April 1, 1925
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# RADIO PROGRESS



"Always Abreast of the Times"

## In This Issue



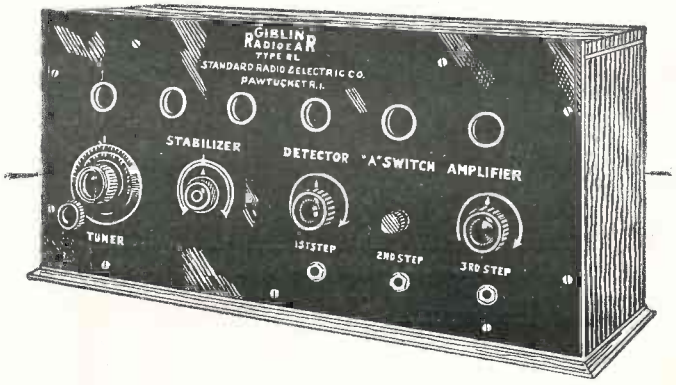
YOU WILL UNDERSTAND THIS MAGAZINE---AND WILL LIKE IT

PUBLISHED TWICE A MONTH

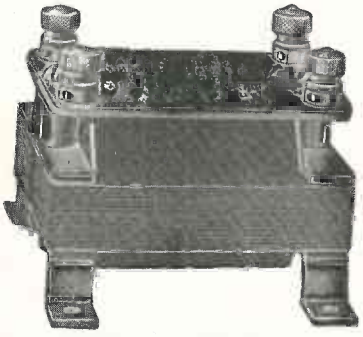
# GIBLIN
## RADIO APPARATUS

# The Giblin Broadcast Receiver

The Giblin Radio Frequency Broadcast Receiver makes it possible to obtain radio entertainment without the necessity of erecting outside antenna wires or using a troublesome ground wire. A small loop aerial placed near the set will pick up signals, which, though they have come long distances, and are weakened by hills, valleys, trees and buildings, will be clear and of great volume. Many families, living in apartments where it is undesirable or impossible to erect antenna wires, can now hear enjoyable, ever-changing programs through the day and evening by "listening-in" with a Giblin Radio Frequency Broadcast Receiver.




The set comprises two stages of radio frequency amplification, a detector and three stages of audio frequency amplification. The parts are mounted on a sub-base to which a Bakelite panel is attached. It is enclosed in a handsome solid mahogany cabinet.
Write for descriptive circulars



**The Giblin Audio-Frequency Amplifying Transformer**
**Price $4.50**


**The Giblin Radio-Frequency Amplifying Transformer**
**Price $5.00**

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## STANDARD RADIO & ELECTRIC CO.
PAWTUCKET, RHODE ISLAND

# RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 2 Number 2

*Contents for*

## *APRIL 1, 1925*



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# The April 15 Number will be Especially Good

There are so many new loud speakers on the market these days that it is hard to decide which one you prefer. With several to choose from, it takes several seconds to plug them in and out. Nickerson has described a simple way of comparing them rapidly in **"A Quick Testing Jack Hook-up."**

This is the season of the year when icebergs begin to worry the steamships. Two very powerful sending stations have been built to patrol the Atlantic traffic lanes. They are being paid for by the nations of Europe as well as America. See the article by Vance, **"Europe Pays for Floating Stations."**

So many descriptions nowadays call for elaborate and expensive equipment. It is a pleasure to run across an article explaining how to build **"A Low Cost Receiver-Transmitter,"** by West, which can be built at small outlay.

The Department of Commerce at Washington has given us a write-up, **"What the Old World Thinks of Radio."** This tells what progress is being made abroad and why our country is leading the world.

Resonance is what you hear a great deal about these days. Perhaps you understand a great deal about it, but do you realize you are carrying a case of it about in your pocket this very minute? This is explained by Taylor in the **"Inside Story of Resonance."**

A superheterodyne is a very powerful set. It is often a powerful radiator as well. In a construction article, Wilder tells about **"A Non-Radiating Superhet."**

Do you know that you have a chance to become the author of a prize song? Radio has developed such an opportunity for you next month? The winner will be given a share of the royalties. The details are explained in **"Prize Radio Song of America,"** by Saudek.

# RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. 2, No. 2 APRIL 1, 1925 15c PER COPY, $3.00 PER YEAR


# Tune Your Set Like a Piano

## *Coils and Condensers Are Explained In Everyday Terms*


By DR. FREDERICK W. GROVER, Department of Electrical Engineering, Union College, Schenectady


WHEN your visitors remark that the piano sounds flat and off the key you naturally decide to have it tuned. This matter of tuning a piano is pretty generally understood, so that when you see the workman tightening up a string you know instinctively that it will vibrate at a faster rate of speed and so will give a higher note. When it comes to radio it is not so easy to see offhand what the various dials do to affect the vibrations.

Every radio fan knows in a general way what is meant by "tuning-in." You turn a dial on the receiving set until the sound is loudest. Without a tuner only the local stations come in, and it is impossible to separate one from another. We tune our sets as a matter of course and naturally give little thought to the actual meaning of what may perhaps be regarded as the most basic of radio adjustments.

**Like An Every-day Affair**

I am asking your consideration of certain analogies which may be pointed out between the actions in a radio circuit and those in the more familiar cases of sounding or vibrating bodies. Analogies are helpful because they explain unfamiliar things by pointing their likeness to every day affairs. However, when we liken an electric oscillation of current to the vibration of a tuning fork, or voltage to an ordinary force, you must remember that they are not exactly the same. We have to use our imaginations, subject to common sense, and make some allowance for points of difference.

A violin or mandolin is tuned by carefully tightening a string until, when it is sounded, it gives off the desired tone, say the note G.

**A Silver G String**

Fig. 1 shows a picture of a violin. The four strings are tuned to G, D, A, and E. The G string is the one at the

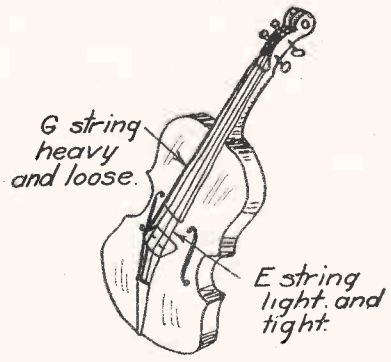



Fig. 1 Illustrates Principle of Radio Tuning

left and is made of heavy material, the string often being wound with a silver wire, merely to add weight. The E string, which is the highest, is as light as possible. This, of course, allows it to vibrate faster or with a higher tone. Of course, this material cannot be changed by the musician when he wants to play a piece of music, so he gets the exact pitch he wants, to correspond with the piano, by changing the tension, or pull, on the string. If he turns one of the keys so that it rolls up the string and makes it tighter, then it raises the pitch. If it is already too high he will unwind a little and so drop the tone. The lowest note is played by a string which is comparatively loose, while the E string is so tight that it often breaks even while music is being played.

It makes no difference how the vibration is started. The pitch of the sound is the same whether the string is struck, as in a piano, plucked, like a banjo, or bowed as a violin. As long as the vibration has the same speed in number of cycles per second, then the note will be the same. The time taken for the string to go through one complete oscillation, that is, go from the extreme left to the extreme right and back again, is called the "period" of the oscillation. We say that the string vibrates in its *natural* period because we let it go at the speed it wants to. If instead we shook it back and forth at some other speed, then the time would

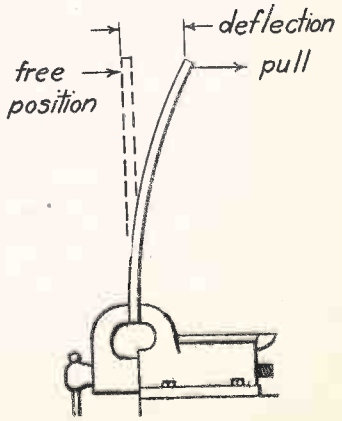



Fig. 2. Note is Same Even with Big Deflection

still be called its period, but it would not be the natural one.

