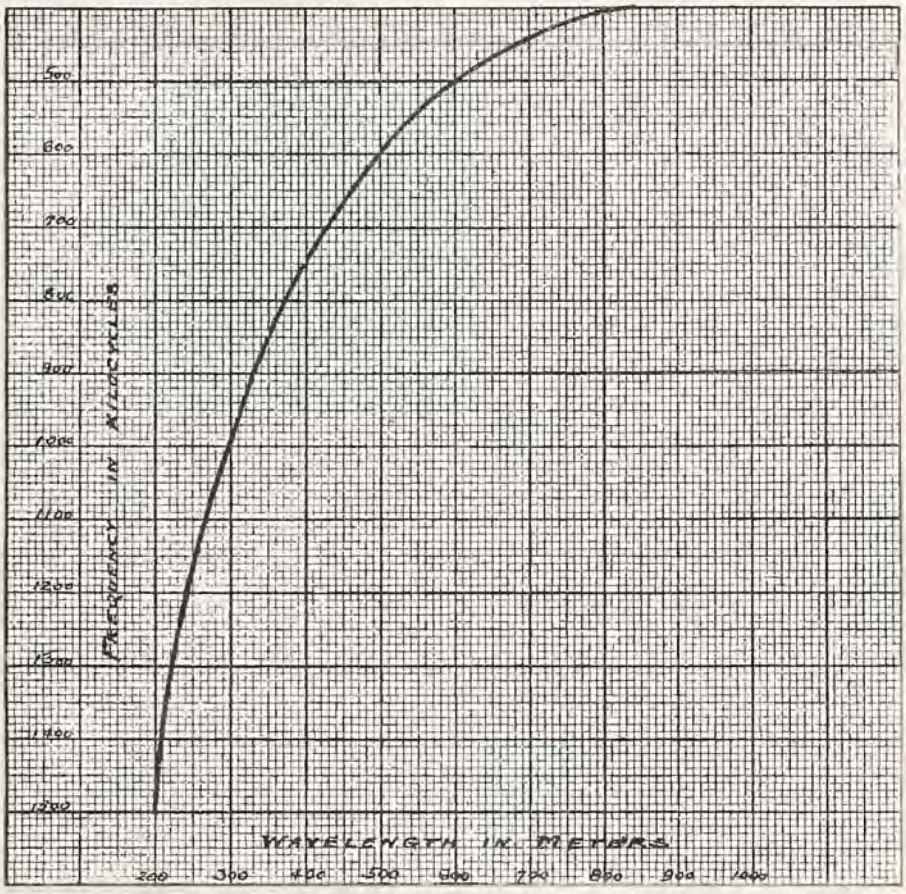
To make matters more perplexing, he learns that brother Jim, who lives in Pittsburgh, has on several occasions tuned out powerful KDKA transmitting on 326 meters, and received KGO, at Oakland, California, on the small margin of 14 meters difference in wave length.

Where's the Fault?

It is only natural to suppose that he is peeved over the matter, in view of the fact that Jim happens to be little more than a novice in matters radio, while he has dabbled in radio long enough to consider himself in the light of an expert. The fault cannot be with his set, he argues, for the reason that he built both, Jim's set and his own, and they are as alike as the proverbial peas in the equally proverbial pod, from binding post to phone jack.

IN HUNTING for the cause of the trouble he is apt to put the blame on the offending local station.

"They surely must be off their wave length," he complains, "for the other local station does not interfere to the same extent. The operating personnel must be becoming careless in their adjustments, causing a wave that is far from sharp." You see he has learned a little about such things as decrement, and other equally mysterious things, and comes to the conclusion that he has discovered the cause of it all by accusing the offending station.



The chart above shows the relation of wave lengths to kilocycles. Notice especially how steep the curve bearing this relationship becomes as it increases in frequency and decreases in wave length.

On the face of it he seems to be right, but nevertheless he is entirely wrong. The cause of complaint is to be found elsewhere, as I shall endeavor to demonstrate. In the first place, it is a mistake to associate broadcasting stations with their wave length assignments, as this practice leads to just such ambiguities as this. One should think in terms of frequencies instead of wave length, in calculating the amount of dial space a certain station ought to occupy.

The relation of wave length to frequency is not, graphically speaking, a straight line, but forms a rather steep curve, as may be observed in Fig. 1. It will be noted that a frequency of 1,500 kilocycles (1,500,000 cycles) produces a radio wave measuring 200 meters from crest to crest, while a wave 300 meters long is created by a frequency of 1,000 kilocycles. The average person is prone to jump at conclusions in a good many things, and radio is no exception. Having discovered at some time that the difference in kilocycles between 200 and 300 meters is 500, he concludes by inference that a hundred meters' difference equal a frequency difference of 500,000 cycles. A second glance at the graph will illustrate to the reader that such is far from being the case. We find that whereas 300 meters has a frequency of 1,000 kilocycles, the frequency for 400 meters is 750 kilocycles—a difference of 250 kilocycles! We also find that 500 meters equals 600 kilocycles, and 600 meters is the equivalent of 500 kilocycles.

How They Stand

The relationship of wave length to frequency is clearly expressed by the formula:

$$\text{Frequency in kilocycles} = \frac{300{,}000}{\text{Wave length in meters}}$$

At this juncture, the reader will begin to see a glimmer of light. However, he fails to see the connection between that and the fact that a station like WEAF, for instance, transmitting at a frequency of 610kc. (492 meters) is practically annihilated in Philadelphia by WIP or WOO, operating on a frequency of 590 kc. (509 meters)—or a difference of 20,000 cycles.

EVEN the novice in radio knows that in order to hear a station one must adjust the receiver to resonance with the

frequency of the carrier wave on which the station is operating. He is also aware that a nearby station allows him considerable latitude in the matter of accurate dialing, whereas a more distant station requires a little skill in the matter of tuning. Why does a local station "smear" itself over a considerable part of the dial? And why is a margin of 17 meters difference in wave length insufficient to tune in a distant station through local interference, in one instance, and 15 meters or even 14 meters difference, in another instance, plenty leeway to accomplish that very thing? These are questions that not only puzzle the novice but in a great many cases are conundrums to the seasoned fan as well.

The answer lies in the fact that one has to deal not with a single frequency but with a wide band of different frequencies in radiophone transmission and reception. The carrier wave of a broadcasting station upon which the voice and music is carried is the wave length upon which the station is permitted to operate. The wave length is determined by the oscillation constants of the transmitting apparatus, before the voice or music is impressed on it. The peak of this carrier frequency is quite sharply defined even in a local station.

When the carrier wave of a station is being modulated with the frequencies of the speech and music impressed upon the diaphragm of the microphone, the result is a composite wave, which modifies the character of the single carrier frequency to a considerable extent. Let us see just how this is effected. It is customary in music to refer to the oscillation of a musical note by the name of vibration. In effect, a vibration and a cycle of oscillation are identically the same thing.

How Music Vibrates

A musical note is the result of vibrations or oscillations of a known frequency, which remains quite constant. When the pitch of the note is altered, the frequency of vibration is automatically changed. We will say that the musical note, referred to on the piano as Middle-C vibrates about 256 times per second to and fro. (Its actual vibration constant according to the International Standard of Pitch is 258.9.) That is to say, it oscillates at a frequency of 256 cycles per second. Since the frequency of a note doubles with each octave, it follows that the C one octave above Middle-C has an oscillation constant of, say, 512 cycles per second. The next C above would register 1,024 cycles and so forth, until we reach the uppermost C (last white key) on the piano which oscillates at the rate of 4,096 cycles per second.

Some instruments of the orchestra go still higher than that. The piccolo flute can produce notes whose frequencies are more than double that of the uppermost note on the piano, while the violin, when being played in the seventh position, reaches notes that are close to the upper audibility limit of the human ear, which is in the neighborhood of 10,000 cycles.

SO MUCH for the frequencies of fundamental tones. A fundamental tone is one having practically no harmonics or overtones. A tuning fork is the only device capable of producing a pure note practically free from harmonics. All musical instruments produce notes which have combined with them a certain number of these by-tones, or harmonics. As a matter of fact, were it not for the harmonics, all music would sound dull and there would be no distinction between the various instruments. It is due to the overtones that we are able to distinguish between the various instruments of the orchestra.

These harmonics supply that colorful

Fotograms, N. Y.

NEW YORK STATION OPENS

Mayor John F. Hylan of New York is shown officially opening WNYC, the $50,000 municipal broadcasting station to be used by New York City.

variety and exquisite shading so much in evidence in the modern orchestra, thereby adding enormously to our enjoyment of symphony concerts, not alone over the radio, but also in the concert hall, auditorium and theater. Thus, by means of these overtones we are enabled to distinguish a violin from a flute, a cornet from a saxophone and a xylophone from a piano. These overtones are therefore vitally necessary to the full enjoyment of music. There are fifteen important harmonics for every principal or fundamental note in music. All of these are not equally prominent. Chimes, carillons and church bells are richer in overtones than any other tone-producing devices.

If we consider the first ten harmonics as of most importance, let us see how they materially affect the music frequencies. High-C is the C situated two octaves above Middle-C on the piano and is the ultimate goal of every ambitious soprano. It is considered the upper limit of the range of the female voice in song and has a vibration constant of 1,024 cycles. The first harmonic has twice the frequency of the fundamental note—in our case 2,048 vibrations. The second harmonic generates frequencies three times that of the principal note, or 3,072 cycles per second—a little more than 3 kilocycles. The tenth harmonic has the enormous frequency of 11,264 cycles, which is over 11¼ *kilo*cycles. The lowest note of the Great Organ has a frequency of 32 or less cycles. We must therefore take into account a musical frequency band of over 11 kilocycles.

How Harmonics Function

As there is a plus and minus component in a radio wave, the carrier frequency is therefore modulated by a voice frequency alternately adding and detracting 11 kilocycles. A broadcasting station transmitting on a carrier frequency of 610 kilocycles therefore occupies a frequency band extending between 599 and 621 kilocycles. Expressed in wave length figures, this means that a station operating on 492 meters really covers a wave band lying between 501 and 483 meters. A local station operating on a carrier frequency of 590 kc. (509 meters) causes interference with the station transmitting on 492 meters, by reason of the fact that it blankets a wave band lying between 499 and 518 meters. (601 and 579 kc. respectively.)

A station like WOO occupies a waveband 19 meters wide, while WEAF uses one only 18 meters in width. WDAR on a frequency of 760 kilocycles occupies a band of only 11 meters with the same 22 kilocycle variation. It is therefore possible to tune out this station in Philadelphia and tune in WGY in Schenectady on 380 meters.

NOW let us see how much better we fare with a station using a comparatively low wave length. Take KDKA broadcasting on 326 meters (920 kc.). A listener in Pittsburgh desiring to hear KGO in Oakland, California, on 312 meters (960 kc.) has no difficulty in tuning out the Pittsburgh station. 11 kilocycles either side of 920 is the frequency range 909-931 kc. Transposed into wave length this equals a band barely extending 8 meters wide. This goes to show that the lower the wave length, the sharper will be the tuning.

The above covers all cases where the interfering station is a local station. The situation will be improved materially as the distance between the interfering station and the receiver is increased. With the interference located some distance away from the listener, a number of the overtones are lost in transmission, which has the effect of narrowing the operating band of the station, consequently lessening its interference possibilities.

(Continued on page 57)

Using One Tuning Control for Hair's Breadth SELECTIVITY

By BRAINARD FOOTE

Test of Best Circuits Now in Their Simplicity

IT IS a peculiar, yet universally recognized fact, that any single tube regenerative receiver will respond to broadcast signals from stations within the receiving radius of a set employing a radio frequency amplifier. This paradox may perhaps be best explained by the simple statement that a certain amount of signal energy is required to actuate any tube, whether it be the detector or the first tube of a radio frequency amplifier. The use of radio frequency amplification does, however, magnify the weak energy to such an extent that broadcasting from distant points may be more loudly heard with such an amplifier than without one.

The fact remains, nevertheless, that a single detector tube, properly connected and used by a keen-eared listener, will have practically the same receiving range as any other form of receiver with the possible exception of the super-heterodyne. There is little to be said in favor of this or that circuit, providing it is regenerative and the best of apparatus is chosen. The widespread differences of opinion regarding various forms of single tube circuits appear to arise mainly because a highly satisfactory form of one circuit has been compared with but a mediocre representative of some other type. To me it seems that one is as good as another as far as actual distance goes, but that there really is considerable difference in selectivity and ease of operation.

ASSUMING fairy equal sensitivity for all single tube circuits, then, they are not to be compared on this basis, but on selectiveness and simplicity of operation. Tendency toward radiation is also a most important factor to think about. Most regenerative receivers involve a most "ticklish" control of oscillation in addition to one or two controls for adjusting the set to the various wave lengths. Tickler feedback receivers and those having plate variometers come in this classification and are for that reason rather difficult to operate handily. In addition to these two objections, I might cite the natural tendency of operators of such equipment to permit the tube to oscillate and to hunt for the carrier wave or "whistle" while feeling around in the dark for some distant station.

Back to DeForest

In searching for a circuit which is not only selective and easy to use but which is not critical in its regeneration control also, we must hark back to the early days of radio when Dr. Lee DeForest brought out the Ultra-Audion circuit. Most circuits have a secondary coil with one end connected to the grid condenser and the other end to the filament. The Ultra-Audion, on the other hand, uses the grid condenser connection for one end but connects the other to the *plate* instead. This normally maintains the circuit in oscillation and depends upon the capacity of the antenna to absorb energy enough to stop oscillation. Heretofore the circuit has been objected to on the ground that a "hum" was picked up from the electric light line. This was due to the absence of the grid return wire to the filament and to the direct connection of the antenna to the grid coil.

In overcoming the hum and providing means for substituting something else for the antenna's absorption, I found it most satisfactory to use the so-called "aperiodic" or untuned antenna system and to insert a variable condenser as a by-pass across the phones. This eliminates the hum and provides a sure control of regeneration—and a non-critical one. The double circuit plan also increases the selectiveness—something that the Ultra-Audion arrangement has long been famous for, anyway.

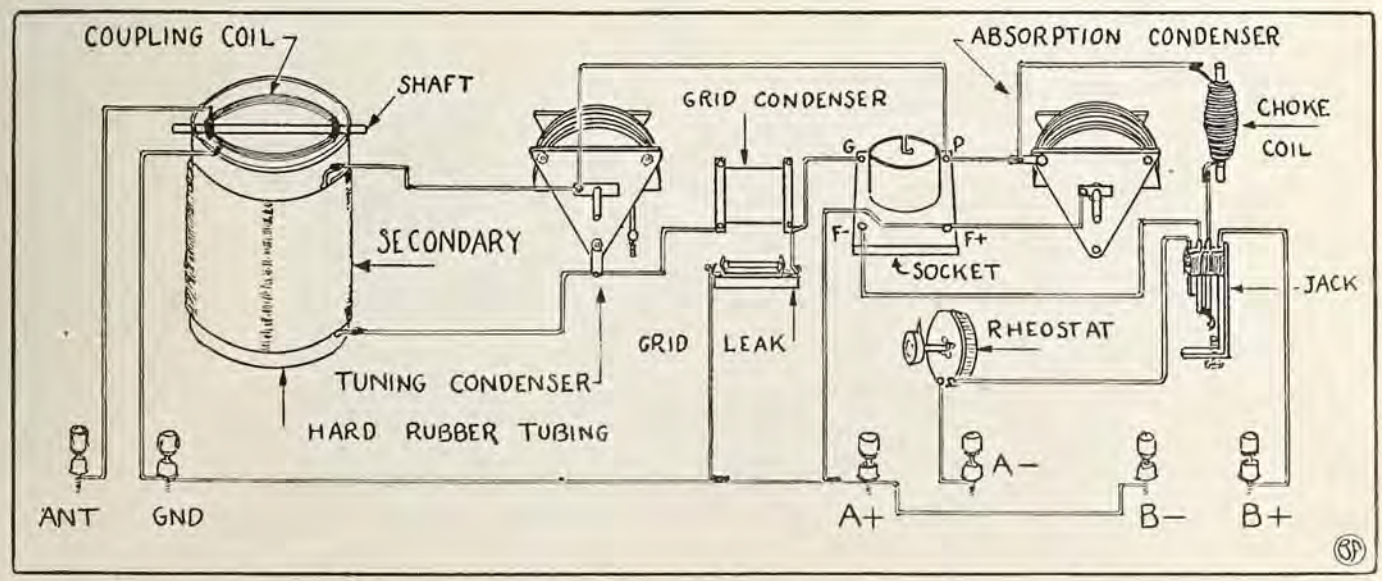
In view of the fact that the set is usually oscillating except when the primary and secondary is tuned to the natural period or wave length of the antenna, a condenser, preferably one of .001 mfd., may be inserted in the antenna or ground lead going to the primary of the vario-coupler.

When a set is oscillating, the incoming carrier wave will be found to tune very sharp.

As a result it would be advisable to exercise great care in the tuning. This will apply to the tuning condenser.

The Choice of Parts

I decided to use only the highest grade of apparatus and insulation; to use large wire for the coils, the best kind of grid



Circuit diagram of the Ultra-Audion receiver. There aren't many parts to assemble and the circuit is simple in operation. Special features are the antenna coupling coil, the low capacity grid condenser, the absorption condenser and the R.F. choke coil which keeps radio frequency current out of the phones.

From the rear. The sub-panel simplifies the mounting, and it's fastened to the socket. It supports the coil, rheostat and binding posts, besides the wiring underneath it. Note the geared and counterbalanced type of condenser.

condenser I could get, and to mount the outfit in the most accessible and pleasing manner. With No. 24 wire for the secondary, I could scarcely get rid of WEAF in a location in New York City in order to receive WIP, but with No. 16 wire, this was easy, thus bearing out the familiar statement that high resistance broadens the tuning.

SEVERAL makes of variable condenser were tried and differences noted in the oscillation point and signal strength in direct ratio to their quality. Results were slightly better with a reduced number of turns on the coil and a little larger size condenser. A vernier control on the tuning condenser is an absolute necessity, but do not select the type of vernier condenser having an extra plate and a small knob for operating it.

A condenser of this style cannot be used with much success since it is not possible to keep a list of the dial settings for various stations. The vernier should move the condenser as a whole and not one of its plates. A friction vernier on the rim will do very well, although a gear of some sort is more rugged and permanent.

The regular .00025 grid condenser was found rather large, and with a .00002 mfds. size the clarity was not only improved considerably but the selectiveness also became surprisingly better.

Some innovations in assembly are shown in the illustrations. The front view demonstrates the simplicity and good appearance of the completed receiver. There is a tuning control and a non-critical regeneration control and a phone jack. Nothing else to "monkey with." The rheostat is placed inside and is a new type which has both a small and a heavy wire so that the one rheostat permits the use of tubes of any character. It is mounted on a sub-panel in the cabinet so that it can be adjusted once and for all and never touched except when another tube is used. A filament control jack automatically turns the current to the tube as the phones are "plugged in." The rheostat is thus always set at the point where the tube operates best; and it doesn't clutter up the panel with an unnecessary knob.

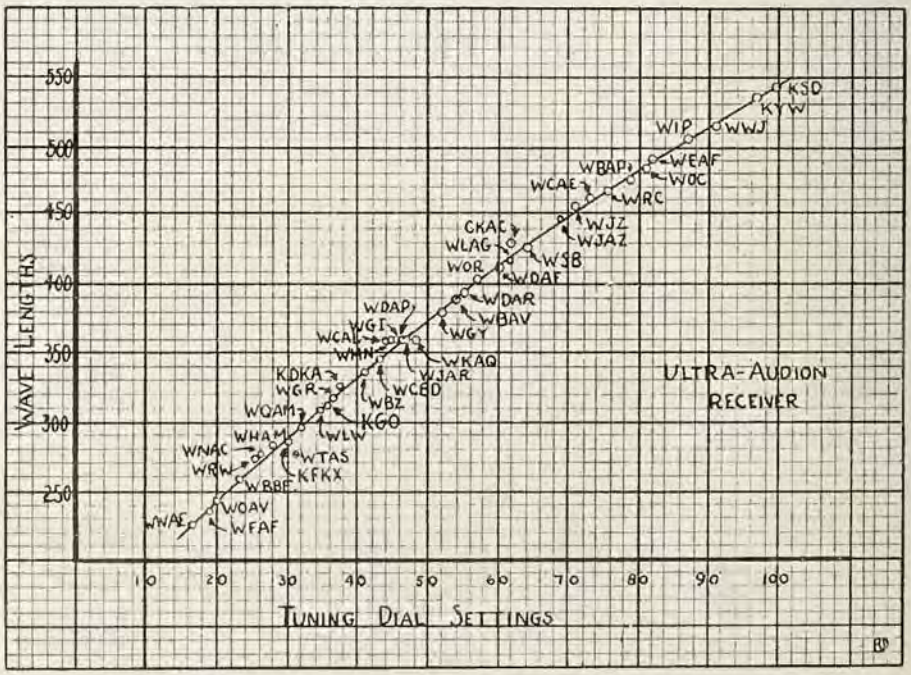
Connections in Rear

The appearance of the interior is good because nearly all the wiring is done underneath the sub-panel, passing the bus-bar wire through small holes drilled through at the proper place. All connections are made at the rear through little holes in the cabinet and again the front of the set is improved. There are no straying wires to binding posts in sight. Eby posts are used because each has a hole in the shaft into which the wire may be pushed from outside the rear of the cabinet with no need of bending the end around the post.

One other problem was met in a manner which will not greatly trouble even the most inexperienced builder. I found that the capacity between the cords of different makes of phones was different in each case and had a most important effect on the absorption of oscillation. With one pair of phones the set couldn't be made to oscillate and with another it was hard to stop it. The remedy lay in keeping all radio frequency current away from the phones, and this was done by the introduction of a radio frequency choke coil. This was a small item and the wire was wound on a short piece of insulating rod.

The parts used for the receiver itself are as follows:

1 7 x 14 inch cabinet.
1 7 x 14 inch panel.
1 7 x 10 black panel (as sub-panel).
1 panel mount socket.
1 grid leak mounting and 2 megohm leak.
1 specially built grid condenser (see below).
1 No. 23 "duplex wound" rheostat.
6 binding posts.
1 4 x 4 inch (hard rubber) tubing.
1 5 inch dowel stick about ⅜ inch diameter (or hard rubber).
¼ lb. No. 30 D. C. C. wire.
1 2 inch dowel stick about ⅜ inch diameter (or fiber).
1 single circuit filament control jack.
5 lengths bus bar.
1 lb. No. 16 D. C. C. wire.
1 .0005 variable condenser with vernier.



Here's what your own receiving record ought to look like, with other stations nearer to you. The condenser and coil are of such size that the broadcast band is just covered from zero to 100.

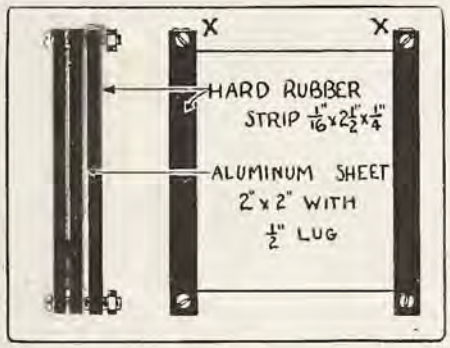
1 .0005 variable condenser with or without vernier.

The Coils

THE ANTENNA coupling coil consists of 15 turns of the No. 16 wire wound first on a bottle or other cylindrical form about 3 inches in diameter. Two pieces of bicycle tape are used to hold the coil in place as it is slipped off the winding form. The secondary consists of 42 turns of the No. 16 wire wound on the tubing very tightly and smoothly. Two holes through the tubing at each end of the winding serve to hold the ends in place. Mount the coupling coil at one end, and the winding of the secondary should be started right near the other end of the tubing so that there will be room enough for the shaft of the coupling coil. Drill two holes so that the shaft will fit rather snugly and tie the coil to the shaft with small pieces of insulated wire. If the shaft is rather large, it may facilitate matters to divide the coupling coil into two parts and put the shaft in the middle. White thread can be used to fasten the parts together as illustrated. The coil should be held in the center of the tubing by two washers which press tightly against the tube and the coil. These may be sawed from a length of fiber tubing. The coupling coil is adjusted to suit the particular aerial in use and then not touched again. Two short lengths of flexible insulated wire had best be used for connecting the coil to the bus leads to the antenna and ground binding posts. The tubing may be mounted to the sub-panel by two small brass angles with 6-32 machine screws in the panel and tubing for support.

Two aluminum sheets are cut 2x2 inches with a lug about ¼ inch wide on one corner and extending about ½ inch out from the edge. The sheets are hammered flat. Then six strips of 1/16 inch thick hard rubber are cut with a hacksaw ¼ inch wide and 2½ inches long. Each has a hole made with a No. 27 drill at each end, about ⅛ inch in from the end. Four 6-32 machine screws ½ inch long complete the parts and the sketch shows the assembly. The lugs are bent over the end of one strip to make contact underneath the screw head or nut—one lug connected at each side. The bus bar may be soldered directly to the screw-heads marked "X" on the sketch. The plates should be parallel and 1/16 inch apart. This form of condenser is simple to make and highly efficient—air is the most perfect dielectric.

The choke coil is made with about 500 turns of the No. 30 wire wound on a short length of dowel stick, hard rubber rod or fiber rod. A convenient way to wind this is to fasten the rod in the chuck of a wheel brace—clamp the wheel brace in a vise, drill two little holes in the rod to fasten the ends of the wire and wind it on. The number of turns is of no importance, the only essential being that it have enough so that the natural wave length of the choke coil is well above the broadcast band. At least 300 turns should be used, and if you wind enough wire so that the coil is about ¾ inch thick, you'll have plenty.



Details of the grid condenser. Two sheets of aluminum and six narrow strips of hard rubber form the condenser, with four screws for the assembly. The most efficient dielectric—air—is employed.

Making the Connections

LITTLE need be said about the method of mounting, as this is shown in the illustrations well enough. In wiring, do not use right-angled bends throughout but run the connecting leads the shortest distance, keeping the following wires at least one inch from all others:

The wire from lower end of secondary to stator connection of condenser;

The wire from stator end of condenser to grid condenser;

The wire from grid condenser to grid;

The wire from the grid condenser to grid leak;

The wire from upper end of secondary to rotor of condenser;

The wire from rotor of condenser to plate;

The wire from plate to stator of absorption condenser;

The wire from stator of absorption condenser to choke coil.

Make these leads short and direct. Some of them need not be made beneath the sub-panel because the points mentioned are nearby above it. The other wires may be run close together, at right angles, or any other way that suits the maker of the outfit.

Use very little soldering flux and wipe off any black deposit after the connections have been soldered. Be careful of the connections to the jack. The frame is joined to the B plus post and the long contact spring to the choke coil. The other two are in the negative filament circuit, for the insertion of the phone plug causes them to come into contact and light the tube.

It is very important that you connect the grid leak to the positive side of the filament, as the tube will not function any other way. Moreover, ground the positive of the filament, as shown in the circuit diagram.

I have found the WD12 to give as good results as any other tube as far as distance is concerned. Just the least bit better volume can be had on the local stations with the UV201A or C301A. The UV199 is also satisfactory, and the rheostat specified will take care of any of them. A single dry cell forms the "A" battery for the WD12 (or C12 or WD11) but with the 201A or 301A tube, four dry cells are needed or else a 6 volt storage battery. The UV200 does not appear to be quite as satisfactory, and inasmuch as the other tubes require only about one-fourth as much current, they are more economical besides being slightly better. Forty-five volts of "B" battery are used for the plate supply.

For local reception, results are quite good with a connection to the electric light line through a .0005 fixed condenser or a plug. The very best aerial is a single straight wire from 75 to 125 feet long, without too long a lead-in. The ground connection is made to a clamp on the radiator or water pipe in the customary manner.

Set the coupling coil at a 45-degree angle to the secondary and the absorption condenser at zero. After making all connections except those to the "B" battery, insert

(Continued on page 55)

Doesn't it look simple? The rheostat's inside and is always set at the right value. The tube lights when the phone plug is pushed in. The left hand condenser has a vernier control and accomplishes the tuning.

Surviving a "Radio Summer"

By J. A. CALLANAN

[As Broadcast for RADIO AGE from Station WTAY.]

For the past few years, ever since the inception of Radio, sales have decreased during the Summer for no reason at all. As a matter of fact, theoretically, trade activities should be greater in the Summer than in the Winter, and undoubtedly during this and ensuing years that condition will prevail.

Heretofore the annual falling off of interest in radio communication has been erroneously ascribed to the belief that seasonal and atmospheric conditions prohibited a full measure of realization of the pleasures attending reception. I have analyzed this subject and have drawn the conclusion that this waning interest is in a much larger measure due to that irresistible call of the Great Out-of-Doors which makes itself felt as the Summer days come on.

But today there is a rival to that call, if we are to discern the signs of the times, from the innumerable inquiries as to the feasibility and the kind of a radio receiver to take on vacations. If it is a truism that a radio set in the home has become an essential of the first order, it is becoming equally a truism that the fan and his receiver are not readily divorced.

Nearly everybody who has a car and goes motoring, camping or touring this year will take along a radio set. No regrets need be experienced for leaving your radio receiver behind you as you journey forth into the open for a day, a week or a month, as the case may be.

Broadcasting will this year, as never before, receive the attention of the fan. All broadcasting stations will be alert for the advantages radio presents as a medium of entertainment through the national interest in vital political events during the Summer. Transmission of such programs is without precedent during the period of time in which radio communication has so gripped the popular mind, as no other one thing has ever done.

Trade has awakened to a new realization that there is to be no interruption. Manufacturers are preparing to supply demands for portable sets. RADIO AGE is deluged with an insistent demand for circuits and data for home construction, and is meeting in current issues these needs by a variety of practical suggestions for making and installing radio receivers in every conceivable way for adaptation to camper, motor and tourist requirements.

Let us consider for a moment the prejudice that admittedly exists in many minds as to the adverse conditions affecting radio reception during the Summer months. Let us admit that radio is variable; that its fascination is in its erratic and elusive characteristics. It unfolds many mysteries, many forces that are not within the ken or control of man. Those much over-worked terms, "Static and Atmospherics," however, carry many burdens which are not their own. While these forces in themselves remain constant in their seasonal manifestations, the refinements of man-made devices are immeasurable and have minimized the ill effects which hitherto have seemed insurmountable. We may always encounter trouble, more or less, at one time or another and must not be surprised or dismayed at its form; but these factors which have seemed a serious deterrent to the uniformed are to the technical mind a foundation upon which the art is building constantly to embrace larger and larger possibilities. Out of this experience the layman is becoming more and more familiar with underlying principles because he finds it a willing medium of helpfulness in diagnosing and correcting his troubles as they arise.