### What Wave Length Has C?

The same is true of any sounding body. Sound waves go off from it through the air and the pitch of the sound determines the wave length, that is, the distance by which one pulse travels ahead of the next. A fast vibration means that the waves are piled up thick together and so the distance between them or wave length is short, while a slow ocillation gives plenty of room from one to the next, with a consequent long wave length. Of course, it is much easier to think of vibration speeds in cycles or thousands of cycles (kc.) per second rather than distance between waves. You probably know middle C is caused by a vibration of 256 per second, but have you any idea what wave length this represents in air?

Likewise a radio circuit may be set vibrating by various means, but it also gives off electrical waves whose length has nothing to do with the method by which the oscillation was produced. The transmitting circuit has a natural period just as in the case of a string. Whereas the pitch of the sound given by the string (so many vibrations per second) depends upon its weight and tension, so the pitch or frequency of the electrical wave (so many kilocycles per second) depends upon the amount of inductance in its coil and the capacity of its condenser.

### Picking One Out of 88

The analogy between a musical instrument and an oscillating hook-up used for broadcasting, may be extended to the case of a *receiving* circuit also. If you sing just one note loudly into the top of a piano, you will observe that one of the strings will play faintly the same note after you. Investigation shows that if that one single string is struck in the usual way, it will give out this note and no other. Of the 88 strings in the piano, all are silent, except that particular one whose natural period or time of vibration agrees with that of the sound vibrations sung. Shout another note, and a different string responds, while the previous one joins the throng of its silent brothers. Of course, the sound waves of your voice have beat upon all the strings of the piano, but are powerless to stir up a real vibration except in the case of the one string which is tuned to the waves you sing.

In the same way, the electrical waves passing out from a broadcasting station produce no appreciable oscillations in a receiving circuit, unless its natural period is the same as that of the incoming electrical waves. When we tune a circuit to these waves, it is just the same as though in the piano experiment we had worked upon a single string, tightening or loosening it, until it responded with greatest loudness to the note sung against it.

### The Vise Experiment

To get a clear idea of the actions involved in the vibrations of a sounding body, let us consider the simple case of

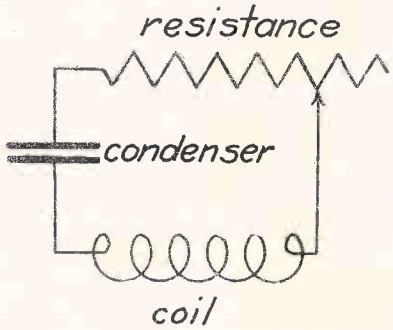



Fig. 3. An Oscillating Circuit Controlled by Resistance

a thin strip of steel, say a foot long, clamped at one end in a vise (Fig. 2.) If the free end is pulled aside, we feel an elastic force resisting us, and this gets greater, the farther we pull it from the original position. If now, we let the spring go, the elastic force causes it to return toward the free position, and we observe that it will vibrate for a short time, sending out pulses or waves into the air. If we try a much shorter and stiffer spring, suitable for a harmonica, the vibrations are more rapid and we hear a musical sound.

As with the string experiment, we find that the lighter it is the faster the speed. Also the stiffer (tighter in a string) the higher the speed. Another point to notice is that the timing of the vibration is not affected by the amount you pull it out at the start. If you have a first deflection of 1/8th of an inch the note will be, let us say C, as heard on a piano. Again try pulling it out 1/4 or 3/8 of an inch and letting it go. In any case the note will still be C. And in the same way as the vibrations get less and less in distance (amplitude) the pitch of the tone does not fall off, but keeps steady. This shows that it goes at the rate of 256 vibrations a second all the time. When it has to travel farther as at the start, the speed through the air is correspondingly faster. It is like two men who want to catch the 5:15 express. One lives nearby and walks leisurely. The other has to travel quite a distance, and so takes a taxi, but they both get there at the same time.

### Why the Spring Vibrates

An explanation of this vibration is as follows: the spring is bent aside at the start, and when released, the elastic force causes it to move. As it returns, the elastic force diminishes, and by the time the spring has reached the original undisturbed or free position, has become zero. However, it keeps on moving, because of its momentum, and as it passes the free position, it begins to bend in a direction opposite to the first, thus setting up an elastic force which works against its own motion, slowing it down more and more until it comes to rest. The spring then moves back, and this sequence of events is repeated. If there were no friction, the spring would make equal excursions or deflections on both sides of the undisturbed position, and once started, the vibrations would never cease. Of course, this is never the case; the vibrations die down gradually, and the spring comes to rest, since, with each excursion, the effect of friction is to reduce the distance travelled from the central position.