In this sketchy little talk I am not forgetting those of my listeners who will not go vacationing. For them I am suggesting the opportunities for fruitful work to be tackled during the Summer, rather than putting your radio set in the cellar for that hot spell when you think that static is going to be too bothersome. Don't. Rather, work your set for all it is worth and devise ways and means for doing away with that disturber. RADIO AGE will give valuable discussions on remedial measures of proven value. Don't forget that the man who invents a device to overcome any one type of interfering medium will go down in history as one of the outstanding inventors of the age.

WHY DO GIRLS LIKE BARBER SHOPS? Kadel & Herbert.

Surely not because they like the barber's time-worn chatter. Maybe the picture will explain why barber shops are no longer dens of torture for girls getting their hair bobbed. The radio set in the background keeps them occupied while the barber shears their locks. Lunella Young is seated in the chair, being assisted through the clipping ordeal by an ethereal entertainment.

Unsnarling Tube Connections

By FELIX ANDERSON, Assistant Technical Editor

How Characteristics of Vacuum Tubes May Be Dealt With Safely in the Various Circuits

IN THE July issue of RADIO AGE, we discussed in detail the various tube controls and accessories, their design and possible faults, and arrived at the conclusion that the choice of well made, low loss and efficient apparatus is a vital necessity in the process of realizing the utmost in results with vacuum tubes. As mentioned in that issue, poor apparatus and accessories are contributors of noises, critical tuning, and are often the underlying reason for the poor showing which some receiving sets make. I would consider the choice of the accessories to be used with the tube of the greatest importance in making a radio receiver, because it is in these little inexpensive parts that great faults may lie, and are overlooked because their action in circuits is considered so trivial.

Granting that we have on hand an assortment of rheostats, tube sockets, potentiometers, grid leaks and batteries that are of the best design both electrically and mechanically, we are confronted with a problem of equal importance. To attain the very greatest efficiency with a triode, we must connect it in a circuit in such a manner that its real virtues may be readily extracted, and we must use our accessories to the greatest advantage possible in arriving at our object.

Consider Little Things

It is a wise plan to consider first the medium with which we are going to connect electrically the various pieces of apparatus which we have assembled in the process of making a vacuum tube receiver. The wire used should be preferably of tinned copper bus bar, No. 14 gauge, soft drawn, so that it will bend easily. It is not wise to cover the grid and plate circuit leads of any receiver with spaghetti, as it may contribute small amounts of distributed capacity to the receiver as a whole. You may consider this trivial, but summing up all the little defects in a radio receiver and subtracting them from the results you should get, will make a great deal of difference.

Suppose you made a receiver that seemed to be ailing some place. Then suppose that you added one or two little improvements that increased the efficiency of the set 3 per cent. Now your ears would be poor judges of the increase in efficiency, because they would not be sensitive to improvements so small. But now suppose you made ten of these little changes, each contributing its little 3 per cent in operating efficiency all at once. When you put the phones on, you would notice 30 per cent increase in the effectiveness of the receiver, and it would prove to you quite conclusively the fact that it pays to respect trifles in radio.

Since the filament connections or wiring are nearly always common to the ground or in other words, because the batteries furnishing energy for the filament and plate circuits are usually not engaged in the actual conveying of the signal while it is of radio frequency nature, it is not important whether they are covered or not. The usual practice in high grade receivers is to insulate the filament and plate battery wiring to prevent any accidental short circuiting and subsequent destruction of some unit in the receiver.

Connections in General

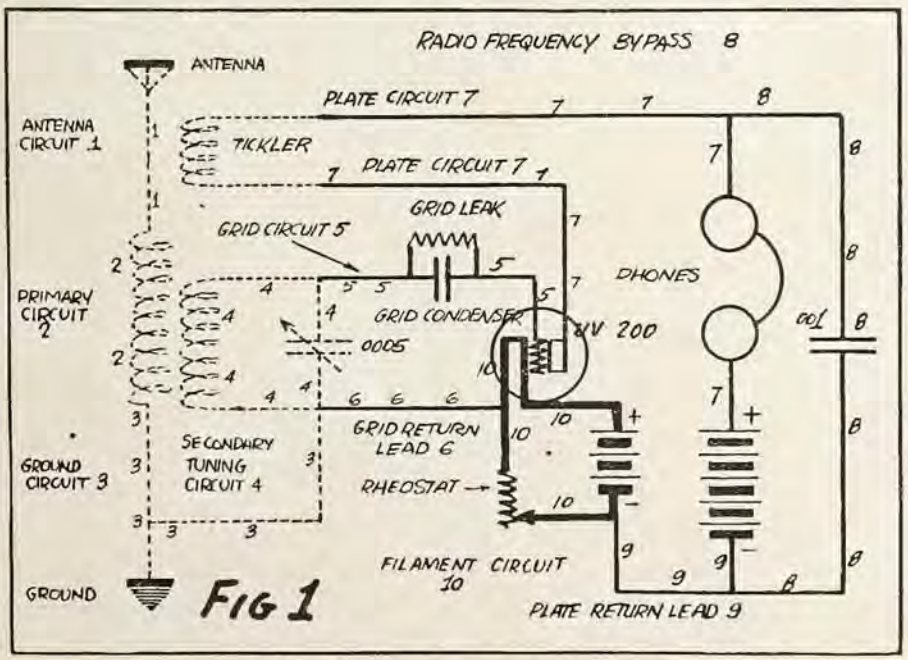
In the various tube circuits being published today, the details of such connections as grid and plate return leads, the position of the filament rheostat and potentiometer and other accessories have been unfortunately ignored, and it is no wonder that considerable doubt should exist in the minds of the tube users as to what connections are best suited to the type of tube they are using. I find that a number of inquiries addressed to our technical department are in search of information of this nature.

For the purpose of easier reference, I am showing in Figure 1 a model circuit with the various connections of the tube and circuit labeled with the terms as suit their value in the diagram. Briefly, the terms apply as follows:

The grid return lead is that lead which is connected to the filament circuit at either positive or negative potential, with its opposite terminal attached indirectly through the tuning system to the grid of the tube. This is vastly important in using different tubes, especially in the matter of which side of the filament battery the connection is made. Various actions can be obtained in circuits by merely changing the polarity impressed upon the grid by the connection of this grid return lead to either side of the filament circuit.

The plate return lead is that lead which connects the negative of the B or plate battery to either side of the filament circuit. It is of equal importance with the grid return lead in respect to the action of the tube in the circuit.

The other connections of the filament circuit, while not of so great an importance, should be carefully observed as one of the little trifles which contribute to the general effectiveness of a receiver.



The values of the wires in the circuit shown herewith are marked with respect to their function in the circuit.

Connection Chart

Allowing that all the present day tubes can be classified under various rules for connections, we can evolve a definite set of rules that can be followed out in the course of connecting the grid and plate return leads of a receiving set. We can then specify in general whether a potentiometer should be used or not from the start, and in this way establish a basis from which to start working. In Fig. 2 is shown a chart giving the various connections of

FIG 2.

CONNECTION CHART

TUBE	GRID RETURN			PLATE RETURN		
	DETECTOR	RADIO	AUDIO	DETECTOR	RADIO	AUDIO
C-301A UV201A	+ FILAMENT			+ FILAMENT		
DITTO		POTENTIOMETER OR – FILAMENT			+ FILAMENT	
DITTO			– FILAMENT OR – C BATTERY			+ FILAMENT
C-299 UV-199	+ FILAMENT			+ FILAMENT		
DITTO		POTENTIOMETER OR – FILAMENT			+ FILAMENT	
DITTO			– FILAMENT OR – C BATTERY			+ FILAMENT
WD-11 WD-12 C-11 C-12	+ FILAMENT			+ FILAMENT		
DITTO		POTENTIOMETER OR – FILAMENT			+ FILAMENT	
DITTO			– FILAMENT OR – C BATTERY			+ FILAMENT
C-300 UV-200	– FILAMENT			POTENTIOMETER		
RHEOSTAT	– F	– F	– F	– F	– F	– F

the grid and plate return leads, as well as the location of the rheostat.

While these rules apply to most tubes and circuits, there will be exceptions, and the most effective way to find them is to first sketch them out on paper and then work them out in practice. If the chart connections fail to give the expected results, the only certain recourse is experiment and trial. Invariably after one or two trials the proper one will be found.

Detector Tubes

We find in popular demand two types of detector tubes. Recently we mentioned that while we considered the UV200 tube a superior tube than the UV201A from a standpoint of a detector, this was an entirely personal view, and does not in any way mean that the UV201A is worthless in this capacity. In fact, it functions admirably in the detector socket, but to make it do so, we must use an entirely different set of connections than that of the UV200. Figure 3 illustrates the connections for the UV200 when employed as a detector. The UV201A should be connected in the manner shown at Figure 4 when used as detectors, as should all the high vacuum tubes. The UV199, WD11, WD12, C299, C301A, C11 and C12 all are classified as high vacuum tubes, and can all be used as detectors.

The connection of the grid return on a detector tube depends largely upon the type of tube used. Gas tubes work best with the grid return lead connected to the negative side of the filament. When high vacuum tubes are used as detectors, the general rule is to connect the grid return lead to the positive side of the filament when grid leak and condenser are used. The difference lies in the corresponding characteristics of the tube with regard to their action as amplifiers.

A few words might be said here about the action of the grid condenser and grid leak, and why they are so important in getting the proper quality of signal at the output end of the circuit. Referring to Figure 3, we have a circuit designed to give the greatest possible output to the amplifier circuit. To effect this condition, the grid leak resistance should be high compared with the input resistance of the tube; that is, about two megohms or more.

When a signal voltage is applied to the input terminals (in this case the secondary of the tuner), a voltage is built up across the resistance R, by the action of the rectifying characteristics of the grid circuit. This voltage is alternating in nature according to the modulation frequency. The condenser C bypasses the radio signal around the grid leak. When the voltage across R rises, this condenser becomes charged and after the wave has passed this charge must leak off by the way of the grid leak, so that the grid of the tube will be restored to its original potential.

Now if the grid leak and condenser are not properly proportioned, so that the charging current can leak off at the proper instant, we have distortion. The rate of discharge of the radio frequency signal which has been impressed upon the grid of the tube depends upon the proper choice of the grid leak and condenser. The customary way to obtain this proper action is to purchase a grid condenser having as the lowest consistent reactance with respect to the operating range of radio frequencies, and then make the grid leak have as high a resistance as we can without introducing distortion.

If static is strong, or you are near a strong local station, this idea does not work out very well, as the charges are excessive, and will not leak off fast enough when a high resistance leak is used. The high grid leak value should be used only on weak signals.

Many people question why a low resistance leak should be used with the gas content tubes, and this can be explained by saying that the gas which is allowed to remain in the tube during the process of manufacture furnishes in connection with irregularities in the plate and grid characteristics a conducting path for the charges to leak off. When the action described fails to accomplish this important leakage path, we use an additional grid leak to help it along.

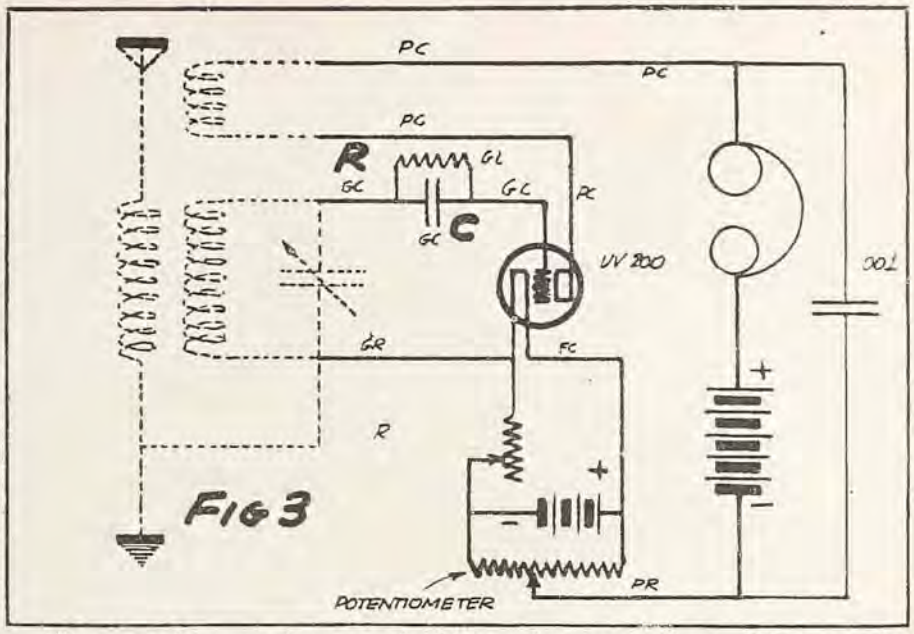
In some circuits, especially radio frequency amplifying, we find that there are connections (usually when impedances are used) which do not provide a direct current path through to the ground, and in such cases we connect the grid leak from the grid post to the positive filament. The Ultra-Audion circuit is another example of this case.

Radio Frequency

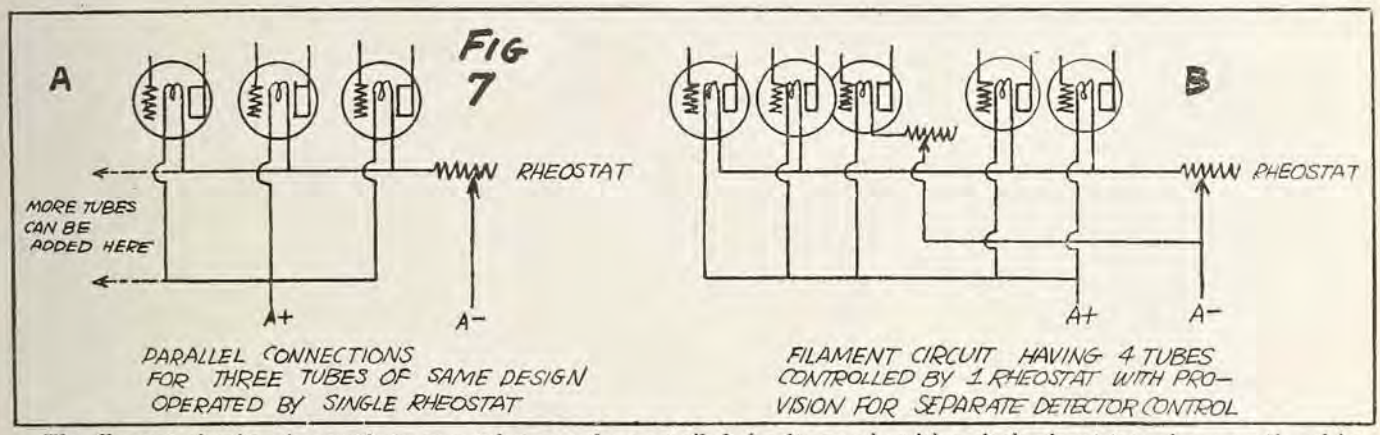
The grid return connection of the tube, when used as a radio frequency amplifier, is entirely dependent upon the nature of the circuit used. When potentiometers are used to suppress oscillations by varying the polarity impressed upon the grid, the grid return connection usually is made to the movable arm of the potentiometer, as shown in Figure 5. The action of the potentiometer in the circuit is to increase very finely the negative or positive charges on the grid.

When the movable arm is advanced toward the positive filament side of the resistance segment, the losses of the grid are increased, and the objectionable oscillations are suppressed. When the arm is moved toward the negative side, the grid losses are decreased, and full amplification value is had of the tube; but usually this state is not entirely possible, for as soon as the plate circuit comes into resonance with the grid circuit of the tube, oscillations start and we encounter distortion and radiation.

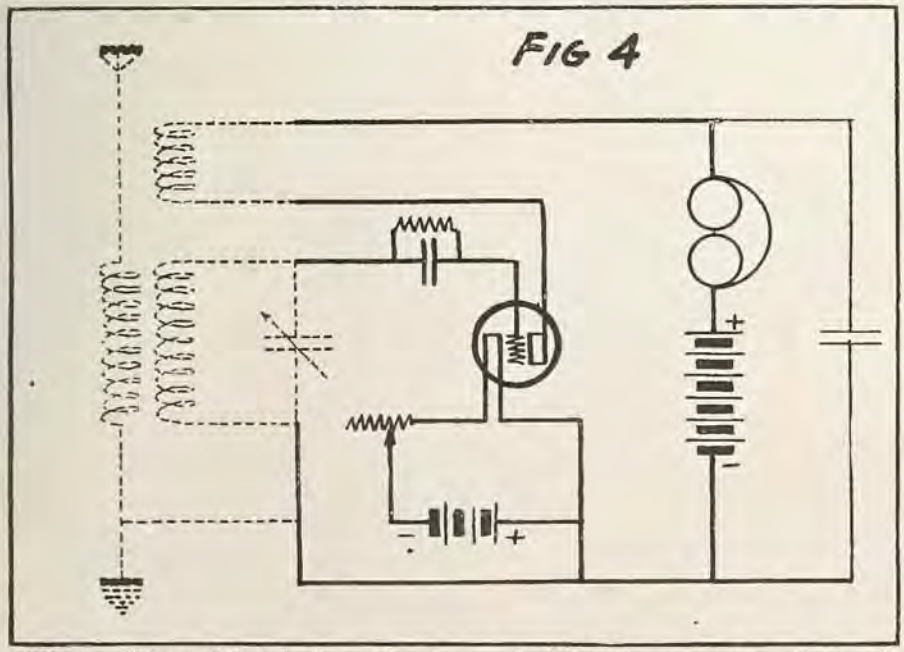
When some other means of stabilization is used, as an example the Neutrodyne, Rice and other circuits which balance off the plate and grid condenser action and oscillations, the grid return leads of these amplifiers should be connected to the negative filament. This gives full amplification efficiency, the obnoxious oscillations having been suppressed by or rather prevented by the neutralization of the plate and grid circuits.



These are the connections you should use when you employ a UV200 or other soft tube as a detector.



The filament circuits of several vacuum tubes may be controlled simultaneously with a single rheostat as shown on the wiring diagram above. This type of filament control is especially useful in multitube sets such as the super-heterodyne.

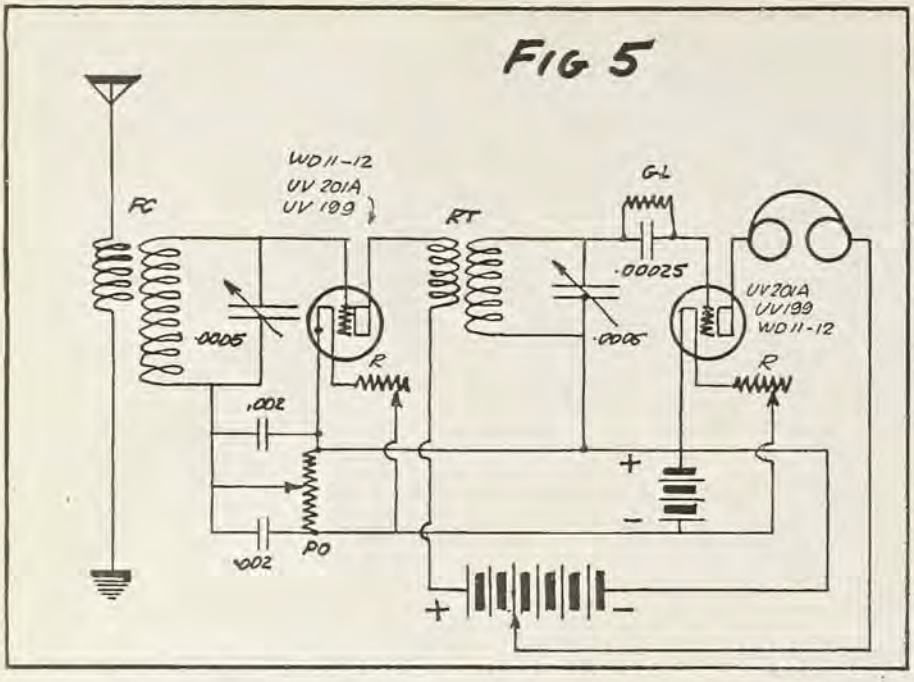


When a UV or WD tube is employed as a detector, the connections illustrated above should be used for the most effective results.

Potentiometer Losses

In radio frequency circuits, where a potentiometer is used to effect this stabilization, we introduce a great deal of losses, and as a consequence the strength of the signals suffer. It is therefore best when making any type of radio frequency amplifier which uses a potentiometer to first try the circuit with the grid return of the first radio frequency amplifier connected to the movable arm of the potentiometer, connecting the remaining stages to the negative side. In this way only the first tube operates at reduced amplification, while the remaining radio amplifiers work at full efficiency. The idea just described is shown in Figure 6.

For reasons that are quite evident, it



is not advisable to use more than normal voltages on the plates of tubes when they are used as radio frequency amplifiers. If more than 60 volts are used, it is advisable to use a grid biasing battery in order to offset an excessive drain on the plate battery. Usually it is only possible to make use of the grid biasing battery scheme when some other means of suppressing oscillations than a potentiometer is used. In other words, only such circuits as the Neutrodyne, Rice circuit and Superdyne or Teledyne is this grid bias battery idea practical.

The normal voltage for the standard tubes on the market as radio frequency amplifiers is 45, and it should be remembered that the little gain in amplification obtained when a higher plate voltage is applied does not compensate insofar as the drain on the B battery is concerned.

Other Radio Frequency Connections

Individual peculiarities of circuits and characteristics of the tubes themselves are often evident in radio frequency circuits, but this matter lies entirely within the scope of experimentation. If it is found that the circuit refuses to give the results expected, the proper recourse is as before mentioned—experiment. Peculiarities of this nature are really so different in nature that it is quite impossible to classify them under any definite head.

We have still another use for the potentiometer in the circuit, in this case controlling the plate return of the detector tube. It is espeially advisable with gas content tubes to use a potentiometer with its outer or resistance segment terminals connected to the positive and negative filament battery, and the movable center arm connected to the negative B battery.

This arrangement of the potentiometer affords a very delicate control of the plate battery current, and inasmuch as gas content tubes such as the UV200 are very critical with respect to plate current, it becomes a matter of much importance.

The A, C and UV, as well as the WD tubes, are not critical to either filament or plate current, and therefore do not require the potentiometer in this capacity.

The Technical Office of RADIO AGE is frequently asked to settle disputes as to whether the filament rheostats should be placed in the negative or positive leads of the circuit. In some cases, as in the UV200 detector tube, the position of the rheostat is not important, but it does make a difference in other cases. Specifically, this is the audio frequency amplifier, and for the sake of uniformity and consistency in wiring, it is always advisable to connect the rheostat in the negative filament lead.

Incidentally, many of our readers request that we designate for them the polarity of the tube socket connections with respect to the posts marked F and F. Often they ask us if the tubes have polarity action within the filament of the tube, because the sockets are marked F positive and F negative. The entire mystery is explained by saying that the filament connections are marked negative or positive for convenience in wiring, and it does not make any difference with regard to tube performance whether either end of the filament is made positive or negative.

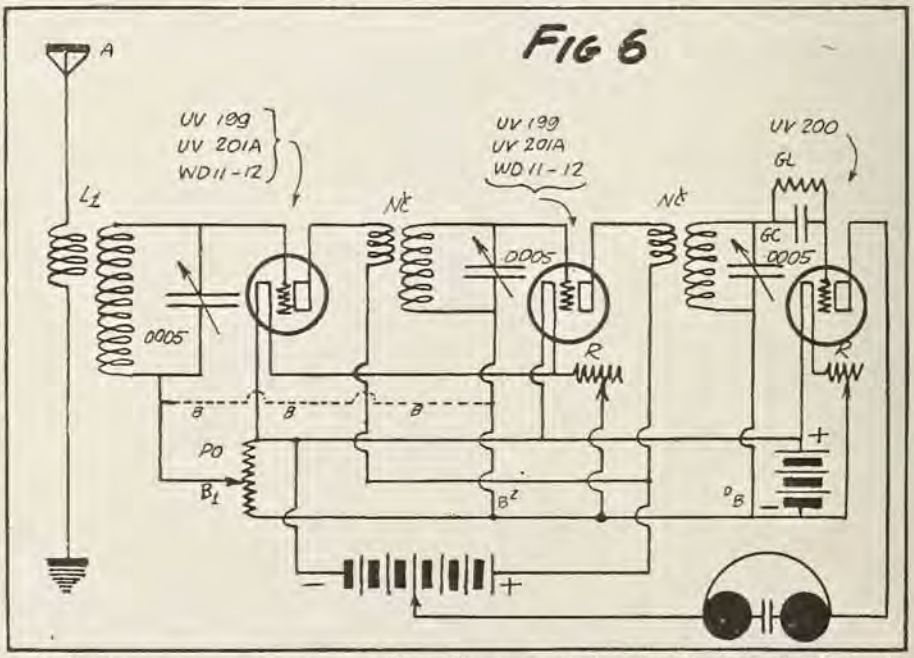
It is often desirable where space is valuable to use as few controls as possible, and the filament circuits, especially in the amplifier components, offer a chance to save panel space. Two or three amplifier tubes can be controlled effectively with one rheostat, and if desired both radio frequency and audio frequency amplifiers can be manually operated by the same resistance. The diagram shown in Figure 7 shows how additional tube may be added. It should be remembered, however, that as you add tubes, the resistance of the rheostat decreases.

Audio Frequency Amplifiers

The connections for audio frequency amplifiers of the cascade type are as old as the hills, and nearly every radio man can draw them from memory. However, many of them vary in design with respect as to how all connections are made, so for those who have any doubt as to the connections, I am showing in Figure 8 a diagram of a standard amplifier which can be added to any receiver without much trouble. It is considered good practice to omit the jack from the first stage, but if it is desired, follow out the dotted lines and the circuit will function just as well.

That leaves us with only one more

(Continued on page 51)



It is often necessary to connect the grid return of the second stage of RF to the potentiometer arm as shown, but should be avoided if possible. With a straight negative bias on the grid of the second RF tube, the circuit gives the greatest amplification.

DX With a Single-Dial

GO-GETTER

By PAUL THORNE

IN THE overwhelming excitement over supers and super-supers, and the ever-increasing members of the Dyne family, we seem of late to have largely overlooked several very important factors in radio development. What of the beginners—thousands of whom appear every day—or the old hands who have tired of many knobs and dials, and now want something that they can just turn on and listen? What of the modest experimenter who likes to tinker, but stands aghast at the multiplicity of controls and the network of wiring that makes even an old timer scratch his head? And what of that growing army of ladies who want to listen in on radio programs, yet are frightened away by "all those things you have to turn?"

These folks may all look far these days without finding any of the comparatively simple but effective hookups that used to appear regularly. Of course, the newcomers can go back and dig up some of the old stuff, but they feel that radio is advancing, and they are expecting something new. And even the old so-called simple hookups had their numerous taps and dials, so the ladies at least would be no better off.

While the engineers and experts are discussing their dynes and supers, here's something for the folks I've mentioned.

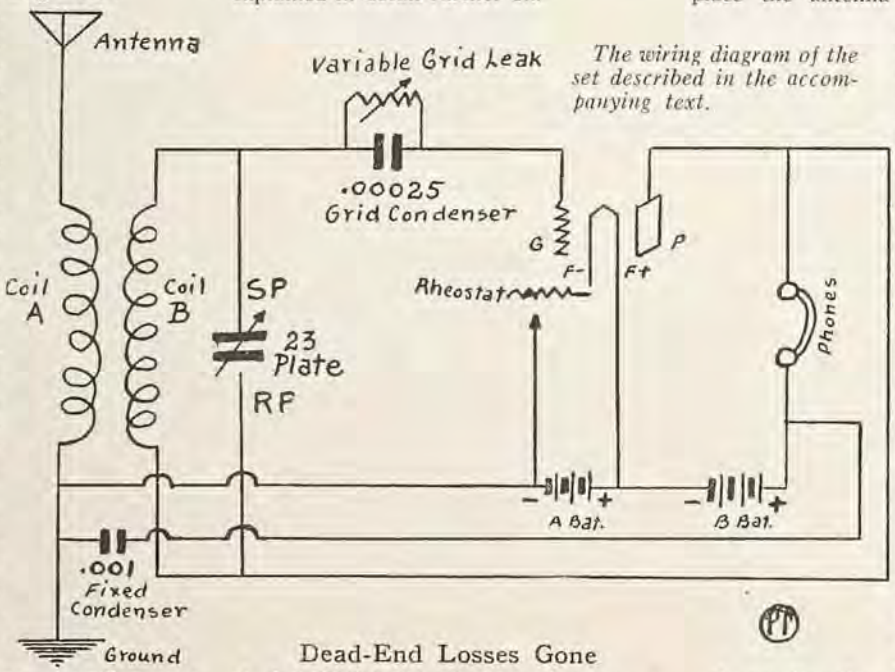
Are Supers Superior?

WHEN one compares the DX records sent to the various radio publications, the doubt often arises as to whether the newer super-circuits are really so superior to the simple circuits as we are sometimes led to believe. Looking over the records sent in by the proud and boastful owners of intricate sets, I find that I have had practically all of the stations listed on one or two tubes, using the hookup presented here.

For simplicity combined with effectiveness, this one-control hookup is hard to beat. It is very compact (note that, you portable set builders); it eliminates taps, operating on a minimum of fixed coupled inductance; uses spider web coils, and has only one tuning control—the variable plate condenser. Regeneration is controlled by the rheostat, but as the tube shows little inclination to "spill," it is seldom necessary to touch the rheostat again after the first station has been brought in with satisfactory volume and clearness.

It enables the beginner to experience the thrill of building his own set, and obtain really wonderful results right from the start, something which the average beginner often finds hard to accomplish. It offers the old hand who has tired of many controls an opportunity to get similar results with less effort. It is a set that the ladies will appreciate, for while the man of the house is away, they can easily tune in. To operate, they merely turn on the tube, and then turn the condenser dial to the station wanted, or if they don't know where to find the station, they simply turn the dial and some station will quickly come in. There is only ONE record to make when logging stations, and as they always come in at exactly the same point, it is easy to pick them up again if the station is on the air and weather conditions are right.

The set is easy and simple to build, and quite inexpensive. The circuit diagram gives all the necessary information except the preparing of the coils. This part is explained in detail further on.



The wiring diagram of the set described in the accompanying text.

Dead-End Losses Gone

AS USUALLY hooked up, however, a variocoupler is employed for inductance. Occasionally, coils wound on a tube, with a tapped primary, have been used. What I have accomplished is the eliminating of dead end losses, and useless work in building and tuning, by doing away with taps. At the same time I have made the circuit more selective. I have also greatly improved the volume and clearness by changing the rheostat to the negative side of the filament, and the addition of the ground connection from A—, and the lead containing a fixed condenser around the batteries. The increase in volume is considerable, especially on DX reception. The clarity of the reproduction is not excelled by any circuit, and is favorably commented upon by almost everyone who hears my sets.

The size of the cabinet and panel is left to the builder's individual requirements. He may want to start with a one-tube set, and add amplification in a separate unit later, or he may wish to combine one or two steps of audio amplification in the set at once. While the diagram shows only the detector circuit, audio amplification can easily be added in the usual way. And in connection with this matter of size, let me say here that by using a compact plate condenser, and a UV199 tube, the set can be built into surprisingly small space, making a very efficient and convenient portable set.