It is well to explain that there are two kinds of friction, which damp down the motion. The first is the internal effect which is caused by the action of one little particle of steel sliding over another part. This also includes any friction, which the sides of the spring may have against the vise. Of course, this has no useful effect at all, and does not give out any tone. The other style is that which causes the air to be set in motion, and which is revealed to our ears as a musical tone. This is not true friction in the ordinary sense of the word, but may be considered so far as the damping or reducing of the motion is concerned.

### When Lobster Suppers Stop

The original work, done on the spring

in bending it aside, is the sole source of energy it possesses, and when this has been dissipated in overcoming the frictional resistances, the motion of the spring is at an end, just as truly as the lobster suppers of a spendthrift must cease when he has squandered all his capital.

To connect this discussion with the oscillating radio circuit, we have only to substitute the idea of *current* for the speed of the spring; for elastic force, the *voltage* between the plates of the condenser; and for the inertia of the spring the inductance of the coil. Referring to Fig. 3 the condenser represents the stiffness of the spring, the inductance its weight or inertia and the resistance is the friction both internal and external.

When an electric charge is given to a condenser, it is strained by an elastic or electromotive force, and this force between its plates will start a current flowing when the circuit is closed. The electromotive force or voltage diminishes rapidly until it is zero, but the coil has inductance, and the inertia thus given to the current makes it impossible for it to stop flowing at the instant when the electromotive force has become zero. As it continues to flow, this charges up the condenser with a voltage in the direction opposite to the original, that is, so as to oppose the flow of electricity, and thus reduces the current finally to zero.

### Why It Stops Working

The current then starts in the opposite direction and the action is repeated. If it were not for the resistance of the circuit, these oscillations would continue forever, unabated in intensity. The energy originally given the circuit in the charge of the condenser is, however, gradually expended in heating the wire and the oscillations of current grow progressively smaller until they cease. In Fig. 3 the resistance is shown adjustable. If this is reduced in value, you will easily see that the oscillations once started will continue for a longer time. Of course, such a resistance, although shown in a lump in the diagram, really is distributed throughout the wire, of which the coil is wound. There is also a small amount of resistance in the condenser itself. Naturally, these resistances can not be reduced to zero, and so it is impossible to make a circuit, which will oscillate very long without a constant supply of new energy.

To maintain continuous vibrations of the spring and continuous oscillations of current in the radio circuit, both require a steady source of external power to make up for what is lost. In the violin this power comes from the player's arm as he pushes the bow back and forth. In the piano there is no such source and so the piano note dies down to nothing in a second or two unless the key is struck again. In the radio set the power to maintain an oscillation comes from the "B" battery.

### Rocking a Big Bridge

It still remains to be explained why exact tuning so marvellously increases the effectiveness of a weak train of waves from a distant station in setting up vibrations in a radio circuit. Perhaps one of the most impressive illustrations bearing on this is furnished by a suspension bridge, (Fig. 4.) As some of you perhaps know from personal experience, it is possible by teetering up and down on a short suspension bridge to set up in it vibrations of really astonishing violence.

Of course, you must time your impulses just right, so that they will continue to increase the swaying rather than to reduce it. You can find the proper timing by observing the way the bridge is acting. When it gets to the top of its swing, then is the time to push it down again.

### It May Even be Wrecked

Random impulses given to it accomplish nothing. The same is true if the impulses are regularly repeated, but are too slow or too fast. They must be timed to just the right frequency. Every impulse must aid the natural vibration of the bridge and none oppose it. Under such circumstances a company of soldiers keeping in step and treading upon the bridge with just the right frequency, has been known actually to break it down.

This is rather rough on the bridge, not to mention the soldiers. But in the case of a tuned electrical circuit, you naturally want the greatest amount of pressure developed in the system, since that is what causes the music in your phones. It is manifest that in such a case the bridge is not broken by any single impulse. The applied force is altogether too small. Vastly greater ones are involved in the bending or breaking of the bridge. When it is vibrating, the elastic forces set up when it is bent put its mass into motion, and when it moves the weight gives it such momentum that the motion bends it.