An effective arrangement of parts is to place the antenna and ground binding posts in the upper left-hand corner of panel (looking at the front), and the phone and battery binding posts up and down the right-hand side. The plate condenser is put on the left, and the rheostat on the right, with the inductance coils behind the condenser and the tube back of the rheostat. If a variable grid leak is used it can be placed in the center of the panel. If a fixed leak is preferred, two megohms will be about right. I prefer the pencil type grid leak, as one can obtain very fine adjustment with it, which is highly important for good DX work.

In winding the secondary (B) coil, the

(Continued on page 53)

Reminiscences *of an Old* OPERATOR

Thru some misunderstanding the youngster let go at the critical moment; the mast fell toward the white-faced and helpless group of would-be engineers, and shot through a skylight into a barber shop below.

Illustration by
GEO. B. DENNIS

Part One: *"My Amateur Days"*

¶ A Vivid Retrospection of the Days When a Radio "Bug" Who Claimed to Extract Messages From the Ether Was Declared Mentally Unsound.

By
ARTHUR LYNCH

MY EARLIEST remembrance of wireless dates back to the latter part of 1906, or the early part of 1907, I am not quite sure which. The excitement started with my discovery in a current boys' magazine of a diagram for "a wireless receiving set which any boy can make," over which fortunate experimenters had heard stations "five miles distant." The diagram of this wondrous creation as it appears on a tattered piece of school drawing paper is now among my prized possessions in case some intrepid experimenter might desire to try it out alongside his superheterodyne.

The slogan "make it out of the junk you have" would hardly apply to a masterpiece of this magnitude, as few if any would find their shop stocked with the necessary apparatus. The list of materials was impressive, containing such highly scientific items as "200 feet of annunciator wire, one 75-ohm bi-polar telephone receiver," and again "one carbon rod from a common dry battery."

Among the concluding items stands out in my memory a shining item—"one brass head upholsterer's tack with head between 3/16" and ¼" in diameter." How I did sweat over that item! With foot rule in hand I visited some fifteen upholstery shops in my own and neighboring cities in search for this elusive item. Upholsterers' tacks by the bucketful, yea, by the wagon load, were to be found in profusion, but not one could I locate that fell exactly within the limits specified by my guiding genius.

Early in my search I found little interest in my micrometer standards as to tack head sizes, the dealers visited feeling that I should somehow squeeze in a tack 9/32" or worry along with one about 5/32". With scorn I rejected their counsel! What could a mere upholsterer understand of the niceties of science!

That was the trouble with the non-scientific gentry of those days. They looked askance at we youngsters' experiments in the mystic sport—wireless. They thought we were tinkering with instruments of the devil—to put it mildly. They offered us absolutely no co-operation at all, which made our efforts all the more difficult. But it was such dogged determination that finally overcame early obstacles and made radio what it is today. And now those same skeptics are our staunchest admirers and the first to say: "I told you so! I knew he'd make good!" But let us proceed.

THIS article is the first of an interesting series by a veteran commercial operator, who describes the facts and thrills of his rise from an awe-inspired experimenter, back in 1907, to a full-fledged radio expert. Don't fail to miss a single installment, you amateurs!

While searching for new stores to enter I concluded to take the next shopkeeper into my confidence, but after three trials I concluded that this would not do at all. In no case did I get beyond a third explanation of my purpose in procuring an upholsterer's tack with head between 3/16" and ¼". The first fellow was merely dumfounded. "Wireless telegraph!" he kept exclaiming. He HAD heard that it was possible to telegraph and talk with wires, but a *wireless* telegraph was absolutely beyond him.

All "Unbelievers"

HE HAD to call Lena, his wife, who came with two babies in arms and several afoot to hear me tell it all over again, which story was no sooner complete than friend Otto, from the bakery, happened in with his Meerschaum for a chat with his good friends. A third telling was finished amid an accompaniment of wondering exclamations from all but Otto. This sturdy German struck a jarring note in the symphony by expressing entire disbelief in the whole project.

In the argument which followed the object of my quest was entirely forgotten and I finally extricated myself, followed by thunderous advice against my foolhardiness from the now thoroughly aroused Otto.

My next conferee quickly became bored at my insistence upon such close dimensions and returned to his bench with the darkness dense and unpunctured by my careful explanations of the wonders of the new science.

The third auditor listened to my opening text, but as I began on the sermon itself he laid his tools down, came closer and started to scowl ominously. Then he interrupted and roughly informed me that I was crazy. Telegraph without wires! Any time a freckled, lanky, short-panted kid armed with a smudged foot ruler laid off in eighths tried to tell him he was going to hear some messages coming through the air without any wires—well, he was too dash-blamed, gadswocked wise for that. I was some young Edison, I was, etc.

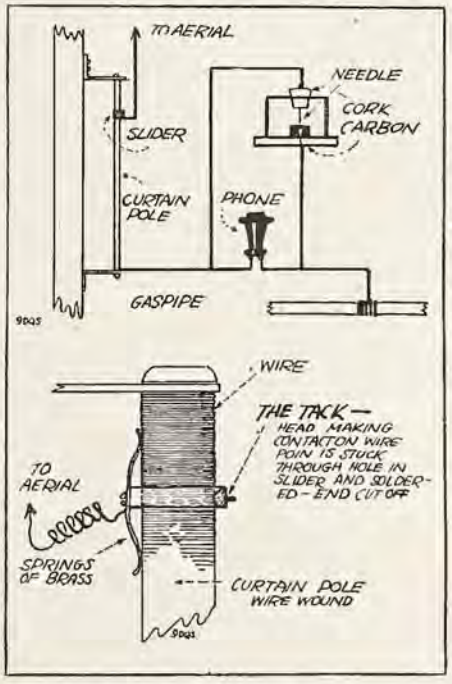
In despair I returned to my room and viewed the lavish outlay spread before me. Everything was there, right down to the "two blocks of soft wood 1¼"x 3"x 1" thick" which were supposed to support the tuning coil on the base "3"x 3'2" long by 1" thick," all shaved down to the hair—but no upholsterer's tack with head between 3/16" and ¼". I almost gave up making the set because to my mind it never could work with an upholsterer's tack over ¼"; and at night I had dreams of Hertzian waves, little purple glowing rings something under ¼" in diameter, dying by the millions, hanging in festoons on my wires with their leader stuck fast on the brass head tack some thirty-second of an inch too large.

Finally, with much care I filed down the circumference of a large tack to just a trifle under one and three-quarters of the eighth-inch spaces on my foot rule, and after polishing off the rough file marks, tried to convince myself that it would work.

With the set assembled, the first of many vigils at the one phone of the outfit began under awesome circumstances. My skeptical upholsterer friends had somewhat cooled my own ardor, and with my confidence further shaken by dissenting voices among my friends, I became chary of confiding my plans to anyone. Only my mother knew what I was doing and on the night of the first trans-continental tests she was in collusion with me falsely to announce that I had gone out for the evening.

In the darkness of my room I lay in hiding until quiet reigned in the household and mother's whisper at the door assured me that all was well. With curtains drawn and light turned low I made a final inspection of my connections from lead-in to gaspipe and found everything as per drawing.

THEN with a firm gulp swallowing my heart for the fifth time, I grasped the



This is the kind of "long distance Carbon receiver" that was in vogue back in the infant days of radio.

receiver and—witness the birth of the loud speaker idea—placed it within a close foot of my ear! Of course it was foolish of me to expect to hear the distant (four miles) station without radio frequency amplification, but remember that I was brand new at the game.

Suffice to say that I heard nothing from that receiver, even with it only an inch from my ear. Gaining courage I pressed it lightly to my ear, then, not suffering any ruptured eardrum, I squeezed it tightly, but no amount of grinding of receiver into ear produced anything but a dead silence. Right ear or left ear made no difference; light pressure or heavy pressure of needle on carbon block; brass curtain ring at top, center or bottom of tuning coil, all was silent as the grave.

Wrathfully I eyed the offending upholsterer's tack which, you recall, I had doctored into a semblance of proper dimensions. There, undoubtedly, was the trouble. However, I decided I would look over my aerial and outside connections on the morrow.

My aerial consisted of a brass rod stuck about four feet above the third story roof. Quite an antenna, at that, when a fellow can get Cuba on a loop—and six or eight tubes. Passing up the good or bad qualities, for I knew naught of either then, my daylight inspection showed everything shipshape, so I decided to give the outfit another tryout that night. Possibly, I thought, there were no messages being sent the night before.

But there was nothing doing that night or for several succeeding nights. Then as I was pondering one day I was chilled by a horrible thought. Possibly our only local station, "CG," Collingswood, N. J., was farther away than the four miles I had always believed lay between our house in Camden, N. J., and the suburb. The article regarding the set only claimed five miles for it, you will recall. Maybe the station was five and a quarter miles!

At first opportunity nothing would do but for me to pedal on my bike to Collingswood, watching the odometer tick off the tenths. 4.3 it registered from my house to Collingswood by road. In an air line it was no doubt much closer.

Now, absolutely stuck, I started doggedly listening, listening. In the morning before breakfast, at noon as soon as I was home from school, night after night, and still not a sound until—

One noon, as usual rushing up to my room, I was arrested at the doorway by a prodigious clicking coming from the general direction of my set. With heart standing still I breathlessly approached and soon traced the wild racket to the seventy-five ohm phone lying on the table. No need to put the receiver to ear—the clicking was of goodly bulk and strong and could be heard perfectly well with the phone where it was.

His Dreams Blasted

ON THE point of tearing madly through the house shouting the tidings to all, I paused. Somehow it struck me that something was irregular about all this. Picking up the receiver and placing it near my ear I immediately noted that the loud clickety-clicks emanating therefrom had little in them of a far off nature. They sounded more like good, healthy battery juice being fed directly into the coils of that phone. We had often used this very hook-up as a variation of our key and sounder circuits.

Hastily I examined my wiring. Sure enough, there were signs aplenty of dirty work at the cross roads. Hooked to my aerial and ground was an extra pair of wires leading over the window sill and down the outside of the house. Tiptoeing softly downstairs and down cellar, I came upon my Uncle Joe, a dabbler in electricity but a skeptic as to wireless, with a key, two dry cells and the other ends of two wires which I could gamble were furnishing sigs to my third floor "wireless" set.

Now that I am more or less grown up

and able-bodied, I am firmly resolved that if I ever meet my Uncle Joe again I am going to poke him hard at least once for that frameup. At that, his signals were the only ones I ever heard on my first set.

There follows a period in my radio career of which I can recall nothing. Then, perhaps a year later, I became acquainted with my first wireless friend, Norman Shepherd, who lived at 214 Broadway in my town, and who I found had quite a complete outfit. It always has been a mystery to me where he got his dope for the good equipment in his station. The details certainly were not being widely published—witness the diagram and description of my premier effort.

Shep had an electrolytic detector with platinum wire sealed in glass tube, later to be supplanted by the "whisker point"; he had fair receivers, a two-slide tuner, some potentiometers made of lead pencils, and a raft of other stuff. His sending set was a sight to behold. A ten-inch spark coil was used on 110 A. C. with about fifteen lamps series-multiple on a board right over the operating table. Broadway was a darkened country lane in comparison when Shep pressed the key. People came for miles to see the display.

The aerial would do credit to any good commercial station today. It was a ten-wire flat top a fair city block long, atop three-story houses and held forty feet farther aloft by two masts, each composed of a 4x6 below and a 2x4 above, supported by a maze of guys. The poles merely rested on the roof and were not fastened at the bottom. The guy wires were calculated to divide the strain equally and to do all the holding up necessary.

And believe me, they did that. I immediately became very active in the game and engineered many an aerial put up like Shep's in the following eighteen months—and always the same system of guys with no bottom support. I believe honestly I would hesitate a long time right now before I would swing a tall stick aloft depending solely on my calculated lengths of guy wires to tighten up and hold 'er there when it reached the perpendicular. Yet we did it dozens of times in those days with never a qualm, and with but one serious smash.

The author of this discordant recollection was barred forever from our construction force, and even now I can picture his disappointed little face in the crowd of smaller kids who were always on hand to pull the ropes, hold the guys and run the errands at every aerial raising.

An Aerial Calamity

ON THE day in question little Harry was detailed to hold for dear life onto one of the two topmast back guys, the two which above all were depended on to come to a comfortable tightness and STAY there as the pole reached its upright position. Through some misunderstanding, although thoroughly instructed, this youngster let go just at the critical moment. Pausing momentarily at the pinnacle, the stick continued its arc, first slowly, then more rapidly falling toward the white-faced and helpless group of would-be young engineers. The remaining top guy had only complicated matters by causing the stick to lurch sickeningly to one side, and the middle guys, not being greatly counted on, were too slack to exercise any restraint until the pole was well on its downward flight. Two fairly good chimneys to which these guys were fastened promptly crashed to the tin roof, upon which the assistant engineer in charge of the remaining middle guy let go the end, thinking to save his chimney from a similar fate.

Careening madly in a side-sweep, the pole knocked two of the boys for a row over the edge of the roof—fortunately a short story to the second floor roof of a wing of the building, then shot like an arrow, amidst a jangle of guy wires on the tin, straight through a skylight into a barber shop below. Although casualties could have been more numerous among us, perched fifty feet above, the nearest approach to actual death was in that crowded five-chair barber shop on a busy Saturday afternoon. A final check showed nothing more serious than several cases of panic, but wireless was strictly taboo in that household—yes, in the entire neighborhood.

ABOUT THE AUTHOR

Arthur Lynch, author of the reminiscent series beginning in this issue, has followed radio from its lowly birth to the lofty perch in the scientific world which it has now attained. After seven years in the commercial field, he spent two years as an operator for the Navy and four years as a practicing "observer" at home. He was one of the first to hear a raucous "Hello" from the De-Forest experimental station in New York in 1909. From all these years of experience, he will unfold to amateurs and "BCLs" some glimpses of the progress of radio through the eyes of one who loves the game.

—The Editors.

How long the Navy and commercial companies had maintained workable systems of wireless I do not know, but I clearly recall that at this period we could hear a string of stations up and down the coast from Cape Cod to Key West. Right fair distances, eh?

Which reminds me that never do I read an account purporting to chronicle the progress of radio that tells the real story of distances achieved or that is chronologically ten per cent correct. Per these accounts no understandable signals were ever received more than five hundred miles prior to about 1913. I am telling you right now that in these extremely early days we consistently copied Key West every night in the Winter, and later on in my accounts of commercial work on shipboard, I will tell of regular two-way exchange of volumes of business between ships and stations 2,500 and 3,000 miles apart. Furthermore, I remember Dave Heilg, my tutor prior to my entry into the commercial game, telling of the same regular transmission of messages as far back as his shipboard days on the Hamburg-American South American ships in 1904-5.

How we used to thrill at "Q1," Washington, with a wonderful high-toned spark —about 120 cycles!—trilling back at "PV," our coarse-voiced neighbor at League Island, now Philadelphia, Navy Yard. "PV's" spark would take fits of breaking, making noises like a big boy whose voice is changing rather late, except that its normal note was high and the break was downward. Catapulting up and down at every other letter, it must have been a "peach" to read through static.

"PT" I remember as Brooklyn Navy Yard and "PR" as Fire Island. If I miss on any of these, somebody please correct me. "QL" I believe was Norfolk's roughly spoken sign. And dear old "RD," Key West—what a triumph when he would rattle in on 1500 meters with a spark frequency of about twenty-five cycles. In the same period was "BX," later "BS," the United Wireless Telephone and Telegraph Company's station on the Bellevue Stratford Hotel, Philadelphia, working with "AX," Atlantic City, "NY," 42 Broadway, New York City, and "FS," the Plaza Hotel, New York City. As the United flourished, more ships and stations were added until any night our electrolytic and silicon detectors brought in a veritable beehive of stations. "WA," Waldorf-Astoria Hotel, New York City, and "DU," Dupont Building, Wilmington, Del., were late arrivals.

The First "World Criers"

SOMEWHERE in this period, too, "CC," Cape Cod Marconi, came on the air—or probably we just discovered him then, and after that, it was press every night at ten o'clock. These bulletins, which we could have read in five minutes in the evening paper, we would struggle for a good two hours, posting same on the kitchen door or back fence alongside of Washington's weather report at the same time we changed the weather flags for the day. Sure—every amateur in our neighborhood had a complete set of signal flags which all the laymen in the block marveled at, but, of course, could not understand.

How many here—hold up your hands —who remember the thrill of that cold, impersonal non-synchronous spark starting promptly at ten with . . . — . . . — . . . — — .—. —.—. —.—. —.—, then "To all Marconi ships and stations," followed by "New York Herald (or some other paper) says—" and a short editorial from some New York sheet and a long string of press, the items separated by the word "stop," with stock reports at the end? This press, we understood, was punched onto a tape and fed through a sending machine twice as both sendings were identical, even to any mistakes which had crept into the punching.

As I think back, however, I believe our biggest thrill came when we heard our first 500-cycle spark. The Navy was running some tests between the scout cruisers Chester and Birmingham and the land station at Brant Rock, Mass. We never heard the cruisers, but one night Shep and I landed "plop" on Brant Rock's tune

(Continued on page 40)

What the Broadcasters are Doing

Radio Station WIP Broadcasts From Bottom of Atlantic

Since radio broadcasting took this country by storm, many strange things and many strange sounds have been broadcast. The roar of the mighty Atlantic's waves, the rattle of a rattlesnake, the voice of an aviator high in the heavens.

And now, the marvels of the deep sea have been broadcast to the entire world. On Thursday, July 31, at 3 p. m. and 8 p. m. the Atlantic City Control Station of Radio Broadcasting Station WIP, of Gimbel Brothers, Philadelphia, broadcast from the bottom of the Atlantic Ocean.

Not satisfied with the new and novel idea of broadcasting the surf noises of the mighty Atlantic, Station WIP's engineers looked for a stunt that would be even more thrilling.

So a deep sea diver dropped over the side of a boat, to the floor of the Atlantic Ocean, fifty feet or so below. In his diving helmet, he had a special radio microphone, connected by lead cable to the boat and from there to the Remote Control Station of Station WIP, on the Steel Pier, Atlantic City, N. J.

C. O. Jackson, expert diver of the Philadelphia Derrick and Salvage Corporation, was the first man to talk over radio from the bottom of the sea.

Through the heavy glass windows of his diving suit, Mr. Johnson has seen many strange and wonderful sights of under-sea life. The special microphone, which was attached inside his helmet, enabled him to describe to the radio public, exactly what was going on at the bottom of the mighty Atlantic.

The strange fish, and other sea creatures living at the bottom of the sea were described. The appearance of the sub-sea foliage and mineral formations were broadcast in full detail.

This was the first time that any broadcasting station has sent a microphone to the bottom of the sea. Special cable, waterproof and flexible, is necessary to connect the diver to the boat. The voice originates from the helmet of the diver, thence to the boat floating on the surface of the water above. The boat, in turn, is connected by wire to the Remote Control Station on the Steel Pier. Here the voice from under the ocean is amplified many thousands of times, then transmitted over special telephone lines to the main station, located on the Gimbel Brothers store in Philadelphia, more than sixty miles away.

Movie Talks On WGY

WGY, the Schenectady broadcasting station, introduced a new weekly feature last month which is sure to be of interest to a great majority of the station's listeners. Quinn Martin of the New York World delivered the first of a series of "Movie Notions." Mr. Martin, who has made a study of the movie industry for years and has visited most of the large studios, told about the best pictures produced and took his listeners back of the silver sheet into the producing studios and explained how some of the stunts are done. He gives intimate pictures of some of the leading figures in the motion picture industry. In his first talk he discussed the slow but sure tendency of the producer to artistic production.

BURTON THATCHER

has gained considerable fame and following for his method of teaching vocal lessons over station WLS of Chicago. His listening clientele consists of hundreds of men, women and children who have profited by his instructions broadcast over the air in the past few months.

Musical Rehearsal Held by Telephone

One of the most unique musical performances in this age of startling achievements was accomplished when a musical rehearsal was successfully completed by means of long distance telephone.

Miss Wellman, who is one of the youngest vocal artists engaged in concert work, was invited by Victor Saudek, director of the KDKA Little Symphony Orchestra, to appear on the broadcasting program of station KDKA and render a few musical numbers. Miss Wellman gladly accepted the invitation and arranged to come to Pittsburgh before the date scheduled for her appearance for the purpose of rehearsing her numbers with the KDKA Little Symphony Orchestra.

A few days later Mr. Saudek received a telephone call at the East Pittsburgh broadcasting studio from Miss Wellman in New York stating she would be unable to leave New York in time for her rehearsal, and so she decided that it would be better to cancel her engagement. Mr. Saudek, however, suggested that she conduct the rehearsal by means of the long distance telephone over which they were conversing. She agreed.

The orchestra was soon in readiness, and with the telephone receiver to his ear listening to Miss Wellman singing, Victor Saudek was able to direct the Little Symphony Orchestra at the East Pittsburgh studio and thus conduct the rehearsal. "The Spring Song" from the opera "Samson and Delilah" by Saint Saens, and "Oh Rest in the Lord" from the oratorio "Elijah" by Mendelssohn, the two numbers which Miss Wellman sang at the concert, were played until the orchestration was satisfactory.

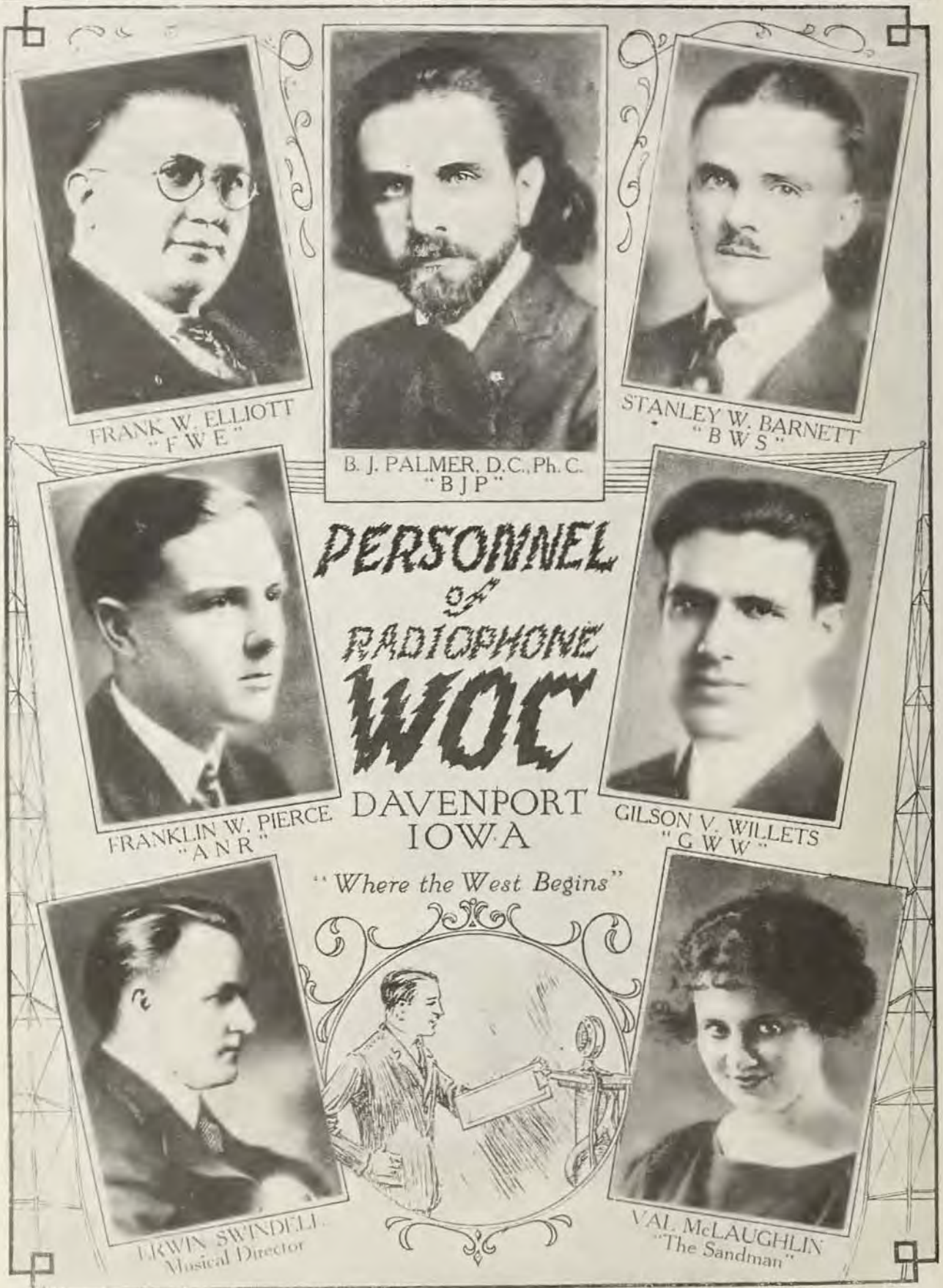
Radio Brings Help for Tornado-Stricken

At the time of the appalling Lorain tornado disaster some weeks ago, various Chicago stations co-operated in many ways toward bringing relief to the stricken areas.

Every one of the local broadcasting stations of the city read off regular announcements from the Chicago Herald-Examiner, soliciting the aid of doctors and nurses to aid and give medical attention to the sufferers of the terrible storm which struck the Ohio towns.

The value of this service can never be computed, but it is a convincing argument in favor of the use of radio broadcasting in times of disaster and danger.

"OUT WHERE THE TALL CORN GROWS"



Here are some of the folks you are sure to hear when you tune in on the Palmer School of Chiropractic station, WOC, at Davenport, Ia., "out where the tall corn grows." WOC recently celebrated its second birthday and for a "two-year-old" it is quite a husky youngster, as radio stations are rated.

A Radio Station That Receives 12,000 APPLAUSE CARDS WEEKLY!

THE "INSIDE STORY" OF WOC

THE radio broadcasting apparatus installed at WOC, the station of the Palmer School of Chiropractic at Davenport, Ia., puts its facilities for broadcasting on a favorable footing with those of the most powerful stations anywhere in the country.

Housed in specially fitted rooms on Up-E-Nuf, the roof auditorium of the school, are the broadcasting apparatus and the studio equipment, each the last word in modernity.

The studio is one of the most efficient in the Middle West. In the first place, the altitude is sufficient to eliminate street noises which might interfere with perfect broadcasting, and secondly, there is genuine beauty of surroundings as well as picturesqueness of furnishings.

Solidly constructed is the room in which the actual broadcasting is done, and the studio and reception room afford ample accommodations for any number of artists that could possibly be used on a single program.

Pipe Organ Programs

THE installation in the B. J. Palmer residence of the pipe organ gives another unique and unusual form of radiophone music. The organ is one of the finest in the country. The console is located at the east end of the music room and the main organ is located in a chamber especially built for it directly overhead.

The Echo organ is placed in a similar chamber at the extreme west end of the porch, and on account of its relative location to that of the main organ, the most charming and enchanting effects are possible.

The outlay of money entailed by WOC's broadcasting service approximates $60,000 annually, indicating the faith the owners of the station have in the permanency of radio as a public necessity. Other organizations in the country are convinced of the place of radio in the American scheme of things, and likewise have invested materially, although few have striven for the completeness of facilities which now characterizes WOC. The most vacillating of doubting Thomases must concede that the step taken by WOC has reacted to the satisfaction and entertainment of the school's friends and has brought the name of Davenport before the country as it could be brought in no other way.

That it has proven a boon to the thousands of receiving stations in Iowa and surrounding states is certain. WOC was planned by and manufactured under the supervision of the same engineers who startled the world in 1915 by establishing vocal contact between Arlington, Va., and Paris, Colon, Honolulu and San Diego, and who during the war contributed materially to radio telephonic developments undertaken by the Army and Navy.

Distance Tests Held

THE Palmer School of Chiropractic broadcasting station is unique in many respects. Designed to cover a region of from 100 to 150 miles from Davenport, and to deliver 500 watts of radio frequency power to the antenna system under all conditions, under favorable conditions it can be heard at very great distances.

In three days following the initial test of the apparatus on the evening of Tuesday, August 15th, 1922, over two thousand enthusiastic reports were received from this test program. These letters came from thirty-five states and from Canada and Cuba. The entire United States had been reached, with the exception of the New England states and the country west of the Rockies.

At the end of the first month's test broadcasting, in spite of severe summer weather, the remaining states had dwindled to three in number, with the record air line distance at 1,765 miles.

Shortly afterward was established the enviable record of being heard in every civilized state and province in the North American Continent on one single program.

To obtain ideal operating conditions for WOC, a special suite of rooms has been prepared, every means having been taken to insure suitable acoustic properties. The chamber that houses the microphone and forms the headquarters for the speakers, vocalists and musicians secured to conduct the broadcast programs is a mysterious compartment with walls shrouded beneath layers of draperies and a floor buried beneath the heaviest of carpets. Constant study has proved that to prevent the reflection of sound and to prevent the impairment of the quality of vocal and instrumental music such precautions are necessary.

WOC has received in one week as many as 12,000 applause cards from "listeners-in" within a radius of 4,000 miles. Acknowledgment cards, form letters, and circular letters are made to cover as much of this work as possible, but there are in addition an endless amount of requests for individual numbers, repeat numbers, replies to police reports, requests by speakers, requests for acknowledgment, etc., which require individual attention.

WOC operates on a 484 meter wave length. Tune in tonight and get acquainted with its peppy staff.

LITTLE LESSONS IN BROADCASTING

George Frenger, better known to WJZ-WGY listeners as "A. F. N.," is giving a few hints on broadcasting to Paul Specht, while the latter is waiting for his orchestra to "take the air" at the Alamac, N. Y. At the left Mlle. Sascha Beumont, dancer, is listening to George's warnings on how to speak to a microphone.

Usually it's hard to smile in the presence of an unresponsive microphone. But Howard I. Milholland, announcer of the Pacific Coast Station KGO, likes to announce. He is shown above at his favorite indoor sport.

How Would You Say 'Good Night'?

WHAT 'GOOD NIGHT' MEANS AT KGO

AS HE left the home of the Rev Milholland in Roodhouse, Illinois, 39 years ago, how was the good old country doctor to know that his cheery "good night" would be echoed years later so significantly by the new voice he had just ushered into the world?

If KGO, the General Electric Pacific Coast Station, had then been in existence, "Daddy" Milholland surely would have preceded his son as announcer and broadcast the glad news to the world. Being of a humorous turn of mind, he perhaps imagined himself, megaphone in hand, on a steep, snowy roof, announcing to the sleeping world, "It's a boy!"

The following Sunday the Rev Milholland blushed a little (he was only 22 at the time) announcing to his congregation, "God has been good to me and has given me a son; we shall christen him 'Howard'."

Howard weighed 10 pounds when he was born, and in less than three years he was big enough to say "good night" plainly. When he was 21, he graduated from the Eastern Illinois State Normal School He then began writing his name "Howard I. Milholland," and decided to go West. After sizing up the Rocky Mountains in the distance, he settled in Denver, engaging in the photographic supply business.

BEING married now, and with a growing sense of his responsibilities, Howard I Milholland is next found growing a mustache. "Straightaway," said "HM," when telling the story of his life recently, "I got the idea of being an impersonator."

A minister's son does not always stay out of church activities even when he fails to follow his father into the pulpit. So for the next few years it's natural that we should learn of "HM" singing in various churches and directing choirs Meanwhile he also traveled considerably as a reader and impersonator

"When I first stepped before a microphone on the evening of January 8, this year, at the opening of KGO," said "HM," "I naturally felt a little nervous, but my platform experience helped a lot With the coaching given me by Mr. Hager of WGY, I saw that announcing required a technique, based upon the ability to enunciate clearly. I also found the routine of announcing very much different than the routine of platform work."

"HM's" ambition is to learn how to say "good night." He believes that much of an announcer's work is so cut and dried that he should give a lot of thought to the way he says "good night." With "HM" the phrase "good night" can mean many things. If your day has been a hard one, "HM" simply wishes you a "good night" or a "better night." Should you have taken a little step aside during the day, "good night" for you means—do a little better tonight. If you are grouchy or unsociable, "good night" is simply a friendly suggestion which might help you If you have the spirit of malice in your heart, "HM's" "good night" may tell you that by kindness and love we fulfill our mission here.

Or you might just happen to be listening in on KGO for the first time. "Good night" then is meant to convey to you the hope that you have enjoyed the program and will listen again.

"Perhaps I take my job too seriously," said Howard I. Milholland "I think I must have inherited a desire to preach from my father. And the best sermon I can think of is simply 'good night'."

N. Y. Philharmonic Orchestra on WGY

During the months of July and August, WGY gave a special musical treat for its audiences. A series of eleven concerts by the New York Philharmonic Orchestra and a series of eight concerts by Goldman's Band were broadcast.

Programs of both organizations, the New York Philharmonic Orchestra and Goldman's Band, were presented in New York, the former at Lewisohn Stadium, College of the City of New York, and the latter at The Mall, Central Park WGY was connected to New York by wire and presented the concerts in co-operation with WJZ.

Broadcasting From Portable Station to Be Tested to Find WJAZ Location

Many Illinois Cities to Compete to Win Zenith Station

AN unusual occurrence took place when a metropolitan broadcasting station was recently disposed of by one of the pioneer radio corporations in broadcasting, because the station dominated the air to such an extent as to prevent radio listeners within its immediate scope from hearing any other stations. It probably began the movement of broadcasting stations having their ultimate location away from the thickly populated areas of the country.

This unexpected stroke of policy was announced by the Zenith Radio Corporation when it sold Station WJAZ, then located on the Edgewater Beach Hotel. Because of the uncontrollable interference caused by this station throughout the entire north shore of Chicago, the company decided to erect a new station far enough away from the city so as to be no longer an interference to the three million of people who live in the city.

A "Portable Test"

On the heels of this announcement, the Zenith Radio Corporation was deluged with letters from the Chambers of Commerce of many of the small communities in the outlying districts of Chicago. Some letters came from places two hundred miles away.

So urgent were many of the invitations from these smaller towns that it was decided to conduct a series of tests to ascertain the best locality for broadcasting and to determine at the same time the place offering the least opportunity for interference. The best working plan which suggested itself was to erect temporary broadcasting stations in all the towns selected for test. For a time it looked as though the plan of making tests would have to be abandoned because the attendant obstacles seemed to be insurmountable. But after planning and experimenting in the company's laboratories a way out was discovered.

The company is now building a complete broadcasting unit mounted on a one-ton truck. There have been portable transmitting stations for code work, but from all available information, this is the first portable broadcasting station in history. It will be equipped with a 100-watt transmitter. It will have the unusual setting of a glass-enclosed truck, so that the public may witness the operation of the station wherever it is taken. It will be operated entirely from storage batteries. Part of the truck equipment will be a motor generator for recharging the batteries. The aerial will be supported above the truck by means of telescoping masts. Gold plated antenna wire will be used, as gold reduces surface resistance and greatly increases efficiency in an antenna of this size.

Arrangements are under way with towns favorably disposed to receive the new broadcasting station. Tests will be arranged in each case for a definite night and the officials of these municipalities will be invited to extend the greetings of their respective communities to the world by themselves speaking into the microphone of the portable broadcasting station. Already programs with two towns provide for the local band taking part in the broadcasting.

To Award Prizes

In every town prizes will be awarded for the longest distance reception. The data gathered through these tests will be especially valuable to radio technicians and engineers. For, as is generally known, it is impossible for radio experts, with all their theory and practice, to predetermine the broadcasting value of any given locality without actual tests.

For this series of experiments the call letters 9XN will be used. They will be remembered as the call letters that played so important a part in the radio communication with the MacMillan Arctic expedition.

Kadel & Herbert.

EVEN THE INDIANS HAVE THE RADIO "BUG"
Radio is becoming the most popular entertainment of all among the Indians on the reservations in Wyoming, where thousands are encamped. The big chiefs and their families are showing a decided preference for radio in place of the traditional Indian tom-tom music. Here you see two Indian chiefs "listening in" on a set donated by a nearby Chamber of Commerce interested in Indian welfare.

Strictly Personal

Harry Aldyne Answers Some Pertinent Questions for Radio Fans

1. *Dear Mr. Alydne:*

Is Jack Nelson of Station WGN married?

—L. R. T., Des Moines, Ia.

Yes, Lois, our good friend Jack is very happily married. More than that, his romance was one of the first to have its origin through a radio courtship. Jack is well satisfied that it pays to broadcast. Come again.

2. *My Dear Mr. Aldyne:*

Are the "Duncan Sisters" that I hear on Wednesday and Friday nights over KYW really sisters, or have they assumed that relationship merely for publicity purposes?

—B. R. S., St. Louis, Mo.

You bet your sweet life they are sisters, and they have a brother and another married sister, too. We wish there were more of them. No trouble at all.

3. *Dear Mr. Aldyne:*

How is it the announcer of WLAG has such a high pitched voice?

—A. B. L., San Antonio, Tex.

We agree with you that the announcer of WLAG has a woman's voice. The announcer happens to be a woman. Don't shoot.

Popularity Contest Waxes Warm

Here Are the Ten Leading Candidates

By Harry Aldyne

They're off! The Radio Favorite Popularity Contest conducted by RADIO AGE has rapidly accelerated in momentum until definite indications of interest have come in from all four corners of the earth. Individuals make this contest a success, all with the one hope of making an impartial test of leadership in the great field of the radio industry.

It must be particularly noted that votes may be cast for any one connected with the radio industry; announcers, individual entertainers, orchestra, manufacturers, inventors, etc. One ballot counts only one vote.

To date the choices have been so widely scattered that it is hardly fair to say any group has a particular lead, and any one of five hundred or so stands a good chance of heading the list when the first of a series of monthly semi-final contests is held.

However, that you may know which direction the wind is blowing, there are listed above the names of the first ten who have a slight advantage over the field.

Name	Classification	Where Heard
Bill Hay	Announcer	KFKX—Hastings, Nebr.
Lamkin Kay	Announcer	WSB—Atlanta, Ga.
Duncan Sisters	Entertainers	KYW—Chicago
Husk O'Hare's Orchestra	Orchestra	WLS—Chicago
E. W. Tyson	Announcer	WWJ—Detroit
Jack Nelson	Announcer-Entertainer	WGN—Chicago
H. W. Arlin	Announcer	KDKA—E. Pittsbugh
Karl Bonawitz	Organist	WIP—Philadelphia
Fred Smith	Announcer	WLW—Cincinnati
Edward H. Smith	Director and Player	WGY—Schenectady

Get in your votes, and if there are any suggestions or questions bearing on the contest, entertainers or broadcasting stations in general, send your letters for the attention of the Contest Editor.

The first contest closes on September 12, so that results may be announced in the October RADIO AGE. Get busy and send in the coupon on this page NOW!

POPULARITY CONTEST COUPON

Harry Aldyne,
Contest Editor,
RADIO AGE,
500 N. Dearborn St., Chicago.

I wish to cast my vote for:

Name of favorite .....

Classification .....

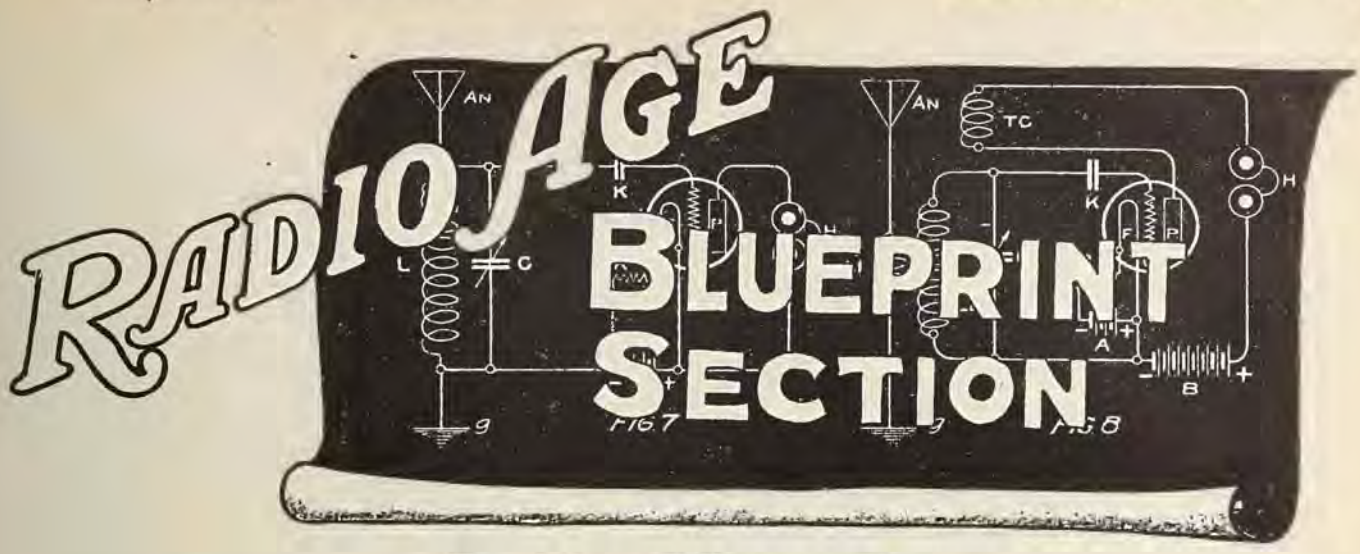
Station .....Date heard.....

Name [optional] .....

Address [optional] .....

RADIO INSTALLED IN SOCIETY SWIMMING POOL P. and A. Photo

Even swimmers like radio entertainment between dives and crawls. Here a group of swimmers, all members of Washington's "400," are paying rapt attention to a concert from New York. The set is installed in the Wardman Park Pool, one of the capital's most exclusive play spots.



For More Efficiency Try

An Aperiodic Variometer Set

By JOHN B. RATHBUN

TUNING the grid circuit inductively by means of a variometer is nothing new in radio. In fact, this is practically as old as the use of the fixed inductance tuned by a condenser, but the idea has considerable merit owing to the fact that it is possible to establish higher potentials on the grid of the tube in this way. Thus, the incoming signal has more effect on the tube grid when capacity is lacking in this circuit than when a variable condenser is used for tuning the circuit to wave length. Better results are therefore obtained.

In the older circuits, the grid variometer was used as a tuning agent for single circuit sets or else it was used in connection with the standard type of tapped variocoupler where the additional losses introduced rather offset the inherent advantages of the variometer inductance. Used in a single circuit set, there was a loss of selectivity. Used with a standard variocoupler, the losses in the taps and tap switches often offset the increased efficiency of the variometer. In other words, the variometer was never used so that it was allowed to develop its full possibilities in the grid circuit.

Variometer "Switched"

After carefully going over this matter and experimenting with various combinations of variometers, it was finally decided to make the variometer an integral part of the primary and secondary tuning circuits so that the variometer formed the secondary winding of the coupler, while a few turns of wire at one end of the variometer acted as an "aperiodic" primary coil. No condenser was needed, and the full selectivity of the variocoupler was attained without losses in the tapped coils and rotor. The construction is simplicity itself and lives up to expectations in every way.

Applying a Variometer Idea to a Wizard Circuit

HAVING progressed this far, the next thing was to apply the idea to some specific circuit where its full possibilities could be developed without complicating the controls. Various circuits were investigated and finally it was decided that the Rathbun Wizard circuit offered an excellent opportunity for the application when the plate circuit was tuned by a second variometer. While the original Wizard circuit worked very well without the plate variometer and with direct inductive feed-back, yet the addition of the plate variometer made the set even more selective than before and greatly increased the signal strength. Regeneration is more easily controlled without accurate filament current adjustment, and by the combined effects of the feed-back coil and the tuned plate circuit, a condition of resonance is more accurately approached in both circuits and the impedance of the circuit can be made more nearly the theoretical zero necessary for the establishment of maximum voltages.

In Fig. 1 on page 30 we show a picture circuit of the set called the "Aperiodic Variometer Set" with the two variometers used for the grid and the plate respectively. For maximum results and for loud speaker operation at fair distances, one stage of audio amplification has been added permanently which gives an excellent two-tube set with great volume and a very considerable range. Of course, the detector tube can be used alone or else another stage of audio amplification can be added, but for the best results for a given investment, I believe that the circuit is at its best the way that it is shown in the figures. It is certain that the addition of radio frequency steps only slightly increases its range and that the expense and trouble of adding the radio stages is not justified by the slight increase in performance.

Variometer as Secondary Coil

In Fig. 1, page 30, is the grid variometer marked (VI) which is used for tuning the set to wave length, this variometer acting as the secondary circuit coil of a two-circuit receiver. At the left is the aperiodic primary coil (L) consisting of about 25 turns of No. 26 D. S. C. wire wound on a four-inch diameter bakelite or cardboard tube. In addition to acting as the primary of the

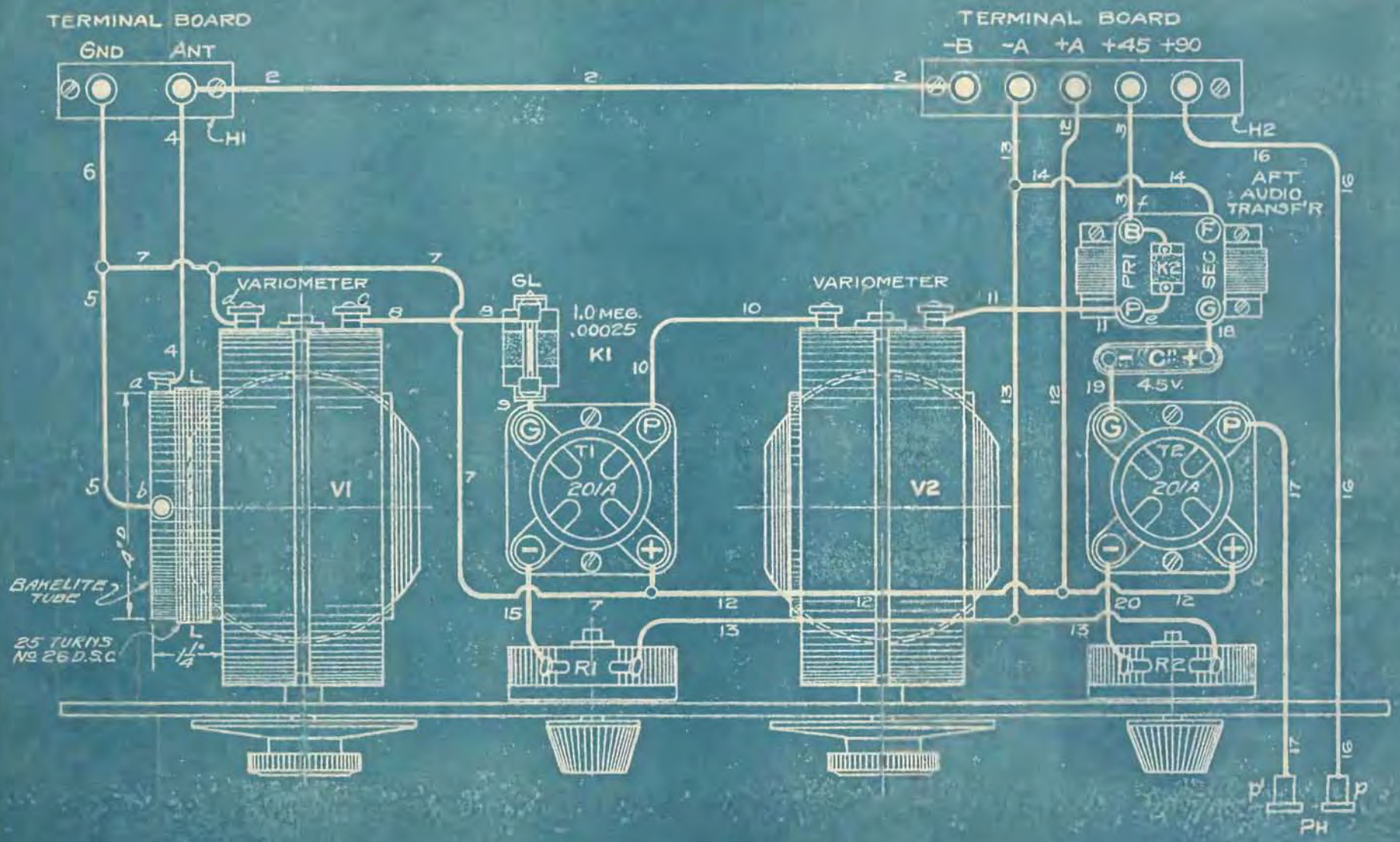
(Continued on page 36)

HOW TO USE RADIO AGE BLUEPRINTS

The blueprints printed in this section are so arranged as to form a complete unit with the explanatory articles when desired by the reader. For example, the center sheet consisting of pages 31, 32, 33 and 34 contains two blueprints and two pages about the Baby Heterodyne. Just follow this four-page sheet at the center and you will have a complete section to follow when you make the Baby Het. Likewise the second center sheet, which also can be followed as one unit, is devoted to the aperiodic variometer set. The blueprints for this hookup are on pages 30 and 35, and the article on pages 29 and 36.

Blueprints appearing in future issues will be arranged in the same manner. —The Editors.

Blueprints for the Aperiodic Variometer Set on Pages 30 and 35.



AN APERIODIC VARIOMETER SET

WITH TWO STAGES OF AUDIO AMPLIF.

FIG. 1

PAT. PENDING

J.B.R

Radio Age Offers

An Improved Baby Heterodyne

By JOHN B. RATHBUN

A New 'Baby Het' that Has Proved to Be One of Year's Most Stable and Sensitive Receivers

OWING to the enthusiastic reception which greeted the first single tube "Baby Heterodyne" published in the February issue of RADIO AGE, it was thought advisable to make further experiments with this circuit with a view to improving its stability and reducing its rather critical adjustment. The result of this investigation is the "Baby Heterodyne II," which is a marked advance over the older circuit in a number of respects.

There have been no radical changes in the principles, but small refinements made here and there which will make the set easier to handle and much more compact. Those of you who are familiar with the original circuit will quickly note the changes that have been made by consulting the schematic diagram in Fig. 3, and the wiring diagram layout of Fig. 1, shown in the actual RADIO AGE blueprints in this issue.

For the assistance of our readers who are not familiar with conventional circuit diagrams, we have shown the wiring diagram in picture form in Fig. 1, where all the apparatus is drawn out in detail. This is further assisted by the isometric view of Fig. 2, which shows the installation of the apparatus in its proper relative positions, together with such of the wiring that can be seen from the back of the panel. All of the parts in the three illustrations are given the same letters and figures so that the parts can easily be traced from one drawing to the others. The schematic drawing of Fig. 3 is for the use of the more advanced students who wish to see clearly the functioning of the circuit, and to whom a drawing of this sort means more than the isometric and picture diagrams. The isometric is useful for the layout of parts, but in making the actual wiring connections we advise the use of either Fig. 1 or Fig. 3.

As a further help, these diagrams are printed as real blueprints to aid the "fans" when actually working on the set.

As with the old circuit, we still use the aperiodic type of coupler (L1-L2) which has proved so selective and effective, but to conserve space and simplify connections, the oscillator coil (L3) has been wound directly on the same tube with the primary and secondary coils. In the old circuit the oscillator coil and feed-back were wound on a separate form which gave the beginners considerable trouble when it came to making the winding. On the present winding (L1) is the primary, (L2) is the secondary and (L3) is the combined oscillator pickup and feed-back coil. The secondary (L2) is tuned to wave length by the vernier variable condenser (C1) and is the only wave length aerial control used.

Windings Without Shellac

ALL COILS are wound in the same direction with No. 26 D.S.C. wire the coils being separated by the distances shown in the coil detail of Fig. 1. The diameter of the tube is 3 inches and the length is about 5 inches, either a cardboard or Bakelite tube being allowed. The windings are dry wound without shellac, paraffin or other energy-absorbing materials. Ten turns are used for the primary (L1), 60 turns for the secondary (L2), and 25 turns for the oscillator pickup (L3). It should be remembered that the number of turns on the secondary (L2) is somewhat affected by the length of the aerial and that this number of turns is correct only for aerials running from 50 to 60 feet in length. Longer aerials require fewer turns, shorter aerials require more turns, but for the lengths given the set will easily tune within the ordinary broadcasting limits.

In making connections of the condenser (C1) we must connect the stator or stationary plates (S1) to the wire (8) which runs to the grid of the tube and "C" battery, and the rotor or moving plates must be connected to the line (12). This is necessary to avoid the effects of body capacity. Performance is very much improved and stabilized by the addition of the fixed condenser (K1) of 0.002 mf. capacity which connects the grid return line to the primary by capacity effect. This also reduces body capacity or the tendency toward body capacity.

One of the most important improvements is the use of the biasing or "C" battery placed in the grid circuit with its negative pole (—) to the grid of the tube. With hard amplifier tubes this increases the sensitivity and on local stations greatly increases the signal strength. It is a substitute for the more usual grid condenser and grid leak, and the grid leak and grid leak condenser can be used of course if preferred. By maintaining the grid at a fixed negative potential, the tube works on the most advantageous point in its characteristic curve and in most all cases will give far better results than the usual condenser and leak. A three cell, 4.5 volt flashlight or standard "C" battery is used with plate voltages of from 67.5 to 90 volts, but with lower "B" battery voltages the voltage of the "C" battery is correspondingly reduced. The bypass condenser (K2) is advisable in some cases, while it does no good in others. The necessity for this condenser can only be tried by experiment in the circuit used, for the units adopted may or may not require this part.

Variometer Less Critical

AFTER much experimental work conducted on plate inductances, I came to the conclusion that a variometer (VA) was less critical and gave better control of the oscillations than the condenser tuned impedance used in the first circuit. The variometer gives more latitude in the range of wave lengths than the former honeycomb coil and there is less tendency toward whistling than before. A very small fixed condenser (K4) is connected across the variometer and establishes the oscillations necessary for this type of circuit. With the apparatus used in the experimental outfit, a condenser of 0.0001 mf. capacity was found sufficient, although 0.00025 mf. might perform better with some classes of variometers. Any standard molded type or self-supporting winding type of variometer can be used at (VA), but we do not recommend wooden variometers as they seldom have sufficient inductance for this purpose.

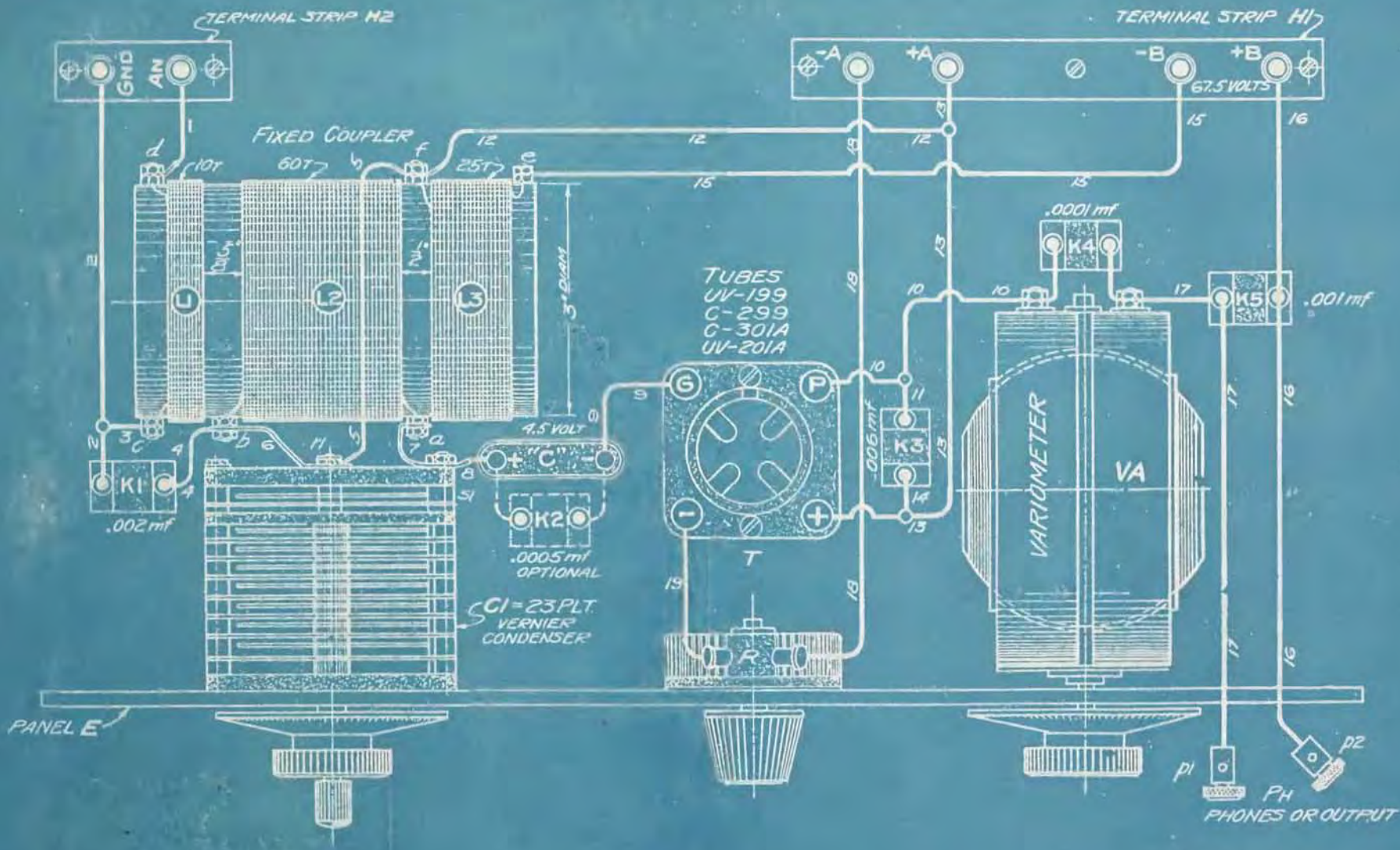
Some improvement can be had when (K4) is made a variable instead of a fixed condenser, but of course this includes the expense and complication of the circuit at a very little increase in effectiveness. In this case an 11 plate 0.00025 mf. variable condenser is sufficient for the purpose. However, a fixed condenser will perform very nicely, conserving space and simplifying tuning.

At (K3) is a 0.006 mf. fixed bypass condenser which is very effective in stabilizing the circuit and in reducing the resistance to the radio frequency current in the plate circuit. Again, it forms a capacious feed-back from the plate to the grid which materially increases the range and signal strength of the circuit. By examining Fig. 3 it will be seen that some plate energy passes to the primary through (K1) and therefore aids sharp tuning in the plate circuit. The phones (PH) are fitted with the 0.001 mf. bypass condenser (K5) which usually is of value in obtaining clear reception.

For the best results hard amplifying tubes must be used such as the UV201A, C301A, UV199 or C299. Detector tubes of the UV200 type cannot be used, and the WD11 or WD12 do not give very good selectivity or amplification. As a rule, a 67.5 volt "B" battery is the best, although 90 volts can be used with a little increase in volume. With 45 volts on the plate we do not get the proper signal strength, while with 90 volts we generally get noise and distortion. The voltage of the filament battery "A" and the resistance of the rheostat (R) of course depend upon the type of tube used.

(Continued on page 34)

Blueprints of the "Baby-Het" on Two Pages Following.



BABY HETERODYNE II

(WIRING DIAGRAM VIEW)

FIG. 1

PAT. PENDING

J.B.R.

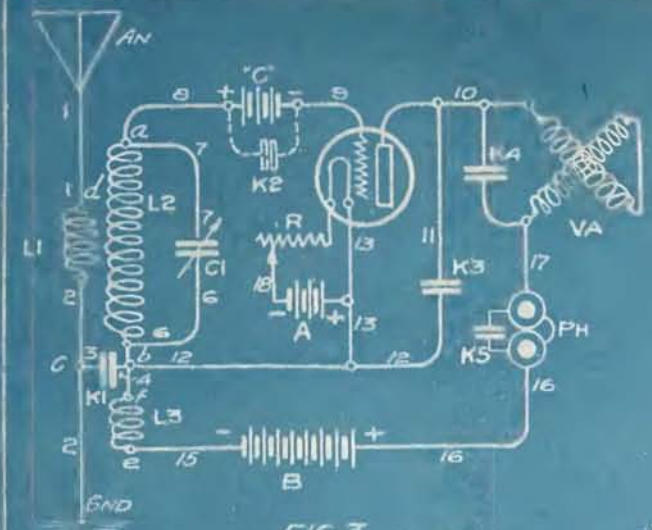


FIG. 3
SCHEMATIC DIAGRAM

NOTE!
OUTDOOR AERIAL BEST AT 50 FT. TO 60 FT. LONG. MUST NOT EXCEED 80 FT. UNDER ANY CONDITIONS.
LOOP AERIAL CANNOT BE USED SUCCESSFULLY.