When the bridge comes to rest for an instant at either the top or bottom of its swing, there is naturally at that instant no energy of *motion* at all, since we have picked out a time when it is not moving. The energy then is all that of bending. This is often called "potential energy." An instant later it has moved back again to the free position and just at the moment when it passes through the spot of zero deflection, it will not be bent at

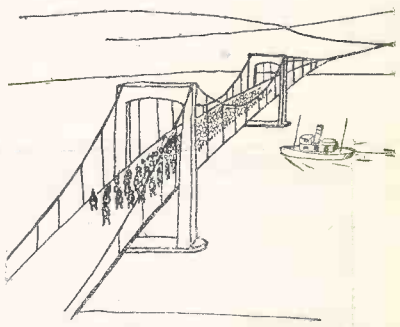


Fig. 4. An Extreme Case of Tuning

all, and so will have no potential energy of bending. At that instant, however, it will be moving fastest, and so will have the greatest energy of motion. In this way there is a constant shift from one form to the other and back again.

### It Breaks Itself

The effect of the impulses is cumulative. Each increases the energy of vibration by a little, until finally the vibration is large enough to set up frictional resistances which use up all the further impulses. Thus the small impulses give rise to enormous forces, but these are actually supplied mostly by the elasticity and mass of the bridge. The bridge in a sense breaks itself.

In a similar manner the weak waves coming to a receiving antenna set up in the circuit only a tiny electromotive force, far too small in fact to pass the necessary current for an audible signal through either condenser or coil alone. If, however, the circuit is properly tuned, each wave adds to the charge on the condenser, and thus to the current which

flows in the circuit. At length it becomes so great as to require all the weak electromotive force induced in the circuit by the waves, in order to force the current through the resistance. At this point the current stops increasing. The circuit then oscillates steadily, but with vastly greater electromotive forces upon the coil and the condenser than the tiny voltage directly induced by the waves.

It is these relatively large electromotive forces which are analogous to the large bending force and those associated with the momentum of the bridge vibration. It is these big forces which overcome the large oppositions of condenser and coil to the passage of current.

It follows from these considerations that, if we could only make the resistance of our receiving circuits small enough, the waves however weak, would produce appreciable voltages upon the detector. On the other hand, the effect of waves for which the receiving circuit is not in tune is alternately to aid and to oppose the natural oscillations of the receiving circuit, with the net result that no noticeable current flows, and the detector is practically unaffected.

### Two Ways to Tune

You may tune your aerial to the frequency of the sending wave, either by varying the capacity (elasticity of the circuit), by adjusting the dial of the variable condenser, or else by varying the inductance, (electrical weight of the circuits) by turning your variometer. As far as the tuning is concerned it makes no difference which, just as it is possible for a violinist to change the notes given out by a string, either by changing its tension, as in tuning his instrument, or by altering the length of the vibrating portion with his finger as in playing.

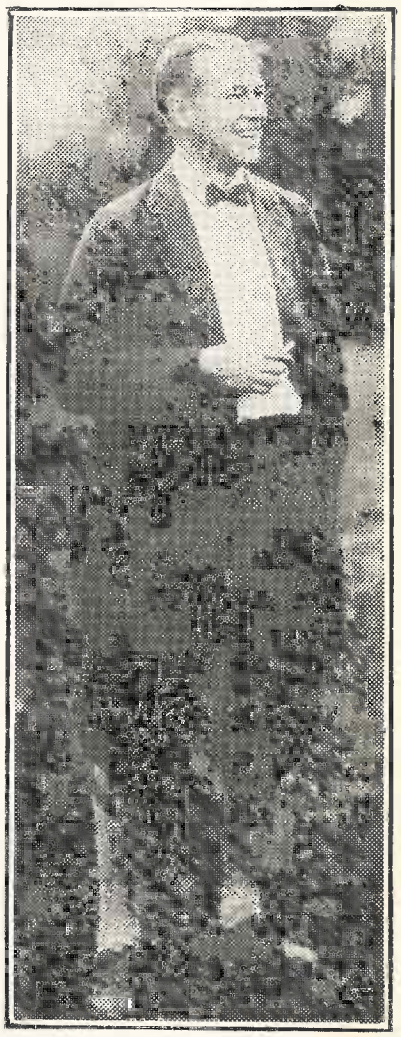
The increase of electromotive force obtained by tuning is, however, greater (with a given current flowing) the larger the inductance and the smaller the capacity, just as the forces involved in the vibration of the bridge are greater, the larger the mass and the smaller the yielding of the bridge to a given force. For each frequency, however, the product of inductance and capacity must