USE ANY HARD AMPLIFYING TUBES SUCH AS UV-201A, C-301A, UV-199, C-299, WITH FROM 67 TO 90 VOLTS ON THE PLATE AND A "C" BATTERY OF 4.5 VOLT

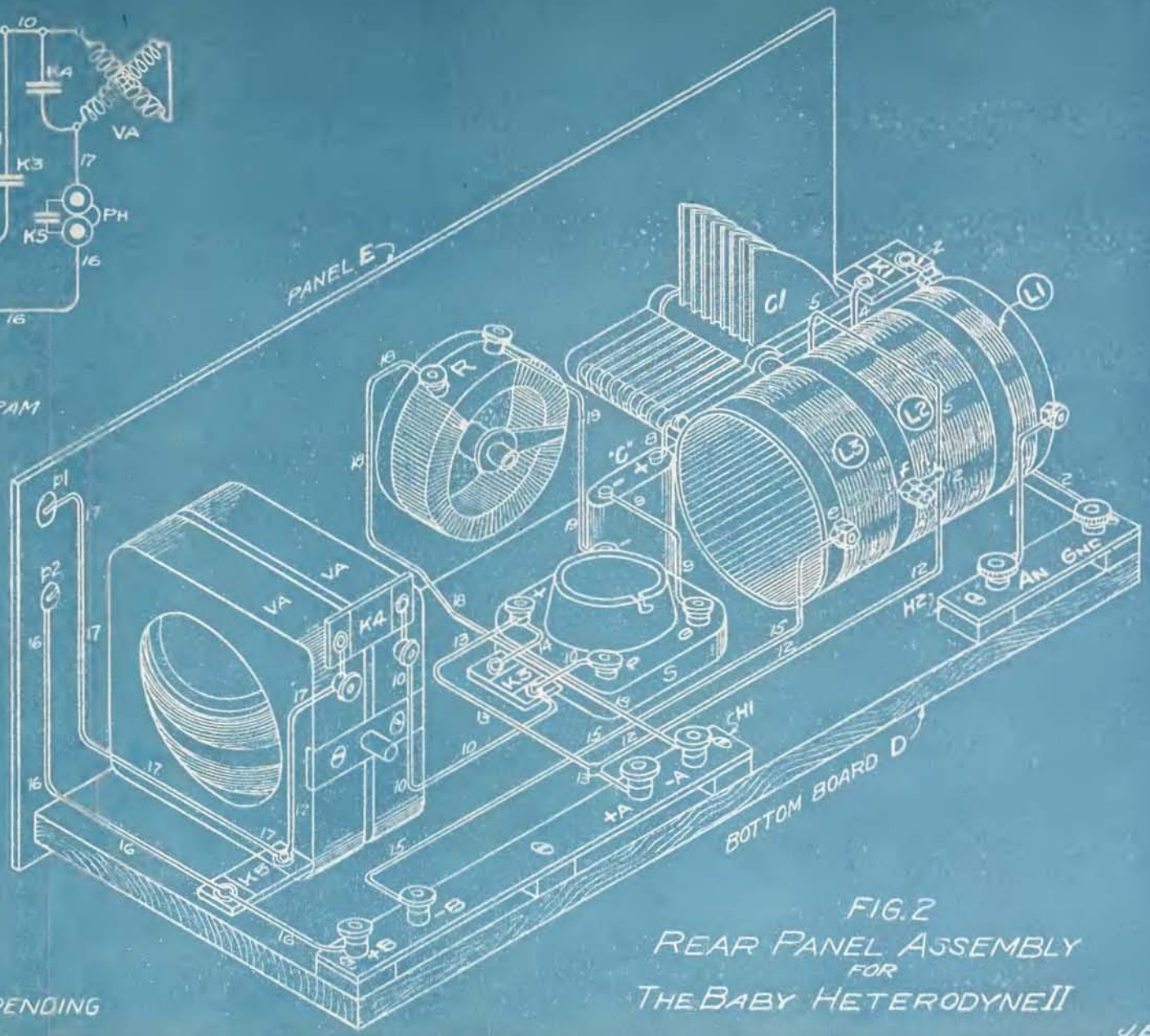


FIG. 2
REAR PANEL ASSEMBLY
FOR
THE BABY HETERODYNE II

PAT. PENDING

J.B.R.

An Improved Baby Heterodyne

(Continued from page 31)

Notes on Controls

THERE are two tuning controls, the variable condenser (C1) and the variometer (VA), both of which are very sharp and somewhat critical. This means that both controls should be of the vernier type, particularly (C1), since the latter brings in or drops a station completely on a very few divisions of the dial. Condenser (C1) is a 23 plate, (0.0005 mf.) variable condenser of the vernier type, and preferably should be of the so called "low loss" variety. The variometer (VA) can be the special vernier type of variometer now found on the market or else it can be made into a vernier type by the addition of the small knobs which act on the edge of the dial. Careful adjustment is needed at this point.

Filament control is also of the greatest importance and requires a rheostat which can be closely adjusted. With the proper rheostat the tube can be kept right on the edge of the "spilling point" where the amplification is at a maximum. One of the most important features of this circuit is its ability to work without distortion when the tube is being pushed hard, but to develop this properly requires accurate control of the filament current.

This receiving set will assemble nicely on a 7-inch x 14-inch x 3/16-inch panel as shown by (E) in the isometric view of Fig. 2. The panel should be of the hard rubber or bakelite type and is fastened to the baseboard (D) by wood screws which pass through the panel and attach to the front edge of the baseboard. The only wire connections carried by the main panel are the phone binding posts (p1) and (p2).

All battery binding posts and the posts for the connection of the aerial and ground wires are "back connected"; that is, are carried by the hard rubber or bakelite terminal strips (H1-H2) located near the rear edge of the baseboard. This arrangement does away with the unsightly wires and connections that are always in view in the front of a front connected panel. The terminal strips are about 1¼ inches wide and ⅛ or 3/16 inch thick, and are raised above the baseboard so that the bottom screws of the posts do not come into contact with the wood baseboard.

Careful attention should be paid to the wiring and wiring connections. All joints should be carefully soldered where possible, and at points where connections are made to binding posts solder lugs should be used to insure good contact. Ordinary No. 14 tinned square bus wire is best for the purpose as it is stiff enough to hold its shape and is easy to solder. While the wire should be covered with spaghetti at points where one wire passes over another, it is bad practice to cover the whole length of the wire as this increases the capacity without correspondingly increasing the insulation resistance.

SOCKETS are of prime importance in the successful operation of a receiving set and not enough attention is given to this point by the average builder. The best bakelite sockets are none too good for this job, for we must be sure that there is no leaking of the precious energy between the socket springs and prongs, and again there must be no unnecessary resistance between the prongs of the tube and the springs. The cheap "tar paper" sockets made of soft compositions are actually fairly good conductors for radio frequency currents and generally leak enough current to considerably reduce the range and signal strength. Some sockets I have tested leak more current than a 0.5 grid leak, and when the tubes were placed in these sockets no grid leak was necessary. However, this is a mighty expensive means of doing away with a grid leak and most certainly is not recommended.

In buying sockets, see that the springs are stiff and that they make the proper contact with the prongs of the tubes. A socket may carry the filament current so that the filament lights, but this is no guarantee that the grid prong conveys the radio impulse to the grid of the tube or that the plate prong is making sufficient contact to close the plate circuit. There have been all sorts of woe at this point and tubes and hookups have been unjustly accused for what is properly the fault of the socket.

Before wiring up the set, test each piece of apparatus separately so that you will not have to dismantle the whole thing later on in order to remove some faulty member. Scrape off the springs in the socket to a bright surface and then insert a tube to make sure that the springs are making uniform contact with the tube lugs before you screw the socket down to the baseboard. If the tubes are making proper contact, the springs will all move when the tube is pulled in and out.

Secondly, test out the coils (L1-L2-L3) to determine whether there are any broken wires or open circuits in the coils. Very often a wire is broken in winding, or the end of the wire does not make perfect electrical contact at the connection screws. It is not easy to see a broken wire, as it is covered by insulation; hence the only sure test is to connect the coil, a battery and the phones all in series. If the circuit is perfect, there will be a sharp click every time the circuit is closed. If there is no noise when the battery is connected, then the wire is broken or there is a poor connection at some point.

Both batteries should be tested at frequent intervals, particular attention being paid to the "B" battery. We can generally tell whether the "A" battery is working by the way it lights up the filament, but the "B" battery requires a voltmeter. Voltmeters for testing "B" batteries can be obtained at a very reasonable price and are the only insurance against the dead "B" batteries that so often are the cause of trouble. Just the other day I was called in to service a stubborn set which would not operate above a whisper, and found that the "B" battery which should have applied 90 volts on the plate only developed 16 volts when the voltmeter was applied. The owner was loud in his condemnation of the set until he saw where the trouble lay.

VACUUM tubes of the present day are rushed through the factory at such a rate that they are not properly tested and hence are a source of trouble when we have no means of making a proper test. Wherever possible, it is a good plan to make a trial of the tube in a set that you know is in proper operating order. Try it in a friend's set and compare it with the tube that he is using.

Next, connect a couple of dry cells in series and connect the end wires to the terminals of the variable condensers. If the sparks fly when you turn the rotor in the dark, it is sufficient evidence that the condenser is short circuited. This, if done before the condenser is mounted in place, may save you from burning out a tube, and at the least will save you a lot of trouble in the future. The fixed condensers should be tested in the same way, touching the battery terminals at each end of the condenser terminals. If you see a spark, throw the condenser away; it is short circuited. Unfortunately, a fixed condenser may have only a partial short circuit that is sufficient to cause trouble but not conductive enough to show a spark. This is not easily discovered without the proper instruments and the amateur is not usually able to determine the fault.

After going over all of the parts in this way before they are screwed into place and wired up, we will save ourselves a lot of trouble. The variometer, like the coils, should be tested for open circuits, due to broken wires and loose contacts at the rotor. The rheostat should also be tested for open circuits and also to see if the contact finger touches the wire coil at all points with equal tension or pressure. Much trouble is had with rheostats that "run off center," since the finger will not make contact at certain points and will open the circuit or dim the tube.

It is generally easier to hook up the filament circuit first—that is, connect all wires of the filament and "A" battery to the rheostat and socket before anything else is done. Then we can follow up with the plate circuit and then the tuning circuit.

In case the circuit tunes broad or the necessary selectivity is not obtained, reverse the aerial and ground connections at (d) and (c). If the variometer seems to have no effect on the control of the circuit, reverse the connections of the coil (L3) at the connections (b) and (e).

If the circuit does not tune down to low enough wave lengths, remove a few turns of wire on (L2). If it does not reach the higher wave lengths, a few turns can be added to (L2).

[*"Baby Heterodyne Notes," containing answers to questions regarding Mr. Rathbun's first "Baby Het" hookup will be published in October* RADIO AGE.]

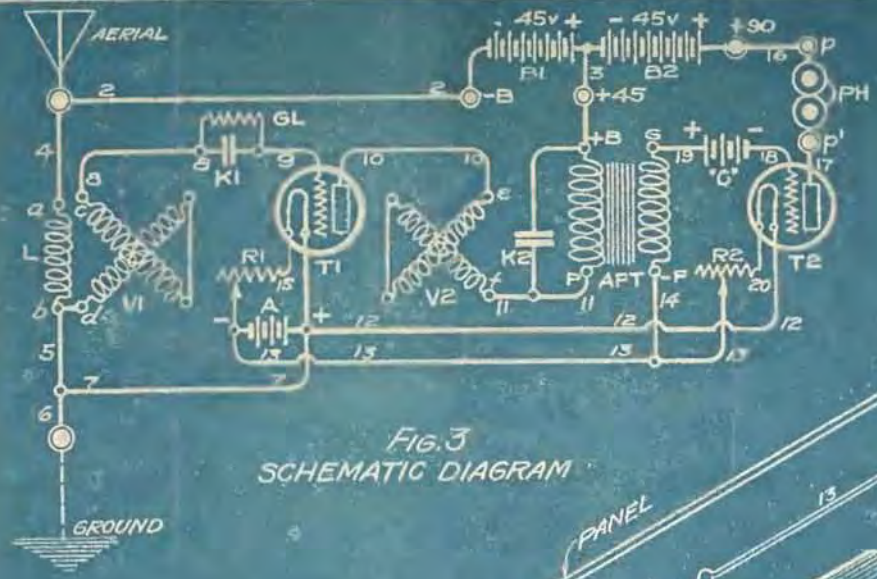


FIG. 3
SCHEMATIC DIAGRAM

OUTPUT OF SET TO BE CONNECTED TO PHONES OR LOUD SPEAKER AT POSTS P-P.

NOTE!
USE ONLY AMPLIFYING TUBES SUCH AS UV-201A OR UV-199 FOR BOTH THE DETECTOR (T1) AND THE AMPLIFIER.

PLATE VOLTAGE ON DETECTOR TUBE = 45 VOLTS; PLATE VOLTAGE ON AMPLIFIER TUBE = 90 VOLTS. USE TWO BLOCKS OF 45 VOLT "B" BATTERIES.

FIG. 2
REAR PANEL ASSEMBLY
FOR
APERIODIC VARIOMETER

PAT. PENDING

J.B.F.

An Aperiodic Variometer Set for Efficiency

(Continued from page 29)

circuit, the coil (L) also acts as the tickler or feed-back coil which induces additional impulses into the secondary by connections with the plate circuit. The tube of (L) is fastened to the side of a standard molded variometer in any way that may be convenient with the instrument used. The distance between the coil and variometer is not critical and can be made as shown. Any type of molded or honeycomb variometer can be used, but a wooden variometer is not usually practical owing to the great clearance space ordinarily found between the rotor and stator of the wooden variometers.

AT (V2) we have the standard plate variometer used for controlling regeneration and for varying the inductance of the plate circuit. This can also be any standard type of molded or honeycomb variometer but usually the inductance value must be greater than can be attained with the ordinary wooden variometer. Very frequently the inductance of wooden variometers is so low that they have absolutely no effect on the regeneration when turned in any direction, and this fact is emphasized for the benefit of those of our readers who may attempt the building of the circuit with this type of variometer. The tuning is exceedingly sharp and fairly critical so that the addition of a "Tiny Turn" vernier button to the dials of the variometers will be of importance, or any other type of geared vernier adjustment which can be conveniently attached to the dials.

At (K1) we have the usual type of grid condenser with a capacity of from 0.00025 to 0.0005 mf, the former value usually proving best for the UV201A and UV199 tubes. Tube (T1) is the detector tube which is controlled by the filament rheostat (R1). Of course maximum results are obtained with the power tubes operated by a storage battery such as the UV201A, but very good results can also be obtained by the small dry cell tube known as the UV199. The WD11 and WD12 are not so selective but can be used if the other tubes are not practical under the given operating conditions. The soft detector tubes such as the UV200 will not give as much volume on strong signals as the UV201A or the UV199 for the reason that we cannot carry such high plate voltages on the soft detector tubes.

Distortion Eliminated

As shown in the diagram, 45 volts are used on the detector tube (T1) and 90 volts on the audio amplifier tube (T2). This gives the maximum results without distortion when the UV201A and UV199 are used. Using a higher voltage on the detector tube (T1) gives a somewhat greater signal strength on local stations but it also introduces undesirable tube noises and distortion. Lower voltages than those specified naturally give weaker signals, and the weaker voltages on the plate also reduce the selectivity of the circuit.

The grid leak (GL) is of the pencil mark or other variable leak. Its value is to be adjusted until the signals are strongest and clearest. If the resistance is too high, then there will be noises and the reception will have a whiney tone. If the resistance is too low, then too much radio frequency current will be bypassed and the signal strength will be reduced. The proper value for any one tube can only be tried by direct experiment.

THE aerial connection at (ANT) together with the ground (GND) and battery connections are placed at the rear of the set, thus allowing all wires to enter the rear of the cabinet and improve the appearance of the receiver. The binding posts at the rear are mounted on two strips of bakelite or hard rubber about 1" to 1¼" wide and about 3/16" thick. The strips are raised above the surface of the bottom board, so that no metal parts or wires will come into contact with the wood. This construction is clearly shown in both Fig. 1 and Fig. 3, page 35, the latter being the isometric view of the set.

USE THE ORIGINAL RADIO AGE BLUEPRINTS
On Pages 30 and 35 to Make This Aperiodic Variometer Set.
Another Group of Unrivaled Blueprints in October RADIO AGE.

Audio Amplification

For aid in picking up distant stations at good volume and for loud speaker operation on local and at moderate distances, one stage of audio frequency amplification has been added. Stations 200 miles away have been picked up with good volume on the loud speaker with the single amplifying stage, and local comes in with terrific volume. In fact, local stations can be had on the loud speaker with the detector tube (T1) alone, but as will be explained, it is considered desirable to have the detector and the amplifier connected in one permanent unit.

A five-to-one ratio audio frequency transformer is shown at (AFT). The primary of the transformer is connected at the posts (P) and (B) to the detector circuit at the output wires (e) and (f).

The secondary of the transformer is at (G) and (F), and is connected into the circuit of the amplifier tube (T2). A three cell, 4.5 volt "C" battery is connected in the grid circuit of the amplifier tube for biasing the grid and is of great assistance in clearing up the reception and for obtaining maximum amplification. In all cases, the negative (—) terminal of the "C" battery should go to the grid (G) of the tube, so that the grid will receive a negative charge or bias. The output or plate (P) of the tube (T2) goes to the phones or loud speaker (PH).

In laying out this circuit, it was considered advisable to omit the usual jack between the detector tube and amplifying stage, both on the score of simplicity and effective operation. While both tubes must be used at all times with the present arrangement, yet it has certain advantages which are lacking when intermediate jacks are installed. For example, there are no losses or noises due to imperfect contacts in the jacks, and, further, as the audio stage is always in circuit, there is no danger of detuning a distant station when the audio stage is plugged in. When a jack is installed after the detector, and when one picks up a faint signal, it often happens that this station is lost when a stage or two of audio is plugged in at the jacks.

In this arrangement, this cannot happen, and when the reception becomes too strong, we have merely to turn down the rheostats.

DeForest Films Sound and Action Miles Apart

Dr. Lee DeForest, inventor of the Audion, which makes possible radio broadcasting and receiving, as well as talking motion pictures, has just achieved another triumph. He has invented a long-distance synchronizing device by which two cameras, one photographing sound and the other action, may be operated simultaneously, and the resultant product afterwards amalgamated in perfect synchronization.

The Democratic National Convention in Madison Square Garden in New York City afforded the opportunity for Doctor DeForest to test out his new invention. A regulation motion picture camera was set up in Madison Square Garden, where the wild scenes of the convention were photographed. At the same time a DeForest Phonofilm camera was in action in the studio of Doctor DeForest on East Forty-eighth Street. These two cameras were connected by radio, the one in the Garden photographing the action and the one in the studio the sound. From the two negatives thus produced, positive prints were made which contain both the sound and the action. The result was a photographic reproduction of the convention that is absolutely startling in its realism.

The possibilities of this latest invention of Doctor DeForest are almost incomprehensible. As an illustration, a great naval battle might be fought off the Pacific Coast, with a news reel photographer on the spot. He would communicate with DeForest at his studio in New York, for instance, and announce that fact. Then he would proceed with photographing the action of the battle, while in New York the sounds of the cannonading would be recorded, in perfect synchronization with the photographed action, and the two amalgamated later on a standard motion picture film.

RADIOTORIALS

EIGHT of the largest radio manufacturing corporations in the United States were named recently as defendants in a complaint filed by the Federal Trade Commission, charging the use of "unfair methods of competition in commerce in violation of Federal Act."

The complaint alleges that the defendants have combined and conspired to create a monopoly in the manufacture, purchase and sale of radio devices and apparatus and other electrical articles. An attempt to monopolize domestic and trans-oceanic radio communication and broadcasting is also charged.

The Government's charges are the natural outcome of the recent trend in the progress of radio. Little manufacturers have been squeezed out of business, while the big corporations continue to absorb their weaker competitors and take over as many radio patents as they can buy.

If such wholesale absorption continues, radio will soon be in the tentacles of a one-man corporation operating only for profit and with no regard for the common good. The Government of the United States has shown wise foresight in investigating these alleged attempts at monopoly and to nip in the bud any effort to take radio out of the hands of the independent broadcaster, listener and manufacturer.

Of course the eight defendants will reply and deny the charges. But their alleged unfair activities have at least been restricted by the bulldog watchfulness of the Federal Trade Commission.

Regardless of who these corporations are, they are attempting to control the radio industry, as big corporations will. If they buy up all the patents of any importance, it is easy to foresee what will happen to the small but efficient manufacturer whose products are now the pride of the radio industry and whose inventions are helping to develop radio so rapidly. Monopoly of radio patents will drive independent incentive to the wall. Radio will become stabilized to the point of stagnancy.

The Federal Trade Commission's complaint also charges attempted monopoly over domestic and trans-oceanic broadcasting. Here the listener is affected. If broadcasting is monopolized, you can imagine the kind of cut-and-dried, political programs that will be served to the listening public in the not too distant future. The listeners will tire of censored programs and interest will drop off as a result.

The amateur operator will also be affected. He will be restricted because his devices are controlled by the big corporations. The corporations will tell him just what he can do and what he must not do. Domestic broadcasting, both in code and programs, will become a joke and the toy of a mercenary trust.

The foregoing examples of what *might* happen do not mean they *will* happen. In fact, the Government's action indefinitely forestalls any chance these corporations might have had to further their alleged monopolistic ideas. But this action should arouse the listeners, the amateurs and the independent broadcasters and manufacturers to such a stage of enthusiastic protest that any plans for a "Radio Trust" will disappear before they are well under way.

Here is a chance for the amateurs to get busy and render another service like that which characterized their fight gainst the proposed radio tax. The life of the amateur and the small broadcaster is at stake. It will be a fight extending over a period of years, and upon it will depend whether radio is to continue to be a public utility for public good or just another means for personal publicity.

A CONVICT in a Middle Western state penitentiary wrote to a storage battery dealer in his home town and asked for a second-hand radio battery to attach to a receiver that he had built and set up in his cell. He paid for it out of his meager earnings of a dollar and a half a month, saved during the four years of his imprisonment. The convict related his life as a shut-in and how the little radio set brought him his first touch with the outside world. He told how the set had cheered him and built hope in his heart that he will be able to live a straight life when his release comes. It was a human letter and touched the heart of the battery dealer, who decided to send the convict a brand new battery instead of a second-hand one. But before doing so he asked the warden of the penitentiary for his consent. The warden refused, explaining that "radio within prison walls has not yet been put through the experimental stage." So the convict didn't get his battery and the world beyond has been cruelly cut off. We believe radio in the future will do more than endless preaching, bullying and solitary confinement to reform prisoners in our jails. That warden would have been doing a public service toward reducing criminal tendencies if he had not only permitted that one convict to have his radio set, but had ordered sets installed in every cell. Some day we hope such a liberal and humane measure will be taken by forward-looking states.

RADIO FANS like nothing better than to make their own sets and be assured that they are making them correctly. The chief fault with thousands of home-made radio sets is that they are the result of wholesale guesswork and not of careful following of specified plans. In printing four pages of real blueprints in this and succeeding issues, RADIO AGE believes it is helping the exasperated radio fan to get down to a working basis and build his sets *right*. The building season is about to start, and there is no better insurance for successful reception than clear, accurate and authentic blueprints for working drawings. The blueprints in this issue are the last word in reliability—as are the hook-ups they portray.

WE NOTE with interest that a group of manufacturers has organized a Radio Manufacturers' Association for the general improvement and stabilization of the radio industry. This is only another indication that the big men in radio are realizing that the best sets and accessories can be made only by individual incentive and not by the hired talent of grasping corporations. The men who make up the Radio Manufacturers' Association are leaders in their respective radio fields and they know that their mutual co-operation will make radio safe for the listener, the amateur and the independent broadcaster who wants to give the public what it wants—not what the broadcaster wants.

You Cannot Afford to Miss the Priceless Hookup Ideas in the 'Annual'

The profound technical problems to be encountered in the study of Radio are all very interesting to the expert, but the great majority of "fans" are vitally concerned in the building of simple sets that really will work and produce effective results.

To supply this demand for practical, simple and efficient sets, RADIO AGE compiled THE RADIO AGE ANNUAL for 1924 in the belief that it contains more real help and meaty material than any other book on this subject ever published.

THOUSANDS have been sold at $1 each since they were first offered to fans early this year. The supply is rapidly becoming exhausted, so we are making this last appeal to the fans to order their ANNUAL now if they have not already done so.

Full of Hookups That Are Guaranteed to Work!

here!

This Coupon, Pinned to a Dollar Bill, Will Bring the ANNUAL to You by Return Mail!

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Two Stage Amplifier
Baby Heterodyne I
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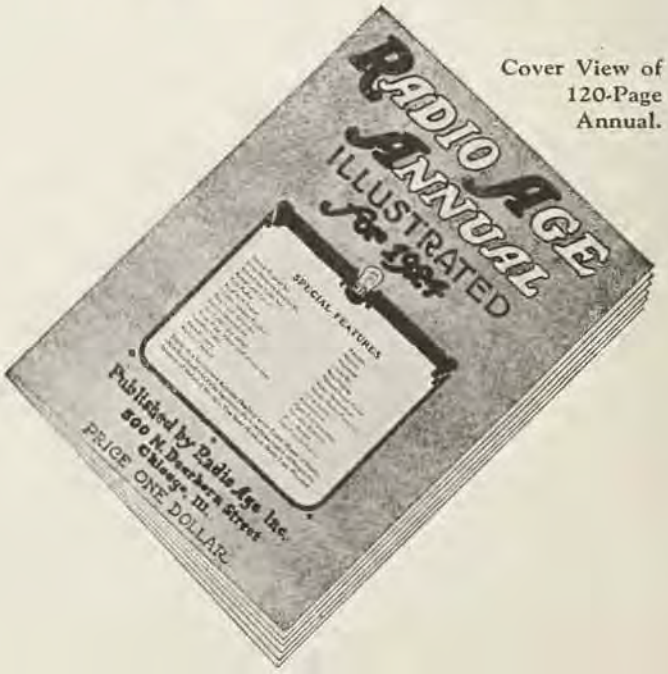
Wave Trap, Filter and Eliminator
Loading Coils
Transformers
Battery Charger
Reinartz
Haynes
Hopwood
Cockaday
Neutrodyne
3-Circuit Tuner
Super-Heterodyne
Simple Radio Frequency
Ultra Audion
Rosenbloom
Push-Pull Amplifier
Portable Reinartz
Wave Meters
Two-Circuit Crystal



Cover View of 120-Page Annual.

Lack of Vision Prevents Germany From Taking Her Place in Radio Progress

By FREDERICK A. SMITH

BERLIN:—If the visitor to Germany were to judge by the number of aerials seen above the roofs of dwellings, he would make the error of assuming that popular use of radio receiving sets in the republic was in a flourishing state. It should interest every American lover of radio and every American official who has to deal with regulation of radio transmission and reception to read the following facts about the collapse of popular radio in Germany after a few months of feverish enthusiasm. By observing the errors other governments and peoples have made in connection with radio development, the United States may avoid committing similar disastrous mistakes.

One reason for the astonishing decline in home radio activities in Germany is perhaps to be found in the fact that Germany failed to perceive the vast possibilities in the new art, either as a social factor or as a richly profitable industry, until long after the people of the United States had made great strides toward developing and stabilizing radio.

Radio a "Toy"

An American in Berlin told me that no longer than a year ago he was requested by New York people to inquire as to the possibility of obtaining twenty thousand complete radio sets from German manufacturers. The Berlin interests to whom the American carried this proposal greeted it with derision.

"Why!" they exclaimed, "the German people are a serious minded people. They would not consider going so extensively into the business of producing such a toy as the radio set."

THAT ended the negotiations. Since then the same German manufacturers have seen the light and are desperately trying to make up for lost time and neglected opportunities.

With characteristic alertness in finding markets abroad for German products, the manufacturers there are constantly pushing out into new fields, offering credits and prices that sometimes are the despair of competitors in other countries. One important radio manufacturing concern in Germany is doing an extensive business and there are scores of smaller establishments that are capable of producing equipment in quantities. But the fact remains that Germany has not been able to make the same popular success with home radio that has been achieved in the United States. England also has far out-raced Germany in the development of radio in and for the home.

RADIO TRAVELOGS

Frederick A. Smith, editor of RADIO AGE and author of the series on foreign radio beginning in this issue, has just completed a tour of eight European countries observing radio conditions and practices. He was correspondent on the West Front during the World War for the Chicago Tribune and flew into Berlin a few days after the armistice in 1918. On returning to the American lines he filed a single cablegram of 17,000 words which was published in all the leading papers of the United States. These experiences equip him with the ability to travel intelligently and accurately observe conditions.

Frederick A. Smith

After looking over the situation in Germany, I would say that the almost tragic suspension of radio interest among the people is due to the following conditions, some of which are being corrected:

The Causes

Limitation of adjustment of receiving sets to 700 meter wave length.

Failure of German manufacturers to standardize standard parts such as bulbs, sockets, head phones and plugs. Fans who sought to replace parts in their sets had great difficulty in finding parts that would fit their sets.

Programs of an unsatisfactory character.

Taxes imposed on manufacturers, dealers and users of sets.

Sale of inferior tubes and insufficient production of tubes.

German broadcasting, manufacturers and use of receiving sets are under supervision of the Reichs Telegraf, which corresponds to the Post Office supervision in England and to the Department of the Interior supervision in the United States. But the paternalism of the German government's attitude is in striking contrast to the rather liberal methods employed by the American authorities. So far as radio is concerned, the German government officials attempted to do all the thinking for the people who might be interested in radio. In the end it was the people who did the thinking and the government is now left with a deflated bubble on its hands.

One of the restrictions placed upon radio operation in the German homes was that which prohibited the use of circuits which might reradiate. The wisdom of any arbitrary exclusion of a radio circuit may well be doubted at any time. In a case where an apparently flourishing home industry fell afoul of evil times, such exclusion must be considered as significant as a possible contributing cause of the collapse of radio interest.

In the next place, the manufacturers of radio sets in Germany were forbidden to make any sets that would pick up broadcasting on other than the 700 meter wave lengths. The manufacturer was compelled to submit a sample of the set he proposed to produce.

THE main telegraph office examined the set and either approved or condemned it. In case the set met with the approval of the telegraph office, the manufacturer was permitted to make sets, always with the provision that each set should be sealed by the government and have upon the seal the initials, "R. T. V." For each set thus made the manufacturer was compelled to pay seven marks (about $1.75) to the Reichs Telegraf. On June 1 of this year this tax was reduced to three and one-half marks per set. It is necessary to stamp each tube produced by a German manufacturer and to pay a government fee of one-half a mark for producing it. It

should be remembered that the mark mentioned herein is the new German mark which appears to have a stabilized value of about twenty-five cents in American money.

Factories which made bulb sets had to pay 2,500 marks to the government.

Retail dealers in radio sets and equipment formerly paid 800 marks to the government each year. It is interesting to note that 300 marks of this sum was for the privilege granted to the dealer to demonstrate receiving sets for customers who came to his shop. The total tax on retail dealers has now been reduced to 30 marks each month.

All Sets Taxed

Now for the tax on the broadcast listener. It appears that the burden placed upon the German radio lover was sufficient without adding a financial weight to it; but Germany insisted that the user of a set should pay 60 marks per year as a penalty for enjoying (?) those programs which might be available on the 700 meter wave length. This tax included the modest crystal set as well as the more expensive tube sets.

The tax on the listener-in produced much the same situation that England faced when it sought to make the receiving set owner pay a fee. Thousands upon thousands of users of sets ignored the tax and went on their way trying to make radio function without benefit of legal rights. The German government very sternly called attention to these delinquencies and serious punishment was prescribed for those who evaded the tax. But the radio fans apparently felt that the government's radio bark was worse than its bite and the tax evasion continued placidly. Nobody went to jail.

It was then decided to reduce the fee to only two marks the month. Immediately there was a substantial increase in the number of permits applied for. Whereas only 20,000 fans had declared themselves as such under the higher tax and obtained the ostensibly necessary government permission to use a set, one hundred thousand persons in Berlin alone now have government license to "listen in." Seven per cent of the proceeds of all these taxes was and is devoted to assisting the financing of broadcasting from the various public stations in Germany. This method of aiding broadcasters is followed in England and the situation there will be described in another article of this series.

There is no estimate available of the number of sets in use in Germany at the present time. Radio in the home was forbidden by the government up to October 3, 1923. There was a small exporting business and a few amateurs were trying out circuits of their own production in secret. On October 3 the government announced that use of home radio sets would be permitted. It was fondly hoped that a revenue could be obtained from the enthusiastic members of the radio fraternity that had refused to be suppressed by a frowning government. The first broadcasting station was established in Berlin, practically financed by the government.

Enthusiasm Grows

THE rush for receiving sets was enormous. The industry had had no chance to develop normally or effectively and there was a consequent rush of manufacturers into the business of making sets and parts. There was absolutely no uniformity of size of parts and the confusion of the fan who wanted to replace any accessory of his outfit may be imagined. He rushed from shop to shop in pursuit of tubes that would fit the peculiar sockets in his set, or went feverishly about looking for plugs that would fit the holes in his panel. Material was put on the market by inexperienced manufacturers who fell far short of excellent production. There was a famine in bulbs and radio folks know how aggravating it is to have a set for which no tubes are available.

Depite all these difficulties, fans bought outfits at prices ranging from 400 to 600 marks. German enthusiasts at first were not aware of the fact that crystal sets could be used and when they learned that this inexpensive form of radio fun had been withheld from them, with the consequent necessity of paying good sums for tube sets, many of them complained that they had been imposed upon.

In addition to all this the requirement that all sets should be sealed by the government and kept sealed caused confusion. If a fan wanted to open his cabinet to replace a worthless tube or other part he was forced to break the seal. Then who was to replace the seal?

Broadcasting stations were apparently unable to meet the varied tastes of German listeners-in. Many wanted jazz music instead of classic numbers, and vice versa. The merest suggestion of political flavor in a broadcast talk caused a whirlwind of protest from fans throughout the republic. And then there was the monotony of that 700 meter wave length. This restriction made it impossible for the Germans to pick up the stations that might have entertained them from England, France, Holland and other adjacent countries.

Radio Suffers Set Back

Then along came more serious financial difficulties in the German business world. In March of this year the radio business suffered a violent slump. Many manufacturers went out of business and sets that formerly had sold for 300 marks are now being offered at 100 marks, and this price is not a sufficient temptation to keep the fan in the game. German landlords appeared to have a strong objection to the erection of aerials on roofs and this led to legal complications, many suits having been brought by radio enthusiasts and by landlords.

I found radio manufacturers and dealers in Germany somewhat doubtful of the possibility of bringing the industry back to a flourishing condition. But I formed the opinion that it will not be long before the government and the business interests will find a readjustment of conditions that will yet put radio back on the map in music-loving Germany. I predict that Berlin one day will be one of the great radio centers, just as it is now one of the most important capitals of the continent.

When the day comes that all the world will be linked in a chain of radio stations and all peoples will be aerial neighbors, it is to be hoped that Germany will have solved her radio difficulties and be a part of the great international game whose brilliant future we in the United States so confidently anticipate.

Keystone View

GERMAN BROADCASTING STATION READY SOON

The largest broadcasting station in Germany is shown in the picture. It is located at Konigswusterhausen and is to be used, when completed, for broadcasting as well as code purposes. Its radius will be 4,000 meters. The entire plant will operate on three 350 H. P. Diesel engines.

Pick-ups *and* Hook-ups *by our Readers*

The material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

YOU remember the way old WDAP used to come on the air? All you old timer Dial Twisters do, I'm sure. They used to have a wonderful song that made you jerk your shoulders and sway when Jack Nelson sang "WDAP." Here's a little parody on his song that opens up this month's Pickups Section:

Hello John,
Are you on
To the good old Pickups Page?
If you haven't tuned in,
You've missed a bet;
It's the best in RADIO AGE.
Now I don't know where you
Happen to be,
But there's one thing sure
That is easy to see:
The contributions snappy,
Will make you happy
As a radio bug should be.

CHORUS

Oh, you ought to read the letters,
And the diagrams so clear;
Learn what the bugs are doing,
Though they live both far and near;
Now if you want to be a member
Of this Dial Twister rage,
You've got to learn to tune, so
You'll get a button soon
From
—The Editor of the Pickups Page.

CONTRIBUTORS

J. H. Fargnahr A. J. Secor J. J. Drey P. Edward Chapman

DIAL TWISTERS

Name	Address	Circuit
Ralph Mellon	25 King Street, Pottstown, Pa	Regenerative
Ray Hahn	1517 Chestnut Street, Milwaukee, Wis	Three Circuit
P. L. Hartnett	316 Henderson Avenue, Tampa, Fla	Single Circuit ES Crosley
Robert M. Hillis	1462 Belle Avenue, Lakewood, Ohio	Ultra-Audion
Clair McCormick	Ewen, Mich	Crosley Trirdyn
Franklin Troutman	11304 Coates Avenue, Cleveland, Ohio	Single Circuit

J. H. Fargnahr, of 3974 Olive Street, St. Louis, Mo., says that he is just "oscillating" with information on a new transformer for a neutrodyne receiver that he thinks is the stuff to neutralize easily. The following tells the story:

RADIO AGE,
Gentlemen:

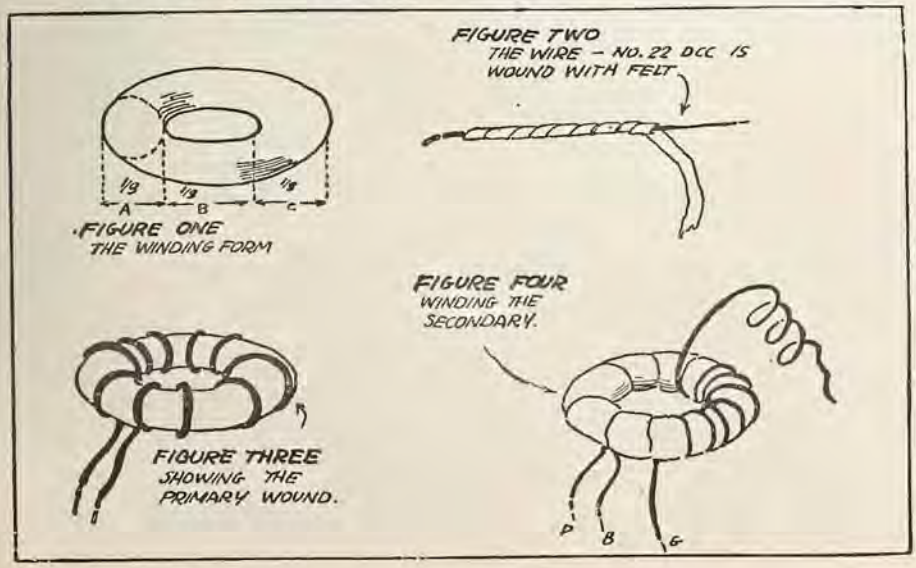
Experiencing quite a bit of difficulty in neutralizing a neutrodyne receiver, I hit upon quite an idea, which, while it gives complete magnetic coupling between primary and secondary, it magnetically isolates each transformer, which in turn prevents magnetic coupling between RF transformers, and also saves considerable space behind the panel in shortening leads.

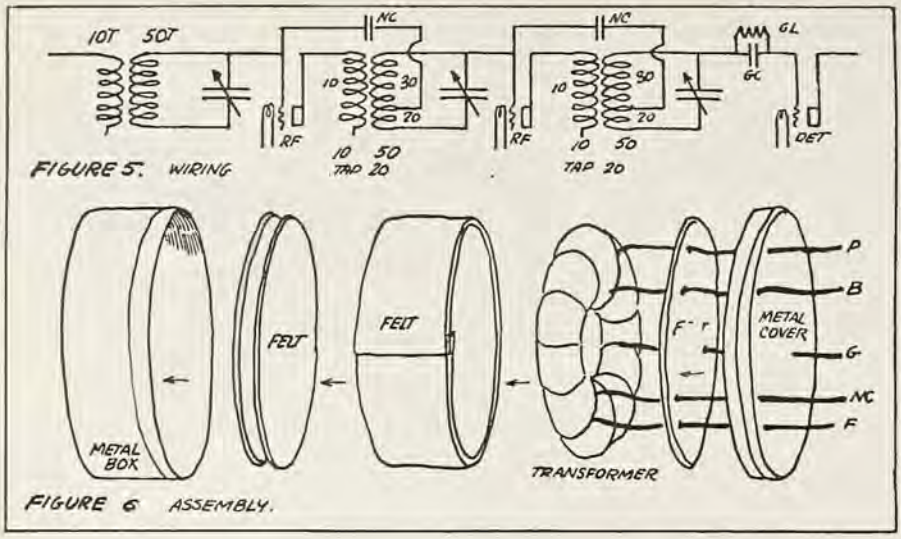
In this "doughnut transformer" the wire to be used for the primary and secondary is wrapped with felt in addition to double covered insulation (to get around the inter-turn capacity effects) in such a manner that the closed magnetic path is run directly through the center of the core. This doughnut core (having practically the same permeability as air) is used as a form only, and any other non-magnetic material would do just as well, as it serves only to guide the transformer windings. It should have an inside diameter, just roughly one-third of the outside diameter.

The primary is wound on the "doughnut" core (threading each turn through the hole in the doughnut) in such a manner that one or more complete layers are obtained. Fractional layers unbalance the magnetic field and defeat the original purpose of the transformer.

A thin layer of felt is wound on covering the primary, and the secondary is then wound, care being taken to obtain complete layers in the same manner as the primary.

Five holes are drilled in the lid of a metal box (obtained in most any drug store) in order to bring out the transformer leads and the neutralizing tap. (Note—If a straight RF transformer is made in this fashion, the neutralizing tap can be omitted. This would make only four leads—two primary and two secondary.) Holes are drilled in the bottom of





the metal box so that the unit may be fastened to the end plate of the tuning condenser. The bottom and sides are lined with felt (be generous) and the transformer windings are put into place.

The boxes should not be connected together, nor should they be grounded. The tube may be mounted directly behind this metal box-condenser unit, and much space may be saved in this manner.

In closing, I sincerely hope that this little suggestion may help some of the fellow DT's out of the neutralizing troubles.

Most oscillatingly yours,
J. H. FARGNAHR.

3974 Olive St.,
St. Louis, Mo.

You have no doubt seen shielded transformers before—but nearly all of them were of the fixed type. We don't know how the above idea works out, but it certainly looks good, and we're giving it to you just as our St. Louis friend gave it to us. If any of the readers of this department try it out, let us know how it works out. The sketches submitted by the contributor are given in Figures 1, 2, 3, 4 and 5.

Old readers of RADIO TOPICS and those readers of RADIO AGE who are interested in reflex stunts will like this next contribution. RADIO TOPICS readers will recall that Tri-Coil circuit, and RADIO AGE addicts have in mind the Sure-Fire circuit. The following is a contribution that can be applied to either of them:

RADIO AGE.
Gentlemen:

Just a few lines in appreciation of a good radio magazine and equally good hook-ups.

I try out all of the reflex layouts, as reflex is my hobby. I built the Sure-Fire reflex as shown in the June number and had very good results with it. I then rebuilt it in accordance with some ideas that I had and increased the volume considerably, without any sacrifice of selectivity, although I suppose Mr. Robbins would not approve.

I enclose hook-up as modified. You will note that I am not partial to potentiometers or the untuned primary.

I have also built the tuned impedance reflex as shown in the July number and had good results with that hook-up also, and then I modified it to better advantage. I enclose modified hook-up of that circuit.

Values for fixed condensers are not given because they are dependent on transformers and other apparatus used, and values are best determined by experiment.

On hook-up No. 1 a .005 MFD was used across the phones, while for No. 2 a .0015 was used.

The R. F. T. in No. 1 is a Tri-Coil type 9.

The variometer in No. 2 is a Raven.

The variable condenser in both hook-ups is of brass milled and turned from the solid block. (I used to be a tool-maker).

I can get WJZ and WOR on a table talker with both of these hook-ups.

Once more, keep potentiometers out of this circuit if possible, as they are "lossers."

Yours very truly,
A. J. SECOR.

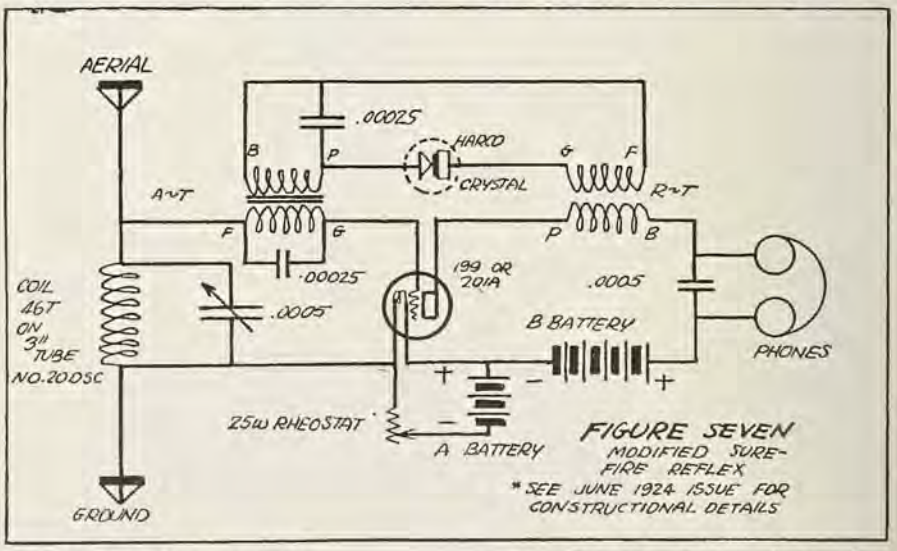
228 Laurel Ave.,
Bridgeport, Conn.
July 19, 1924.

This is just the type of letter and report we are looking for; concise and to the point with a report of results, type of apparatus and modifications used. Some of the experimenters who read this department might use Mr. Secor's form of giving the results with various circuits. Your suggestions are certainly appreciated, and we'll bet they will make a good many reflex fans change wires in their receivers.

And now we've got to devote some space to our friend, J. J. Drey, of Iron River, Michigan; who still continues to be flooded with mail. Evidently there is some question as to how he winds his coils, and he has kindly consented to tell the many Twisters just how he does it. Right here I might ask the fellows to be a little judicious about asking other Dial Twisters for information. Remember some of them are busy men; they have other things to do, and while they would be glad to help you out, they really *have* to devote some attention to private interests. If you really *must* ask questions of these generous radio men, make your questions to the point; ask only what you really need.

RADIO AGE,
Gentlemen:

In your June issue of RADIO AGE you have published my hook-up, as I have found, through experiment, to give exceptionally good results and through my experiments I have found the correct winding of a coil, that covers the general broadcasting waves, which is submitted in the sketch. To date I have received many letters requesting further information on the winding of the coil. You neglected to state the number of wire. It should be a 24 or 26 single cover cotton. Either one will do, but louder and clearer signals I have



found better with number 24 gauge.

There seems to be also a misunderstanding by the Reinartz fans in regard to the winding of the coil. I am herewith submitting to you a new sketch clearly illustrating the numbers on the taps. Will you kindly publish this as clearly as possible to enlighten numerous Reinartz fans. I am a very busy man with store duties and have not the time to answer each one personally in detail, but will always welcome any information, should one be in difficulty regarding the hook-up.

The instructions for widening the coil are as follows: Procure an ordinary spider frame which may be purchased at any radio shop. It has a wooden center of about 1¾ or 2 inches in diameter, with 17 spokes. Start winding the plate coil, which is on the inside of the frame. The starting end of the wire is the first tap. Wind 15 turns around in spider web form in weaving every second spoke in each one. This will form a Duo-Laterical air winding. Wind for 15 turns, make the second tap. Wind 15 more turns. This will be the fourth tap or the end of the plate coil. Cut the wire off, twist around the spoke. Now start your grid coil, which is wound right next to the plate coil, the end being about a quarter of the diameter away from the forty-fifth or end tap of the plate coil. The starting point of the grid coil is the first tap. Wind one turn, make the second tap. Wind two more turns, make the third tap. Wind two more turns, make the fourth tap. Wind one more turn, make the fifth tap. Wind one more turn, make the sixth tap. Wind one more turn, make the seventh tap. Wind one more turn, make the ninth tap. Wind two more turns, making the tap which goes to the ground. Wind eight more turns which will be the twentieth turn on the first tap for the grid switch. Wind seven more turns, make the second tap. Wind seven more turns, making the third tap. Wind three more turns, make the fifth tap. Wind three more turns, make the sixth tap, or the end of the outside coil. This end should be the forty-third turn from the end of the grid starting coil.

The other parts are to be connected as shown in the hook-up of the June issue of RADIO AGE.

I also wish to call attention to the fact that the second or third stage radio frequency transformer cannot be used in this hook-up. It must be a first stage radio frequency transformer. I have had many requests for this information.

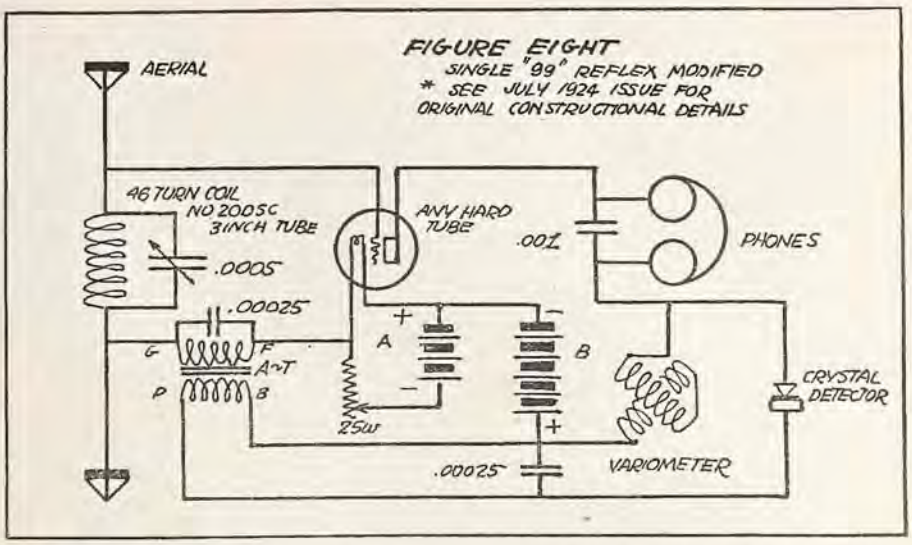
I did not realize that your RADIO AGE was so popular, but by the numerous letters the writer has received from practically every state in the union, requesting further information regarding the Reinartz hook-up, and from this fact it is evident that the readers have confined themselves to a good magazine.

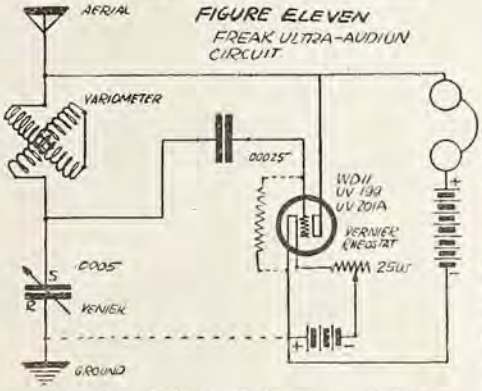
Thanking you to please publish the instructions of the coil in full detail so that all Reinartz fans will know how to construct it. If this is done correctly, according to my specifications, and according to the publication of your June issue, they will have a hook-up that will give remarkable results. I remain,

Yours very truly,
J. J. DREY.

Iron River, Mich.

Mr. Drey's procedure for winding the coil for this Reinartz circuit is illustrated in Figure 8.





P. Edward Chapman, of 805 North Preston Street, Philadelphia, Pa., is prompted by the article of the June issue Pick-ups Section on the Improved Superdyne, by M. C. Williams, to submit a few of the results he obtained with his four-tube "Selectdyne." Here they are; the hookup will be printed in our next issue.

Calls Heard By
P. E. Chapman,
805 N. Preston St.
Philadelphia, Pa.

WOR, WJZ, WEAF, WJY, WDT, WGI, WHAZ, WCAE, KDKA, WOC, KYW, WDAP, WNAJ, WSB, KSD, WGY, WRL, WRR, WFAA, WLW, WAAD, WSAI, CKY, WGR, WWJ, WOP, WRAX, WDAF, KFAW, WMAF,

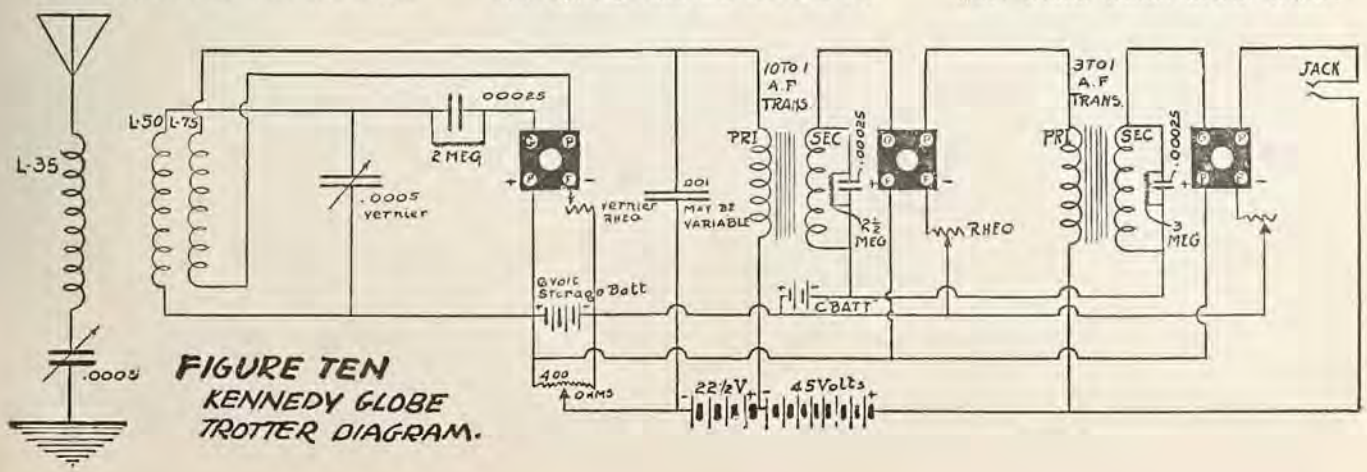
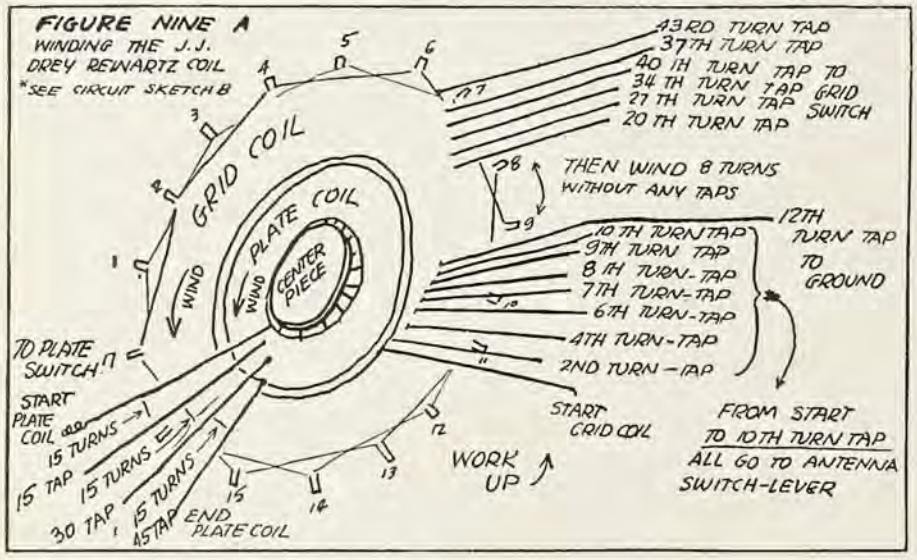


FIGURE TEN
KENNEDY GLOBE TROTTER DIAGRAM.

WSAQ, WCAP, WRC, WCAW, WOAW, WPO, PWX, 6KW, WMAQ, WJAX, WTAM, WIAF, WBZ, WLAG, WBAH, KHJ, KDYQ, KZN, KFIQ, CFCA, WIAD, WCBD, WEAH, KFAS, WSAL, WCAH, WBT, WHAS, WHAA, KFI, WCAT and verified receptions of 2ZY Manchester, England, and 2LO London, England.

From England to California—that's some receiver if you think it over. And only four tubes, too! (At this point the owners of super-heterodynes will plug in another stage in the tooth gnashing-hair pulling act.) Some of the fellows who felt that the six tube affair of Mr. Williams printed in the June issue is just a trifle too large will without question seriously consider this little four tube "Selectdyne" of Mr. Chapman's. In the popular vernacular, it's what you would dub "the berries."

Two Dial Twisters have called our attention to the fact that in our diagram of the Kennedy "Globe Trotter" hook-up,



published in our June, 1924, Trouble-shooter Section, there are several inconsistencies which would confuse the average beginner. Louis A. Cass of Chicago, and T. J. Kennedy, the designer of the circuit, are the watchful bugs who are responsible for the corrected diagram shown in Figure 10.

A Prize Offer

We would like to mention the fact that the idea of giving a free copy of RADIO AGE to each fellow who points out an error in the Corrected List of United States, Canadian and Cuban Broadcasting Stations works out fine; so far we have had to give out only a few copies. But don't let that keep you from helping us to make that list just as up-to-date as possible.

Incidentally, does anyone happen to have a complete, reliable list of British and French broadcasting stations that they would like to have added to our regular monthly list?

September means the commencement of the DX season, and we are sure to have reports of more and more fellows hearing foreign broadcasting, so the list will be handy.

Before we leave the contributions and go on to the DX lists, we want to say that we are still open to suggestions, and more contributions. The Summer has run us a little short of our supply of available contributions for the first part of the Pickups Pages, so if you fellows want to read more of them, you've got to loosen up and let us hear from you.

The response to the Static Puncturing Contest was not as great as we would have expected it to be, but nevertheless when one considers that the idea of listening in through static is not one to be relished, we can hardly blame the boys. At any rate, here are the results for June and July.

First Prize List

RADIO AGE,
Gentlemen:

As I would like to enter your "Static Puncturing Contest," I enclose the list of stations I have heard during the month of June. The receiver I used in getting this list was a single tube portable set, using a regenerative circuit. The list of stations is as follows:

Calls Heard

WTAR, KDKA, WBZ, WHN, WGY, WTAM, WFI, WEAF, WJZ, WRC, WOR, WCAP, WJY, WGN, WJAR, WBBR, WSAN, WTAT, WLW, WIP, WDAR, WOO, WCBD, WHAZ, KFKX, WTAS, WDAP, WLS, WHAM, WPAB, WGR, WEAN, WANC, WSAI, CKAC, WEAP, WAAM, WSB, WJAX, KFNG, WCAE, WWAP, WBS, WJAS, WRAX, WCAU, WEAM, KQV, 2XR, 2XI, and WNAT.

I will leave it to you whether this is a good DX record or not. What little DX I do get, your magazine helps me to make it possible. Last Summer I did not read your magazine and the best I could do with a three tube set was WGY.

I think that speaks for itself.

Yours truly,
RALPH MELLON.

25 King St.,
Pottstown, Pa.

Ralph is mighty modest about that list. Fifty-one stations in Summer time is a good list. Last Winter we used to make a fellow a Dial Twister for a list like that. So Ralph Mellon's name goes down on the subscription list for one year—FREE!

Second Prize—June

RADIO AGE,
Gentlemen:

Ever since reading about your Dial Twisters, I have had a desire to become one of them, so I looked over my log book to see if my list might entitle me to admittance. In the past three months I have heard the following (excepting all local) DX stations:

Calls Heard

WLW, WBZ, WGY, WHAZ, KHJ, PWX, WLAG, WDAF, WSB, WOS, WIP, WOAW, KFKX, KGO, WGR, KDKA, WEAF, WGI, WHB, WJZ, WSAI, WTAY, WOR.

I am using the old two-variometer-variocoupler hook-up, slightly modified as per the enclosed diagram. This change makes the set oscillate more freely and gives slightly more volume. (Editor's Note: The above list is not the prize winner; the one following did the trick).

Using this set on June 12th, from 9 to 10 p. m., I heard the following:

Calls Heard

KYW, KSD, WLS, KDKA, WTAS, WMC, WCBD, WOC, WBAP, WDAF, WEBH, WQJ.

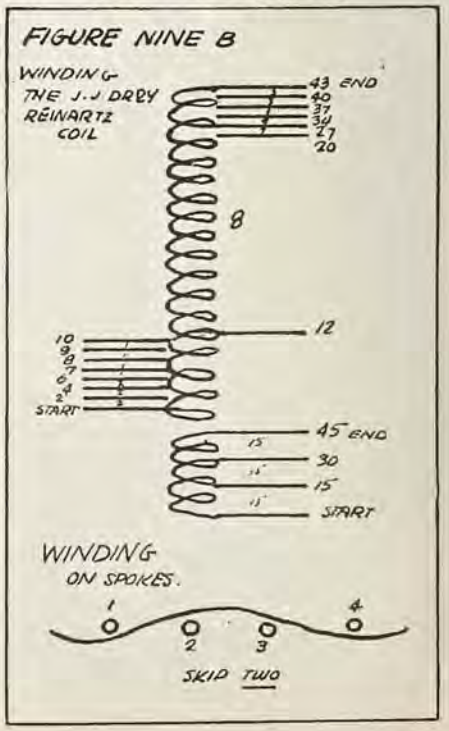
A curious thing was noticed about WOC. They were transmitting on two wave lengths; one their regular wave, and the other one right among the "hams." (A harmonic.)

I hope that this at least makes me a Dial Twister.

Yours truly,
RAY HAHN.

1517 Chestnut St.,
Milwaukee, Wis.

(*Continued on page 54*)



Trouble Shooter

E. K., New London, Conn.

Question: I am constructing the four tube neutrodyne receiver as described in the RADIO AGE ANNUAL. May I use a 5:1 ratio transformer instead of a 4:1 with equal results? I am going to use UV199 tubes. If not, please name a good 4:1 transformer. What is the use of the C battery? Where should this C battery be connected? What is the correct voltage of such a battery when using about 75 volts on the plate?

Answer: You may use a 5:1 ratio audio frequency transformer without impairing the results of the set. The UV199 tubes are good for the circuit you are building. Use the 5:1 transformer you have on hand, and save yourself the price of another one of 4:1 ratio, which is not absolutely necessary. Don't forget that we cannot answer questions which relate to comparison of manufactured and advertised apparatus. It is the purpose of the C battery to place a strong negative charge of the grid of the tube when excessive plate voltages are used. This lowers the drain on the battery and makes it last longer. The proper voltage of the C battery with UV199 tube 75 volts plate potential would be from three to four volts. The negative of the C battery is connected to the F post on the audio transformer (the grid return post), while the positive of the C battery is connected to the negative A battery.

C. P. J., St. Louis, Mo.

Question: I have a radio receiving set using the Reinartz hookup. I am not getting any results with respect to long distance stations. If I get any distant stations, there is a howl or whistle in the coil or tube all the time. If I put my hand near the dials or tuning switches, it makes the noise worse. Sometimes I can put my hand in a certain place and if I hold it there, I can tune the station in, but as soon as I move my hand it will start to whistle. I have a two-strand aerial about 30 feet long. I have the 23-plate condenser connected with the rotary plates to the ground, and I have the 43-plate rotary plates to the aerial side. Have a .0005 MF condenser hooked between the grid and the coil and I am using a UV200 detector tube. I am not using any amplification at all. Could this be my trouble? If I use a crystal coil in series with the aerial to the tube set, I can get pretty good results. If I do not use this coil, there is a howling noise all the time. I get KSD loud enough to hear all over the room with the phones, without the crystal coil. The crystal coil just works good on long distance stations.

Answer: The howl or whistle can be due to several causes. First it may be due to improper tuning, inasmuch as the set may be oscillating at the time you are receiving, which is not correct. The set should be so adjusted that it is just at the spill-over point, which is just below the point of regeneration, where the maximum amplification effects are obtained without distortion. The second possibility lies in the grid leak. Make or buy one that is variable, and adjust it. I find that many of the sets now in use are hampered in not using a leak that is adjustable in some way or other. Noises are common from poorly adjusted grid leaks. The hand capacity you mention may be due to the fact that your grid and plate wiring comes too close to the panel or mounting board, and it would be a wise move to rewire the set, and keep the leads short and direct, at the same time running them high in the air and at right angles to other wiring. Your trouble might also be due to a set of poor variable condensers. Get yourself a set of the new low loss type of condenser which is now being sold everywhere, and you will note a difference in both tuning and results. Adjust the plate battery voltage carefully; to do this it is wise to use a potentiometer connected across the A battery, with the center arm connected to the negative B battery lead. The B battery in addition should be tapped. The crystal coil in the aerial circuit is an indication that your antenna is too short. Thirty feet is ideal for 150 to 200 meter reception, but not for 300 to 400 meter work. If you can't lengthen your antenna, add a few more turns (about 15 or 20) to the antenna coil (the one with the 10 single turns), which is connected to the switch and the 43-plate condenser, and about 10 more turns on the grid coil. A local station of any appreciable strength will break through the tuning of a receiver (especially if the condensers are poor), even though the set may be way off resonance, and for local reception tuning does not have to be so accurate.

VACUUM TUBES (JJ-9-25)
OPERATING CHARACTERISTICS

BIASED AUDIO FREQUENCY AMPLIFICATION. High vacuum tubes used for audio amplification circuits should always be given a negative bias when the plate voltage of these tubes exceeds 45 volts, and even at 45 volts a saving is shown in the plate current and hence in the life of the "B" batteries. Greater amplification, greater freedom from distortion and a smaller demand on the "B" batteries are obtained by proper biasing voltages on the grids of the tubes.

Biasing the audio stage tubes is generally performed by placing a "C" battery in the grid line or return grid line with the negative post of the battery next to the grid post (G) of the socket. Potentiometers are seldom used because of the comparatively high plate voltages used with the amplifying tubes. As the "C" batteries supply only a very small amount of current during the operation of the set, and are automatically placed on an open circuit when the tubes are turned out, a small flash-light battery will last a long time on this service without the necessity of switches or special attention. The small special "C" batteries now on the market are excellent for this purpose, and after installing will last for more than a year without replacement or attention.

Fig. 1 on the adjacent data sheet shows the biasing battery "C" in the grid line of a single stage audio circuit. It will be seen that the negative of the "C" battery is placed toward the grid, and in addition to the negative pole of the "A" battery maintains a negative potential on the tube. That is all the secondary in circuit (SEC) of the audio frequency transformer (AT).

Fig. 2 shows the same effect obtained by placing the biasing battery in the grid return line, but it is likely that this is not so effective as the direct connected battery shown in Fig. 1. While the current drawn from the battery is so small that there cannot be much resistance loss, due to the resistance of the secondary winding of the transformer, yet there is an impedence loss which is likely to pull down the voltage slightly on extremely loud signals, and which would therefore tend to reduce the bias at the time when biasing was most needed. However, this system works very well and is used extensively.

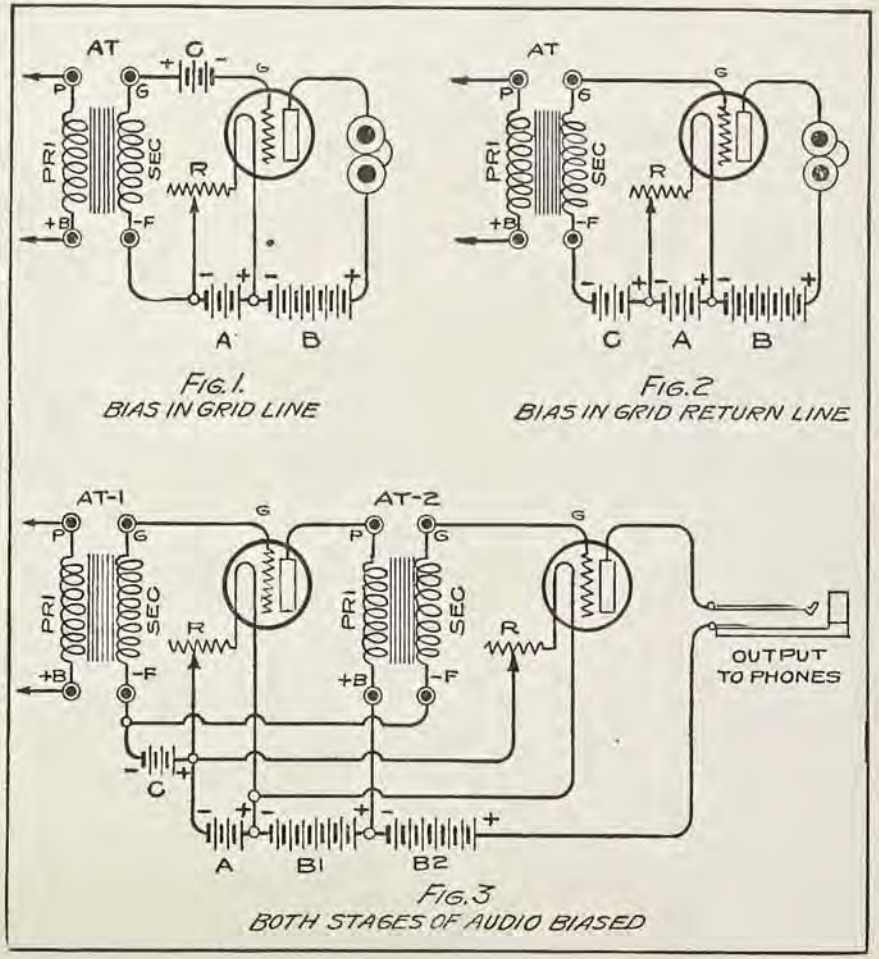
Fig. 3 shows a two stage audio amplifying circuit in which a single "C" battery biases the grids of both tubes by a connection of the negative of the "C" battery to the secondaries of both transformers. The battery is therefore in the grid lines. The same results could of course be obtained by the use of two "C" batteries, one battery being placed directly in the grid line of each tube as in Fig. 1. The system outlined in Fig. 3, however, saves one battery and simplifies construction. The audio frequency transformers are shown at (AT-1) and (AT-2). Two "B" batteries (B1-B2) give minimum distortion but only (B1) need be used.

At voltages of approximately 40, biasing has not much effect on reducing distortion, nor does it noticeably increase the volume. It does, however, reduce the demand for current on the "B" batteries and in this way prolongs the life of the "B" batteries. At about 60 volts, the effect of biasing becomes very noticeable with a considerable increase in volume and less distortion when the tubes are being pushed hard. At 90 volts the volume depends very greatly upon the degree of bias and the proper bias voltage eliminates the mush and distortion that would otherwise be present without the "C" battery.

The biasing voltage must be increased as the plate voltage is increased. The proper biasing voltage varies with different tubes, and is given in the tables in the next data sheet.

COMPILED BY
J. B. RATHBUN

VACUUM TUBES (JJ-9-26)
OPERATING CHARACTERISTICS



COMPILED BY
J. B. RATHBUN

Reminiscences of an Old Operator

(Continued from page 22)

at something above fifteen hundred and we positively did not get over it for weeks. The sound of that marvelous Fessenden synchronous rotary, with its pure soft whistle, will live with me forever.

And then—Shep went to sea. Which marked the turning of my footsteps toward the commercial game, and, incidentally, nearly marked the head of my grave with the usual inscription. It happened like this:

Shep, being away on the ships, had commissioned me to dismantle his set, for which I was to receive most of the equipment. The ten-wire flat top had been replaced by an enormous two-wire triangle extending along two sides of a city block and diagonally from one corner to the other, this last side being about 500 feet long.

In taking this long stretch down, I was standing on a tin roof, grounded through the rain spout, heaving away on these two long strands when they swung low onto some old 4,600-volt power lines in the alley on which the insulation was hanging in shreds. There was a tremendous report and a great flash and I found myself sitting on the roof with the ends of the wires dangling over the roof—absolutely untouched and without having felt a slightest tingle.

Very quietly I sat while the neighbors returned, one by one, indoors, figuring how in Sam Hill I was still there, absolutely as green and uncooked as if I had not just a moment before shorted, or grounded, or in some way run counter to a lot of volts on the wrong side of the transformer. Cautiously investigating, picking up a couple of handfuls of perfectly rounded copper marbles in the alley under the power lines, where some six feet of aerial wire had been melted, I found a perfectly satisfactory explanation. It was a nicely fused ground switch from which I had "neglected" to disconnect the lead before trying to pull the wires over to my roof. That was all—but that was enough.

My amateur days overlap into my commercial with my first trip to "BX" station and my adoption by Dave Heilig as one of the men "posting up" for a ship job. But more of that in the next issue, if the good editor will let my sigs get through.

(In an early issue of RADIO AGE *Mr. Lynch will write on "My Initiation Into the Commercial Game," in which he experiences some hazardous adventures while serving as operator on the S. S. Seminole to Haiti. Watch for it.)*

BUYERS' AND SELLERS' SERVICE SHEETS

TUBE SOCKETS No. 3-A-24

1. **Spring Contacts.** Design:—Double contact springs or the new "side swipe" springs are desirable, since single contact springs are apt to bend out of contact and **stay bent**. Note that springs are so designed and fastened that they will not work loose.

Tube Socket Assembly.

Material:—Phosphor bronze, not too thin, is the best material, and gives longest life. It should be punched with the grain lengthwise with the spring not cross-wise, or the springiness will be diminished.

German silver is more apt to bend out of contact, and its resistance is higher. Test the springs by plucking them to ascertain that the material is springy and strong.

2. **Insulation.** Material:—Bakelite, hard rubber or porcelain. The latter when thoroughly glazed has low specific inductive capacity and high insulating qualities, but cannot be so well designed, and is more easily broken.

Soft compositions called "moulded mud" and used in cheap sockets, are partial conductors and to a large degree short-circuit signals to be detected or amplified. Such material is easily cut with a knife. Felt, and fibre are apt to gather moisture and are not first choice.

3. **Connections.** Design:—Lugs for soldering are desirable since contact must be perfect. If you are going to solder, be sure the insulation is good and will not soften under heat, as melting is not only unsightly but metal parts may be disarranged and open-circuited.

4. **Cleanliness.** Do not accept socket which has dirt, pencil marks or grease on the base.

5. **Shock-absorbers.** Design:—For tubes which are microphonic, such as U. V. 199 and C. 299, supports made from strips of rubber or a cushion of sponge rubber are desirable. Some cushioned tubes are fastened to the base by a screw through the socket. Such a method of connection does away with the effect of the cushion.

6. **Finish.** Style:—Metal posts should be nickeled and polished in order that they may not tarnish.

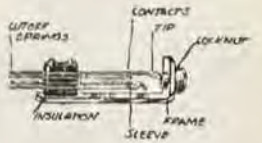
7. Socket must be so designed that there is no possibility of the tube prongs touching any of the springs unless the guide pin on the tube base is in the corresponding slot on the socket. Some sockets are so made that when the tube is put into the socket and rotated until the guide pin drops into the socket, the prongs will often make contact so that B-battery will burn out the filament.

COMPILED BY
EDMUND H. EITEL

BUYERS' AND SELLERS' SERVICE SHEETS

JACKS No. 4-A-24

1. **Springs.** Material:—Phosphor bronze or German silver. Former has lower resistance and greater elasticity; latter matches other metal parts and its appearance may be preferred.



Length:—Longer the better to insure long life, constant tension; short springs crystallize and break. Thickness: Heavy springs preferred for long life and to eliminate complication of booster springs. Design: If tip or short spring is placed next to frame with an insulation between spring and frame, plug may sometimes cause spring to touch frame and short circuit, especially after thimble wears a little.

2. **Terminals.** Design:—For convenience in soldering spread lugs preferred, and should be well tinned; to accommodate wires, holes of sufficient wire up to No. 12 B. & S., or whatever is to be used, needed for security and neatness in soldering.

3. **Contacts.** Material:—Pure silver will not oxidize, turn black or corrode, and therefore insures a clean and satisfactory contact; be sure contact points are clean.

4. **Insulation.** Material:—Such special compositives as Bakelite, Formica, or Micarta preferred, since these do not expand, contract, or absorb moisture. Design:—Insulation if attached to springs prevents slipping of springs from one side of frame to the other. An insulating sleeve or tube should extend for the full length of the screws which pass through the ends of the springs when held by lock washers; the screws are more secure.

5. **Frame.** Material:—Brass or heavy iron, nickel-plated; may be polished (there is little to be said in favor of an argument sometimes advanced that iron frame may become magnetized except that in certain positions iron may encourage flow of stray lines of force). Design:—Straight or tapered; width of latter type is such that greatest strength of frame is located where greatest strain occurs, at the bend; also bent frame eliminates insulation stack-up between frame and springs and makes for more solid mounting for the springs. Straight jacks may be turned upside down and make mounting for a subpanel. Special mounting screws and washers for tapered jacks make same thing possible with them; also this type permits wires to be run beneath it.

6. **Jack Thimble.** Design:—To compensate for varying panel thicknesses washers are supplied; stationary thimble riveted to frame with adjustable lock-nut preferred, since this insures against incorrect mounting and makes for plug entering correct distance and consequent good connection. If plug enters too far, it may reach cut-off springs; if not far enough, may rest on insulator of plug. Size:—Test with plug if possible; standard diameter is ¼ inch; some jacks and plugs are made oversized; a loose plug may fail to lift springs high enough to make contact in a filament control jack; or it may short-circuit against a misshaped frame; therefore be sure to make test, at least, before making radio assembly. Heavy thimble preferred to light one because threaded part may be twisted off.

7. **Capacity.** The capacity of standard jacks is negligible as compared with the capacity of the two lead wires to the phones or loud-speaker, and moreover you generally use a condenser across the phones anyway. On a few circuits using very short waves, a so-called low-capacity jack may be needed.

8. **Soldering.** Beware of a jack with soldering flux on it. Most soldering fluxes are corrosive and contain zinc chloride, a conductor of electricity which will short-circuit the jack.

COMPILED BY
EDMUND H. EITEL

Unsnarling Vacuum Tube Connections

(Continued from page 18)

problem to cope with; namely, the filament and plate batteries. Not infrequently we receive questions asking how long a battery will last with a certain tube. It is impossible to answer this; unless one knows how long you listen, an accurate record of the current used and the tube or number of tubes uesd.

About the best answer I can give to a question like that is to say that to obtain the greatest life and efficiency with dry cells, never let the drain per cell exceed one-quarter ampere, and it is decidedly wiser to connect batteries in series parallel so that the current rate of discharge is in the neighborhood of one-eighth ampere. Have a voltmeter handy, and never discard the cell until it falls below 1.0 volt.

A standard 6-inch, 1½-volt cell used for two hours per day at a discharge rate of six hundredths of an ampere will last a good deal more than 300 hours. At a discharge rate of one-eighth ampere, under the same conditions, it will last somewhat over 200 hours; at .18 of an ampere discharge, the cell will last about 125 hours, and with a quarter ampere discharge rate, under the conditions as above mentioned, it has a life in hours of about 100 or slightly more. This also assumes that the battery is useless after the voltage has fallen to 1.0.

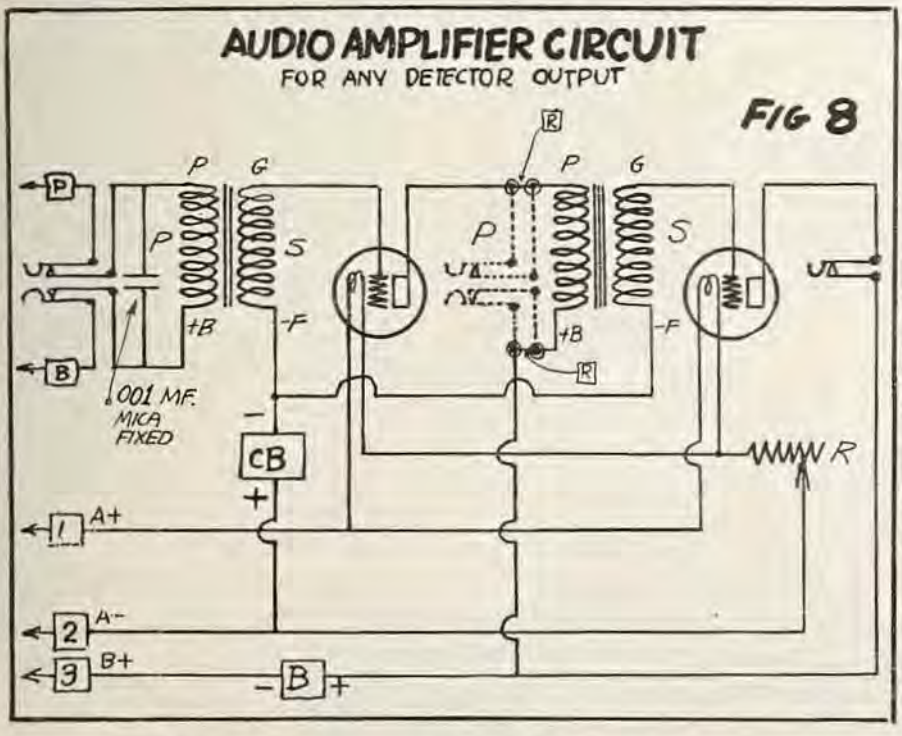
Knowing the amount of current it takes to operate your tube, and knowing the voltage, it is a comparatively easy matter to figure out from the above scale the number of batteries you will need.

Tapped B batteries are always advisable, especially in detector circuits. I have found that many times I could bring in five or six stations which I had never heard before by simply varying the plate battery voltage of the detector tube. It is decidedly wise to run up and down the scale of these taps in the course of long distance listening, for I am sure that you will discover its worth.

In conclusion, I would like to bring up the subject of poor tubes. Not infrequently do I run on to these "duds," and if I find a circuit properly connected and not giving the best results or none at all, I immediately suspect a "dud" tube. The only real way to determine this is to substitute it for one that you know is good.

In adjusting any receiver, it is a good plan if more than one tube is used to try changing the tubes around in the sockets, as often it will be found that a tube will work more effectively in one socket than in another.

Editor's Note: This is the second and last article on vacuum tube efficiency. The first part dealing with the choice of apparatus was published in the July issue of RADIO AGE, which is available at the customary price of 30 cents in stamps. Brainard Foote gave a discussion of detector tubes with grid bias battery, in the July issue. Further information on vacuum tube efficiency appears in the DATA SHEETS of the months of June and July. Readers who have not read these articles, on operating efficiency, should by all means do so.



"Reminiscences of an Old Operator,"
the True Story of an Amateur's Early Struggles,
Begins in This Issue.

WITH THE MANUFACTURERS

Deresnadyne Receivers Give Clear Tones

The Deresnadyne Receiver introduces a new principle in radio reception, which seems to possess decided possibilities. It is the invention of E. A. Beane and E. F. Andrews of Chicago. The circuit itself is similar to that of standard tuned radio frequency hookups, differing in the omission of certain parts heretofore considered necessary and in the proportioning and placing of the parts. Its performance is different from previous types. Its most impressive feature is its clear reproduction. This tone quality is, however, attained without the slightest sacrifice of volume or distance. On these points, the Deresnadyne is easily the equal of the best present-day receivers. It is extremely selective, tuning sharply enough to eliminate any ordinary interference, even in congested areas, and at the same time avoiding the critical sharpness which makes tuning difficult. Another feature is its freedom from undesired oscillations that produce whistling and distortion. No setting of the controls will cause the set to whistle. Tuning is still further simplified by the fact that each station will always be found at a particular setting of the dials and can be logged.

Liberty Electric Corp. Moves

The Liberty Electric Corporation moved recently to a new factory at Stamford, Conn. The factory is of the modern type, with more than 35,000 square feet of floor space to accomodate the need for increased manufacturing facilities.

The principal Liberty product is the Liberty Super-Heterodyne Kit No. R-40. Liberty intermediate wave transformers have been especially designed for perfection with super-het reception. These transformers are shielded to prevent interstage couplings and may be placed close together. Liberty units are also known for their selectivity. Three stations operating on 455, 462 and 469 meters—one of them a 1,000-watt station near by—were completely separated with Liberty units. The Liberty super-het kit comes complete.

A Liberty "Super-Het."

The Bradleyleak

The Bradleyleak, manufactured by the Allen-Bradley Company of Milwaukee, Wis., is one of the very finest type of variable grid leaks on the market. The accompanying cuts illustrate its appearance, which is very much like the familiar Bradleystat filament control. The leak is variable continuously from about one-quarter to ten megohms of resistance, and can be used with any type of tube now on the market with perfect satisfaction.

A special provision is made for the grid condenser connections, in the form of a sunken bed in the porcelain itself to accommodate the small size fixed condensers now in vogue. Screws are provided for the mounting of this condenser and short grid leads are effected by its use.

New Electrad Products

Several new and improved radio products have been placed on the market recently by Electrad, Inc., New York City.

Among them are the Electric Certified Grid Leak, which is accurately calibrated and fixed, having permanent resistance; the Electrad "Hydrogrounds," made in the temporary drive type for campers; disc permanent type, and drive type—permanent. The hydroscopic element in the Hydroground has an affinity for moisture and holds it permanently in suspense.

Other new Electrad products include lightning arresters, indoor and outdoor types; vernier dial; lamp socket antenna, Electrad Diode tube, grid leak mountings, resistance coupled amplifier kits, etc.

Reichmann Designs "Thorola"

Frank Reichmann, inventor of the thorite horn and the thorophone loud speaker, has just designed a new reproducing unit known as the Thorola, which is being manufactured by the Reichmann Company of Chicago.

"The Thorola has proven its superiority in direct competition with other amplifying and reproducing devices in the $25 class," says Mr. Reichmann. "It reproduces the highest violin notes and the lowest drum beats without distortion and with great volume."

This design uses for the first time the push and pull principle with a permanent adjustment. The horn is one piece thorite and cannot be thrown into resonance with any audible sound wave frequency.

Franklin a Freshman Stockholder

Albert W. Franklin, chief engineer of the Charles Freshman Co., manufacturers of radio apparatus, of New York City, has just been made a stockholder in the concern.

Mr. Franklin is the inventor of the Freshman Variable Grid Leak and many other popular radio items.

Marshall-stat for All Tubes

The Marshall-stat, known as the "Universal Rheostat," is a smooth accurate-adjustment rheostat. Specially treated Marshall resistance discs enable the operator to obtain any resistance down to the finest vernier adjustment for any tube or combination of tubes. Breakage impossible. Only one hole required in panel.

The New Liberty Electric Corp. Factory at Stamford, Conn.

A One-Control "Go Getter"

(Continued from page 19)

builder may have to be governed somewhat by the plate condenser used. I find that different makes of condensers of the same rated capacity actually gives varying results, calling for from 48 to 55 turns. Therefore, while I give 48 turns as standard (and this will usually be satisfactory), the builder may find that it will be best to wind on about 55 turns at first, and then remove one or two turns at a time, if necessary, until the correct number for the condenser being used is found. This is easily done without disturbing the coils or any other part of the completed set. To get correct dial reading and number of turns, select, say, a 360-meter station. When this station tunes in at approximately 30 on the dial, you have the right number of turns on your secondary, and will then be able to cover all the broadcast wave lengths.

Get Correct Spacing

COIL "A," the primary, consists of *six* turns of No. 18 DCC wire. Coil "B," the secondary, has 48 turns (see suggestion above) of No. 22 DCC. Be sure to wind the wire on both coils in the same direction, and leave the ends of the wire of sufficient length to make your connections. For winding these coils use the wooden type of spider web form, with a center approximately 2½ inches in diameter. This type has thin round spokes, and in winding you pass the wire under two and over two, and so on until required number of turns is completed.

When completed, place the centers of the two coils evenly together, which automatically gives correct spacing between coils, and securely fasten together with a small *brass* machine bolt and nut. A neat effect can be obtained by cutting off the unused ends of the spokes down to the wire on both forms. On the secondary, which is toward back of set when set up, leave *one* spoke untouched. Drill a hole of proper size in baseboard and insert this long spoke. This gives an easy and secure mounting for coils.

The set as described will cover the entire band of broadcast wave lengths with an average-size outside antenna, and under favorable local and weather conditions will give the fan all the DX records he wants.

Magnavox Produces a Tube

The engineers who developed the Magnavox line of reproducing and amplifying equipment have now produced a vacuum tube which has been placed on the market at a price of $5.00. The Magnavox tube, Type A, is a storage battery tube for use as audio frequency and radio frequency amplifier in all standard circuits. Also recommended for detector use. It is not critical of adjustment either as to plate or filament. Filament consumption is one-quarter of an ampere. Its principal feature consists in its capacity for eliminating the grid.

First of a Series of Technical Radio Articles by Armstrong Perry Begins in October RADIO AGE

Pickups by Our Readers

(*Continued from page 44*)

I think Mr. Hahn's letter is a good one, and I think he will be glad to receive RADIO AGE for one year FREE. You fellows who missed out on that contest—MISSED SOMETHING!

I feel that this fellow deserves some recognition at least, for his good work. His listening is done in static the year around, far away from broadcasting stations, and his perseverance gets him a RADIO AGE ANNUAL.

RADIO AGE,
Gentlemen:

I have been getting your magazine from newsstands ever since you published your first number. I have every issue. I would sooner lose my tuning arm than to miss a number. I think that RADIO AGE is the biggest and best publication on the market.

I am a ham (my call being 4VA) but I would rather mix in with this bunch of Pick-up Birds of RADIO AGE than anything else. I have a single tube single circuit, and a Crosley Model X. I understand that the Crosley won't count in the lists, will it? Do I have to use one tube? I want to be a Dial Twister—I think it is more fun to be a BCL with the RADIO AGE bunch than getting a glass arm from poking at a key.

Here is a list I got on my one tube set:

KDKA, KJS, WBAP, WSY, WSAI, WOC, WSB, WWI, WLW, WMC, WGY, WOO, WJAX, WTAM, WCAI, WEAH, WDAR, WEAO, WOR, WMAJ, WFI, WDAT, WOAI, PWX, 6KW, WHAS, WSAF, WWJ, KSD, CYL, WGY, WSI, KWG, 2BY, WIAS, KGO and one in Porto Rico, the call of which I missed in tuning.

Now I don't think this is so bad, because all you fellows are up there amongst all the stations; where I am, way down here, there aren't many stations. To get any, you've got to reach out a long way first.

I want to wish you all the success in the world with your "million dollar RADIO AGE."

Yours truly,
P. L. HARTNETT.
316 Henderson Ave.,
Tampa, Florida.

Yessir! That letter deserves third prize. Down in the land of everlasting Summer, you do have static. I've had some of the radio bugs tell me that if it ever gets much worse, it would be fatal to listen. HI!

Score so far, by the courtesy of the Pick-ups Station of RADIO AGE is as follows:

June Game:

	Prizes					
	1	2	3	4	5	Total
Dial Twisters....	1	1	1			3
Old Man Static...	0	0	0			0

Here's another live wire:

RADIO AGE,
Gentlemen:

I am sending the following article for the Pick-ups Page in RADIO AGE. (He's quite a poet, and doesn't know it—makes 'em rhyme any time).

I am using the following hook-up employing a UV200 tube and have an antenna 40 feet long and 25 feet high. I have received as far as 200 miles with a wire 20 feet long and 10 feet high. My list of stations is as follows:

Calls Heard

KGO, KLZ, WCAP, WRC, WDAE, WSB, KFAU, KYW, WLS, WEBH, WGN, WMAQ, WQJ, WTAS, WTAY, WCBD, WGAZ, KFLZ, WOC, WHAA, KFKB, WEAH, WEAR, WNAC, WGI, WBZ, WDAS, KOP, WCX, WWJ, WBAH, WLAG, KFMX, WCAL, WOS, WDAF, WHB, WOQ, KFEZ, KSD, WCK, WEB, KFKX, WAAW, WOAW, WCAJ, WOR, WEAM, WOB, WGR, WSAW, WCAP, WMAC, WMAK, WEAF, WHN, WTY, WJZ, WHAM, WGY, WHAZ, WBT, WABW, WLW, WSAI, WTAM, WJAX, WHK, WBAV, WEAO, WABD, KGW, KDKA, WDAR, WOO, WIP, WIF, KQV, WCAE, WIAS, WPAB, WEAN, WJAR, KFDY, WNAV, WMC, WCM, WFAA, WBAP, WEAV, WCAR, KTW, WHA, WCAY, WHAD, CFCN, CKAC, CKCK, CFCA, CKY, PWX.

This makes 94 stations in all, in 30 different states, 5 in Canada and 1 in Cuba. A good part of this list was made during June and July.

ROBERT M. HILLIS.
1462 Belle Ave.,
Lakewood, Ohio.

Some time ago, a fellow, when subscribing, wrote in and told us that our magazine was not filled with a lot of crazy DON'TS—so we are going to spoil his perfectly good opinion of RADIO AGE by printing the following:

Don't forget to point out errors in the broadcast line.

Don't forget to renew your subscription.

Don't fail to read the October issue of RADIO AGE containing the story of the August Static Puncturing Contest.

New Lego Detector

A new fixed detector, The Lego Wonder, is being put out on the market by the Lego Corporation, of 225 West 77th Street. The engineers of this concern, after months of experimentation, maintain that the Lego Detector is ideal for Reflex and Crystal sets. Among the features of the Lego Wonder are the following:

No parts to replace or wear out; the use of a *new material* that effectively eliminates distorted and interrupted reception, and substitutes clarity and increases volume; 100 per cent sensitive; no searching for sensitive spot; glass encased, is immune from sun and dust.

Attaining Hair's Breadth Selectivity with One Control

(Continued from page 13)

the tube and put the phone plug in the jack. The tube should then be illuminated and the rheostat knob turned until the brilliancy is in accordance with directions accompanying the tube. Then connect the "B" battery and a sharp click should be heard. The tube should respond with a bell-like note when it is jarred slightly. Rotate the tuning condenser dial until a bird-like whistle is picked up—signifying the "carrier wave" of a broadcasting station. Increase the absorption condenser to about 70, when the whistle should cease and voice or music be heard.

IF THE absorption condenser does not stop the oscillation, increase the coupling between the antenna coil and the secondary until the oscillation does stop. The proper degree of coupling will be such that oscillation may be started and stopped by a movement of the absorption condenser at any point on the tuning condenser's dial. In the case of a small aerial, it may not be possible to stop oscillation, and in that case, wind about five more turns on the coupling coil.

Without oscillation, and with the absorption condenser at 100, tune in a local station on the tuning condenser and adjust the rheostat for best reception, using no more brilliancy than is necessary for loud and clear signals. Then decrease the absorption condenser to a point near oscillation, when the volume will be several times as great.

It is important to note that the circuit may be quite close to the point of oscillation over a wide range on the tuning dial. In searching for DX stations, the best and most thoughtful practice is to keep the reading of the absorption condenser slightly higher than is needed to produce oscillation, and at that point there will be sufficient regeneration to bring in the stations well. The presence of a DX station, or in fact any station, is indicated by a swishing sound caused by the contacts of the high voltage generator at the station. This slight swishing noise is very sharp in tuning, and if the station is weak it is utterly impossible to get it without the use of the vernier control.

How the Scale Should Read

Users of some condensers (.0005 in size, however) may find that the condenser scale isn't just right as regards its tuning range. To be sure of getting 546 meters (KSD), the highest broadcast wave length, WIP or WOO should come in at about 84 on the tuning condenser. The accompanying "curve" will show plainly about where the various stations may come in and will also give the reader an idea of the appearance of a "DX List." Anyone can make up such a curve

CLASSIFIED ADVERTISEMENTS

Ten 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 10th of month for succeeding month's issue.

RADIO CIRCUITS

SPECIAL FOR SEPTEMBER
The Reinartz Radio Booklet, by Frank D. Pearne, fully illustrated, and RADIO AGE, for $2.50. Price of booklet alone is 50c. Send check, currency or money order to RADIO AGE, 500 N. Dearborn Street, Chicago.

RADIO EQUIPMENT.

WHOLESALE PRICES ON STANDARD RECEIVERS, 25% discount; list for stamp. LIVE PROPOSITION to DEALERS. Thomas Radio Co., 111a Dix St., Muncie, Ind.

RADIO BATTERIES

Super Radio A and B Circuit Batteries, which bring in long distance reception. Sold for cash or on payment plan. Write for prices and details. Radio Battery Corporation, 501-B Industrial Bank Bldg., Flint, Mich.

MISCELLANEOUS

158 GENUINE Foreign Stamps. Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc., only 5c. Finest approval sheets 50 to 60%. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 Years. Hussman Stamp Co., Dept. 152, St. Louis, Mo.

QUALITY PRINTING—200 bond letter heads, $1.50; 250 envelopes, $1.50; 250 cards, $1.25. Samples. Midland Press, 543 West Hickory, Kankakee, Ill.

after he has listed the tuning dial numbers for a dozen stations or so, all that is required being a sheet of plain graph paper. Divide the lower line into tens for the dial numbers and the left vertical margin into tens for wave lengths between 200 and 550 meters.

The selectivity of the circuit will be sufficient to bring in WKAQ, Porto Rico, without a whisper from WDAP (now WGN) or WJAR—both 360 meter stations also. The fact is that WKAQ is a bit higher than 360 meters. The selectivity will also be sufficient to tune out WLW of Cincinnati (309 meters) and bring in KGO, Oakland, California (312). Of course, such long distance as KGO cannot be accomplished every night or even every week, but there are dozens and dozens of stations within the reach of this Ultra-Audion receiver. All that is necessary to get them is patience with the vernier "knob," as this is the heart of the control. Keep the regeneration up near the oscillation point, but be careful not to let it "spill over" and whistle very often as this will interfere with other listeners within a quarter of a mile or so. The circuit is not nearly as serious an interferer as a regenerative circuit where the aerial circuit is tuned, but it can radiate to some extent. The beauty of the arrangement shown is that the tendency is to tune the set without allowing it to oscillate whereas in other forms of regenerative circuit users are naturally more prone to use oscillation as a means of picking up DX stations.

The little "swishing" sound mentioned is your guiding notice and you can turn the vernier from 15 to 25 past eight or ten easily receivable broadcasting stations without having to touch the absorption condenser at all.

RADIO AGE
The Magazine of the Hour

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All contributions should be addressed to R. H. Hopkins, Associate Editor, Suite 730, 500 N. Dearborn St., Chicago, Illinois. Contributions such as are not available will not be returned unless full return postage is enclosed. Remuneration for contributions printed in RADIO AGE is made upon publication, the word rate and amount being decided at the judgment of the Editor. Rates differ for various subjects. Good gloss photographic prints or other illustrations are solicited.

Other communications should be addressed to various departments as follows: Technical, Felix Anderson; Advertising, H. A. Ackerburg, advertising manager. Davidson & Hevey, Eastern representatives, 17 West 42d St., New York City; business and magazine returns, A. M. Leeb. All departments, excepting New York agency, are located at 500 N. Dearborn St., Chicago, Illinois, in care of RADIO AGE.

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The How and Why of Interference

(Continued from page 10)

Distinguishing Instruments

How often have you found that, were it not for the announcer telling you that such and such a composition was a violin solo, you would be unable to tell whether it was played by a violin or a flute? Having been told that it was a violin playing the piece, your imagination comes into play and you believe that you are listening to a violin.

The above explanation also accounts for the fact that one can separate equally distant stations operating on nearly the same wave length, within less than the space of one degree on the tuning dial, while with the case of a comparatively near station and an extremely distant one, a goodly number of harmonics have to be reckoned with in the music from the near station, which are entirely absent in the distant one.

So, don't tear your hair in exasperation when your receiver fails to obliterate that local interference sufficiently to allow you to bring in that coveted DX. No wave trap or filter is of any help in this case, for its use would also eliminate the signal itself. And, above all, do not blame the offending station.

The fault lies in the proximity of your receiver to the local station and the obvious remedy is—remove your receiver to a more advantageous location with respect to the home station or wait until local stations get "off the air" before you attempt to tune in DX.

New Ray-dio "B" Battery

The famous Lavier Formula, a new method for making batteries, has just been applied to radio batteries by the Jordan Battery Company, Ypsilanti, Michigan, manufacturers of Ray batteries.

Ths battery is called the Ray-dio "B" Storage Battery and is said to be a revolution in radio battery construction.

Among the many unusual features of this battery is the fact that no separators are used, giving free, unobstructed passage of the current, thus eliminating the hissing and sizzling that are often laid to static.

Ray-dio "B" Storage Batteries, it is said, respond instantly to atmospheric variations, and eliminate the annoyance of constant tuning.

"Babydyne" Latest in One-Tube Reception

The latest marvel in the radio world is the International Babydyne Radio Receiver, made by the A. and T. Radio Co. of Danvers, Mass. It owes its efficiency to a well-balanced hookup and to the newest radio improvements it incorporates. The Babydyne is compact, durable and easy to handle. It can be placed easily in a handbag, can be coupled to two stages of amplification and will tune in distant stations 1,500 miles away with ease. Static is reduced to a minimum.

Have You Seen the Real Blueprints in This Issue?

Corrected List of U. S., Cuban, Canadian, British and French 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
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	Rhodes Department Store	Seattle, Wash.	270
KDZI	Electric Supply Co.	Wenatchee Wash.	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 Corporation	Denver, Colo	278
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
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.	242
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	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCL	Leslie E. Rice	Los Angeles, Cal.	236
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Texas	360
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tuscon, Ariz.	368
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDR	Bullocks' Hardware & Sporting Goods (Rob. G. Bullock)	York, Nebr.	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
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	Screggin & Company Bank	Oak, Nebr.	268
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 and Concentrating Co.	Kellogg, Idaho	360
KFEZ	Asso. Engr. Societies of St. Louis	St. Louis, Mo.	248
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFP	First Bantist Church	Moberly, Mo.	266
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graceland College	Lamoni, Iowa	280
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pincus & Murphy	Alexandria, La.	275
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFID	Rose Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oregon	360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	First Methodist Church	Yakima, Wash.	242
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 (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJQ	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. D.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
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.	286
KFKZ	Nassour Bros. Radio Co.	Colorado Spring, 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
KFLO	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, New Mexico	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 Cloneh	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
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	283
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
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, Calif.	234
KFNX	Peabody Radio Service	Peabody, Kansas	240
KFNY	Montana Phonograph Co.	Helena, Montana	261
KFNZ	Royal Radio Company	Burlingame, Calif.	231
KFOC	First Christian Church	Whittier, Calif.	236
KFOD	Vern Peters	Wallace, Idaho	224
KFOJ	Moberly High School Radio Club	Moberly, Missouri	246
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOQ	Ora William Chancellor	Galveston, Texas	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOX	Board of Education, Technical High School	Omaha, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	226
KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark.	233
KFPR	Edwin J. Brown	Seattle, Wash.	224
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPH	Harold Chas. Mailander	Salt Lake City, Utah	242
KFPL	C. C. Baxter	Dublin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPN	Missouri National Guard	Jefferson City, Mo.	242
KFPO	Colorado National Guard	Denver, Colo.	231
KFPP	G. & G. Radio & Electric Shop	Olympia, Washington	236
KFPQ	Clifford M. Esler	Denison, Texas	231
KFPR	Los Angeles Co. Forestry Dept.	Los Angeles, Calif.	231
KFPS	Carter A. Ross Motor Service Co.	Casper, Wyo.	242
KFPV	Heintz & Kohlmoos, Inc.	San Francisco, Calif.	236
KFPW	St. Johns M. E. Church, S.	Carterville, Mo.	268
KFPY	Symons Investment Co.	Spokane, Wash.	283
KFPX	First Presbyterian Church	Pine Bluff, Ark.	242
KFQA	The Principia	St. Louis, Mo.	261
KFQB	The Searchlight Publishing Co.	Fort Worth, Tex.	254
KFQC	Kidd Brothers Radio Shop	Taft, Calif.	227
KFQD	Chovin Supply Co.	Anchorage, Alaska	280
KFQE	Dickenson-Henry Radio Laboratories	Colorado Springs, Colo.	224
KFQG	Southern Calif. Radio Ass'n	Los Angeles, Calif.	226
KFQH	Albert Sherman	Hillshourgh, Cal.	231
KFQI	The Thos. H. Ince Corp.	Culver City, Calif.	234
KFQJ	Harbour-Longmire Company	Oklahoma City, Okla.	236
KFQK	Democrat Leader	Fayette, Mo.	236
KFQL	Oklahoma Free State Fair Assn	Muskogee, Okla.	252
KFQR	Walter LaFayette Ellis	Oklahoma City, Okla.	250
KFQS	Dickenson-Henry Radio Laboratories	Manitou, Colo.	246
KFQT	Texas National Guard	Denison, Texas	252
KFQU	W. Riker	Holy City, Calif.	234
KFQV	Omaha Grain Exchange (Portable)	Omaha, Nebr.	231
KFQW	C. F. Knierim	North Bend, Wash.	248
KFQX	Alfred M. Hubbard	Seattle, Wash.	233
KFSG	Angelus Temple	Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	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 (Reb. 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.	283
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
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
KTW	First Presbyterian Church	Seattle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KYQ	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	Cope and Johnson Co.	Salt Lake City, Utah	268
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	360
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 of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	286
WABB	Harrisburg Sporting Goods Co.	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
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABN	Oil Radio, Inc.	LaCrosse, Wis.	244
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABT	Holiday-Hal, Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WBAA	Purdue University	W. Lafayette, Ind.	283
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360

Corrected List of Broadcasting Stations

WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	390
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
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBBH	J. Irving Bell	Port Huron, Mich.	246
WBBJ	Neal Electric Co., P. E. Neal	West Palm Beach, Fla.	258
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	283
WBBM	Frank Atlass Produce Co.	Lincoln, Ill.	225
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	244
WBBT	Lloyd Brothers	Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.	Monmouth, Ill.	224
WBBV	Johnstown Radio Co	Johnstown, Pa.	248
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Infantry, Co. "B" 118th Inf.	Charleston, S. C.	268
WBBZ	Noble B. Watson	Indianapolis, Ind.	227
WBL	T & H Radio Co.	Anthony, Kans.	254
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc.	Newark, N. J.	360
WBT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clyde R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	263
WCAK	Alfred P. Daniel	Houston, Texas	263
WCAL	St. Olaf College	Northfield, Minn.	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
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	Milwaukee Civic Broadcasting Station	Milwaukee, Wis.	226
WCAY	The Milwaukee Civic Broadcasting Assn., Inc.	Milwaukee, Wis.	266
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
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	236
WCBI	Nicoll, Duncan & Rush	Bemis, Tennessee	226
WCBJ	J. C. Maus	Jennings, Louisiana	244
WCBK	E. Richard Hall	St. Petersburg, Fla.	266
WCBL	Northern Radio Mfg. Co.	Houlton, Me.	280
WCBM	Charles Swarz	Baltimore Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBO	The Radio Shop, Inc.	Memphis, Tenn.	250
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	University of Mississinpi	near Oxford, Miss.	242
WCBR	Charles H. Meester (Portable Station)	Providence, R. I.	246
WCBT	Clark University, Collegiate Dept.	Worcester, Mass.	238
WCBU	Arnold Wireless Supply Co.	Arnold, Pa.	254
WCBV	Tullahoma Radio Club	Tullahoma, Tenn.	252
WCBW	George P. Rankin, Jr., and Maitland Soloman	Macon, Ga.	226
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WCBY	The Forks Electrical Shop	Buck Hill Falls, Pa.	268
WCBZ	Coppotelli Bros. Music House	Chicago Heights, Ill.	248
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurence Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Kilburn	New Bedford, Mass.	360
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBA	Fred Ray	Columbus, Ga.	236
WDBB	A. H. White & Co., Inc.	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBE	Gilham-Schoen Electric Co.	Atlanta, Ga.	252
WDBF	Robert G. Phillips	Youngstown, Ohio	246
WDBH	C. T. Scherer Co.	Worcester, Mass.	268
WDBI	Radio Specialty Co.	St. Petersburg, Fla.	226
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va.	229
WDBK	M. F. Broz Radio Co.	Cleveland, Ohio	248
WDBL	Wisc. Dept. of Markets	Stevens Point, Wis.	278
WDBN	Electric Light & Power Co.	Bangor, Me.	252
WDBO	Rollins College, Inc.	Winter Park, Fla.	240
WDBP	Superior State Normal School	Sunerior, Wis.	261
WDBQ	Morton Radio Supply Co.	Salem, N. J.	234
WDBR	Tremont Temple Baptist Church	Boston, Mass.	256
WDBS	S. M. K. Radio Corp.	Dayton, Ohio	283
WDBT	Taylor's Book Store	Hattlesburg, Miss.	236
WDBU	Somerset Radio Co.	Skowhegan, Maine	258
WDBV	The Quimby Enterprises, The Strand Theatre	Fort Wayne, Ind.	258
WDBW	The Radio Democrat	Columbia, Tenn.	268
WDBY	North Shore Congregational Church	Chicago, Ill.	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	Vermillon, 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	The Evening News Publishing Co.	Baltimore, Md.	261
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	360
WEB	Benwood Co.	St. Louis, Mo.	273
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind.	246
WEBE	Roy W. Waller	Cambridge, Ohio	248
WEBH	Zenith-Edgewater Beach Broadcasting Station	Chicago, Ill.	380
WEBI	Walter H. Gibbons	Salisbury, Md.	242
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEV	Hurlburt-Still Electrical Co.	Houston, Texas	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
WFAH	Electric Supply Co.	Port Arthur, Texas	236
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	360
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFBB	Eureka College	Eureka, Ill.	240
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	261
WFBH	Concourse Radio Corporation	New York, N. Y.	273
WFBW	Ainsworth-Gates Radio Co.	Cincinnati, Ohio	309
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.	252
WGAW	Ernest C. Albright	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
WGN	The Tribune Co.	Chicago, Ill.	270
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y.	319
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	484
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. As Pulis)	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
WHO	Bankers Life Company	Des Moines, Iowa	526
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Texas	360
WIAD	Howard R. Miller	Philadelphia, Pa.	254
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	246
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	283
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIAY	Woodward & Lothrop	Washington, D. C.	273
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Neb.	229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	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
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
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
WKBF	Dutee Wilcox Flint	Cransten, Rhode Island	286
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAL	Naylor Electrical Co.	Tulsa, Okla.	360
WLAP	Wm. V. Jordan	Louisville, Ky.	286
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
WLBL	Wisconsin State Dept. of Markets	Stevenspoint, Wis.	278
WLS	Sears, Roebuck and Co.	Chicago, Ill.	345
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	423
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
WMAK	Norton Laboratories	Lockport, N. Y.	273
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
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	261
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	Omaha Central High School	Omaha, Nebr.	258
WNAM	Ideal Apparatus Co.	Evansville, Ind.	360
WNAP	Wittenberg College	Springfield, Ohio	231
WNAR	First Christian Church	Butler, Mo.	231
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNYC	Dept. of Plant and Structures	New York, N. Y.	526
WOAA	Dr. Walter Hardy	Ardmore, Okla.	360
WOAC	Maus Radio Co.	Lima, Ohio	266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WOAE	Midland College	Fremont, Nebr.	280
WOAF	Tyler Commercial College	Tyler, Texas	360
WOAG	Apollo Theater (Belvedere Amusement Co.)	Belvedere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Texas	385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Lundskow, Henry P.	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
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
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak.	283
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPAM	Auerbach and Guettel	Topeka, Kan.	275
WPAP	Theodore D. Phillips	Winchester, Ky.	360
WPAR	Ward Battery and Radio Co.	Beloit, Kans.	236
WPAU	Concordia College	Moorhead, Minn.	286
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Texas	234
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258

U.S. Gives Amateurs New Wave Lengths.

WASHINGTON.—Practically 15,545 amateurs will rejoice over the news that Secretary Hoover's radio aides have opened four new short wave bands for their exclusive use.

Nine district radio supervisors have received orders from Commissioner of Navigation D. B. Carson, under whose direction the Radio Section operates, to issue general and restricted amateur radio station licenses permitting the use of the wave lengths between 75 and 80 meters; 40 and 43 meters; 20 and 22 meters; and 4 to 5 meters, for pure CW telegraphy, 24 hours a day.

COMING IN OCTOBER RADIO AGE

Just to show you RADIO AGE has a bag of surprises for its readers in the October issue, we are giving you an inkling of some of the features. Look these over:

First of a Series of Technical Hookup articles by
ARMSTRONG PERRY

TWO More Unique Hookups illustrated with Four Pages of
REAL BLUEPRINTS
By John B. Rathbun

The Latest in
SIMPLE, EFFICIENT HOOKUPS
for Beginners, by
FRANK D. PEARNE
ROSCOE BUNDY
BRAINARD FOOTE
FELIX ANDERSON
And others.

Also, all the latest studio features for some entertaining reading between work on RADIO AGE hookups—including:

The Sunny Side of Running a Broadcasting Station

Being The "Inside" of WGN.

The WINNERS of the First RADIO POPULARITY CONTEST and all about them.

Handling Temperamental Movie Stars With Radio

A Unique Dispatch from Hollywood.

Second article on "Reminiscences of an Old Operator."

And a Choice Portion of "PICKUPS BY OUR READERS"
MORE FEATURES—MORE PAGES

ON THE STANDS SEPT. 22

Corrected List of Broadcasting Stations

WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAX	Radio Equipment Company	Peoria, Ill.	248
WQJ	Calumet Baking Powder—Rainbow Gardens Station	Chicago, Ill.	448
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
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
WRBC	Imanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corporation of America	Washington, D. C.	469
WRH	Chicago Herald & Examiner	Chicago, Ill.	536
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
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	259
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAU	Camp Marienfeld	Chesham, N. H.	229
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	L & 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	Belvedere, 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
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Oak Leaves Broadcasting Station	Oak Park, Ill.	283
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	220
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
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	Centennial Methodist Church	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
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.)	Saskatoon, Saskatchewan	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec	400
CHAC	Radio Engineers	Halifax, Nova Scotia	400
CHBC	Alberton Publishing Co.	Calgary, Alberta	410
CHCB	Marconi Company	Toronto, Ont.	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
CHCM	Riley & McCormack	Calgary, Alberta	415
CHCS	The Hamilton Spectator	Hamilton, Ont.	420
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
CJCM	J. L. Phillipe	Monti Joli, Quebec	430
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebec	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CKCO	Ottawa Radio Association	Ottawa, Ont.	440
CKCX	P. Burns & Co.	Calgary, Alberta	445
CKLC	Wilkinson Electric Company	Calgary, Alberta	400
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba	450
CNRO	Canadian National Railways	Ottawa, Ont.	435

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
20K	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
2K	Alvara Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo V. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinucu	340
6KJ	Frank H. Jones	Tuinucu	275
6CX	Antonio T. Figueroa	Cienfiegos	170
6DW	Eduardo Terry	Cienfiegos	225
6BY	Jose Ganduxe	Cienfuegos	300
6AZ	Valentin Ullivarri	Cienfuegos	200
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Anduz	Stgo. de Cuba	275

British Stations

2LO	London	365	
5IT	Birmingham	475	
5WA	Cardiff	350	
6BM	Bournemouth	385	
2ZY	Manchester	375	
5NO	Newcastle	400	
5SC	Glasgow	420	
2BD	Aberdeen	495	
6SL	Sheffield (relay station)	303	

French Stations

YN	Lyon	740	
FL	Paris (Eiffel Tower)	2,600	
8AJ	Paris	1,780	
ESP	Paris	450	

Department of RADIO ENGINEERING

Radio Age Institute Tests

Look for the Approval Seal

The above approval seal will be furnished free of charge by RADIO AGE, and any article bearing this seal has been approved by the Institute Laboratory.

We will be pleased to receive and test any materials that are offered on the market and give them our endorsement where they meet all Institute tests. Send materials to RADIO AGE INSTITUTE, 504 N. Dearborn St., Chicago.

The following radio accessories have successfully passed RADIO AGE INSTITUTE tests for awards in September, 1924.

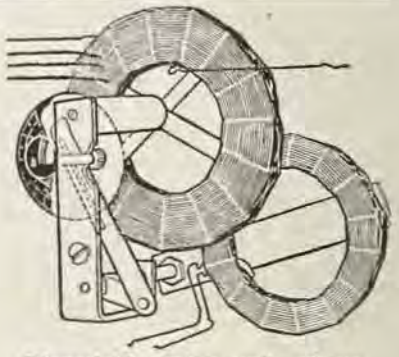
Test No. 1. All American Transformers. More than 750,000 now in use. Include audio frequency transformers, power amplifying transformer, long wave radio frequency transformers. Made by Rauland Mfg. Co., Chicago. Tested and approved by RADIO AGE Institute.

Test No. 2. Radolene, flexible radio insulator. Known as the "liquid spaghetti" and something new in the field of radio and electrical insulation. A liquid to be applied with a brush; dries at once. Has withstood voltage puncture tests under severe conditions up to 800 volts. Passed by Radio Age Institute Tests. Made by Neumade Products Corp., 249 W. Forty-seventh St., New York.

Test No. 3. Security electrical soldering iron No. 25. Made especially for radio work. Designed to reach heretofore inaccessible points of complex sets. A 3/8" rod 5" long and with 1/2" removable copper tie 2" long. Heating element of nichrome wire at tip where heat is needed. Flows solder freely. Guaranteed for one year and passed by Radio Age Institute Tests. Made by Security Electric Mfg. Co., Chicago, Ill.

Test No. 4. Allen Special Radio Soldering Paste. Manufacturers' tests with this item permanently eliminated 122 potential noise centers. Allen soldering paste is non-corrosive, acidless and protective. Guaranteed to eliminate noises, squeals and whistlings caused by loose connections. Volume increased and greater reception gained. Passed by Radio Age Institute Tests. Made by L. B. Allen Co., 4519 N. Lincoln St., Chicago.

Test No. 5. Pfanstiehl tuning unit—a variocoupler. Same advantages offered as variometer. Inductance tapped for 200 to 600 meters with ample overlap. Tested with unusually satisfactory results by Radio Age Institute. Made by Pfanstiehl Radio Co., Highland Park, Ill.



Pfanstiehl tuning unit—above.

Test No. 6. Electrad Variable Grid Leak and condenser combined. A novel instrument that is attracting wide attention of fans who want compact parts. A perfect variable pressure Grid Leak, 1/4 to 30 meghoms, together with special .00025 mfd. condenser. Practically no hysteresis losses noticed in special Radio Age Institute tests. Metal parts gold plated. Mounted on a bakelite panel. Made by Electrad, Inc., 428 Broadway, New York.

RADIO AGE INSTITUTE will not place its approval on any radio set or accessory which will not meet the most exacting tests. A gummed stamp bearing the test number will be sent to all inventors or manufacturers whose products pass Institute tests.

For further information on these articles, address RADIO AGE INSTITUTE, 504 N. Dearborn St., Chicago.

Your Radio Troubles Ended for 30 Cents in Stamps

HOW LONG have you postponed making that favorite hookup of yours because you couldn't find reliable and clear diagrams? Too many sets have been spoiled and dispositions ruined because fans have followed inaccurate diagrams. If you are constructing a receiving set and need diagrams that will produce perfect results, RADIO AGE can help you by return mail.

We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups and diagrams to be found in these issues. Select the ones you want and enclose 30 cents in stamps for each one desired.

An Index to the Best in Radio Hookups!

May, 1922
—How to make a simple Crystal Set for $6.

September, 1922
—How to make a Regenerative Set at a low cost.
—Getting good results from Armstrong Super-Regenerative Set.

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.

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?

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 announced from stations WJAZ, WOC and WOAW.
—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.

March, 1924
—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—Junior Heterodyne Transformers.
—A Tuned Radio Frequency Amplifier.
—How to make the Kopprasch Receiver.
—Adding Radio Frequency to the Variometer Set.
—Simple Reflex Set.

April, 1924
—An Efficient Super-Heterodyne (fully illustrated).
—Selecting the Right Receiver.
—A Ten-Dollar Receiver.
—Anti-Body Capacity Hookups.
—Radio Frequency Amplification.
—Reflexing the Three-Circuit Tuner.
—Index and first two instalments of Radio Age Data Sheets.

May, 1924
—Construction of a Simple Portable Set.
—An Ideal Set for the Summer Camper.
—A Traveling Man's Receiver.
—Radio Panels.
—Making a Basket-Weave Tuner.
—Third Instalment of Radio Age Data Sheets.

June, 1924
—Important Factors in the Construction of a Super-Heterodyne.
—A Universal Amplifier.
—A Sure Fire Reflex Set.
—Adding Radio and Audio to Baby Heterodyne.

July, 1924
—A Portable Tuned Impedance Reflex.
—Operating Detector Tube by Grid Bias.
—Getting the Most Out of Vacuum Tubes.
—A Three-Tube Wizard Circuit.
—Recharging Storage Batteries From a 32-Volt Lighting System.

August, 1924
—The Invisible Circuit.
—Breaking Into Radio Without a Diagram.
—The English 4-Element Tube.
—Filtered Heterodyne Audio Stages.
—An Audio Amplifier Without an "A" Battery.

RADIO AGE, Inc.

500-510 North Dearborn Street, Dept. 730, - - - - - CHICAGO, ILL.

The PAUL REVERE of TODAY

TWENTY MILES in a single night. That was the wonderful broadcasting achievement of Paul Revere as he galloped from village to village, waking the countryside with the cry "the British are coming."

Just one-hundred and fifty years ago he made that broadcasting record. Today news flashed in any part of the country is heard almost instantly, not a mere twenty miles but thousands of miles away.

In every part of the United States Crosley Radio Receivers are bringing in far distant stations clearly and distinctly. Up to the minute news, concerts, music, lectures, are yours to enjoy right in your home when and from where you choose if you own a Crosley.

Keeping always at the head of the procession in improvements and innovations, the Crosley Radio Corporation has made it possible for every one to possess the maximum efficiency in radio reception at the minimum cost.

The Crosley Trirdyn 3R3 illustrated below is, in the opinion of many experts, the best radio receiver ever offered to the public at any price. The experiments of over 200 experts have shown that in ease of tuning, sharpness of signals and nicety of calibration, the Trirdyn cannot be excelled. Local stations may be easily tuned out even if very close to you, and far distant reception almost instantly brought in.

The Trirdyn 3R3 illustrated below is a three tube set incorporating tuned radio frequency amplification, regeneration and reflex. It has been proven to give the efficiency of a four or five tube set. And yet it is priced at only $65 without batteries, tubes and headphones. The Trirdyn Special, set in a special solid mahogany cabinet which is made to house all the necessary accessories, may be had for only $75.

Before you purchase a radio receiver, listen in on a Crosley Trirdyn.

For Sale by Good Dealers Everywhere.

Crosley Trirdyn, 3R3 $65.00

Other Crosley Models

Crosley 50	A one tube Armstrong Regenerative Receiver. Price, less accessories, $14.00. A two stage amplifier, Crosley 50-A, may be added to it for only $18.00, thus making a three tube set.
Crosley 51	The two tube Armstrong Regenerative set that became the biggest selling receiver in the world in just 24 days. Price, less accessories, $18.50. By adding the Crosley 51-A, a one stage amplifier at $14.00, a three tube set may be formed.
Crosley 50-P	The Crosley 50 in neat, strong, portable quartered oak cabinet for only $18.00.
Crosley 51-P	The Crosley 51 in compact leatherette portable case, completely self containing, at $25.00.
Crosley 52	A new Armstrong Regenerative three tube set assuring loud speaker volume on distant stations under almost any conditions. Price, without accessories, $30.00.
Crosley X-J	One of the best known and most popular four tube receivers on the market. A radio frequency set at $55.00, without accessories.
Crosley X-L	A rearrangement of the four tube Crosley X-J set in a beautiful mahogany console cabinet. Price, without accessories, $120.00.

The Crosley Radio Corporation

Powel Crosley, Jr., President

963 Alfred Street, Cincinnati, Ohio

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963 Alfred St., Cincinnati, O.

Gentlemen: Please mail me free of charge your complete catalog of Crosley instruments and parts together with booklet entitled "The Simplicity of Radio"

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