Continued on Page 27

Frederick W. Wile

### CHECK UP THE POLITICIANS

If you are interested in politics tune in some Tuesday night, with WJY, New York, or WRC of Washington. These two stations are broadcasting a series of radio talks on, "The Political Situation in Washington To-night." They are being given by the special Washington correspondent and political observer, Frederick W. Wile. He enjoys the reputation of being the shrewdest political observer in the capital and has broad cast his opinions on what Congress should and should not do for the past eleven months. He will be worth listening to.



A Victor Star

### ATHLETE AND SINGER

One of the most famous of American singers is Reinald Werrenrath. He ought to be good, for he is a descendant of five generations of singers. At New York University he was quite athletic, and made the 'Varsity teams. His recent performance in the last Victor presentation was so good, that we are all hoping to hear him again as soon as possible.

# A Dry Cell That Can Be Recharged

## *How to Reduce the Cost of Running WD and 199 Tubes*

By VANCE

WHY do you use dry cell tubes in a radio set? There are usually two reasons. One is, the fuss and bother of a big acid filled storage battery is avoided and the other that the cost is very much less. A good dry cell is priced at 40c, while you must pay $15.00 or $18.00 to get a first class storage acid battery.

Of course, the chief objection to a dry cell for operating your radio set is that every couple of weeks or so they have to be thrown away and new ones bought. This is not a very expensive process to be sure, but if you have some way of recharging them from your electric light circuit the expense would be very much less. You see an ordinary cell has about 18 ampere hours in it at an average pressure of about 1.3 volts. Multiplying 18 by 1.3 gives a little less than 25 watt hours. As there are one thousand watts to a killowatt this is equal to 25/1000 or 1/40th of a kilowatt hour.

### Sixteen Dollars or Ten Cents

That means that it takes forty cells to give an output of one kilowatt hour. At 40c a piece this would cost $16.00. But if you buy your energy from the local light company you probably do not pay more than 10c for this amount of power. In many of the larger cities the rate is only six or seven cents. So if you prefer to pay 10c instead of $16.00 you are the kind of person who would be interested in charging up these dry cells after they are exhausted.

Of course, you can't expect 100 per cent efficiency in charging any kind of battery, either of the dry or storage variety. Besides that the charger, or rectifier, is not absolutely perfect, either. The losses in the charger plus those in the battery will amount to about 50 per cent. That means that half your energy is thrown away. But even at that, assuming that half the power is wasted you are paying only 15 or 20 cents per unit used as against about $16.00 when supplied by ordinary cells.

### How Much Do They Weigh?

Another point of interest is the weight of various styles. Of course, the storage battery is always very heavy as it uses lead for the plates. This material is chosen because it is the only one which will work in sulphuric acid without being eaten away. In the ordinary form of small storage batteries the output is about 9 watt hours per pound. That means that a 1 pound battery of 6 volts would give the equivalent of an ampere for 1½ hours (6x1½ equals 9.) Edison's alkaline type is much lighter and has an output of 16 watt hours per pound in the large sizes. This drops off, however, to about 8 watt hours per pound in the small ones. This new rechargable battery, the Re-Vi-Vo, will deliver 11 watt hours per pound in the ordinary "B" battery sizes.

The chemical action of this cell is somewhat different from that of an acid battery. In the latter the plates consist of an oxide of lead for the positive and a mass of porous spongy lead for the negative. The sulphuric acid, which is the liquid or electrolyte does not attack the plate unless a circuit is made out side the cells through which current can run. When the current flows because your filament switch is closed, then the acid attacks both positive and negative plates, and changes them both to sulphate of lead. The sulphate part comes from the sulphuric acid.

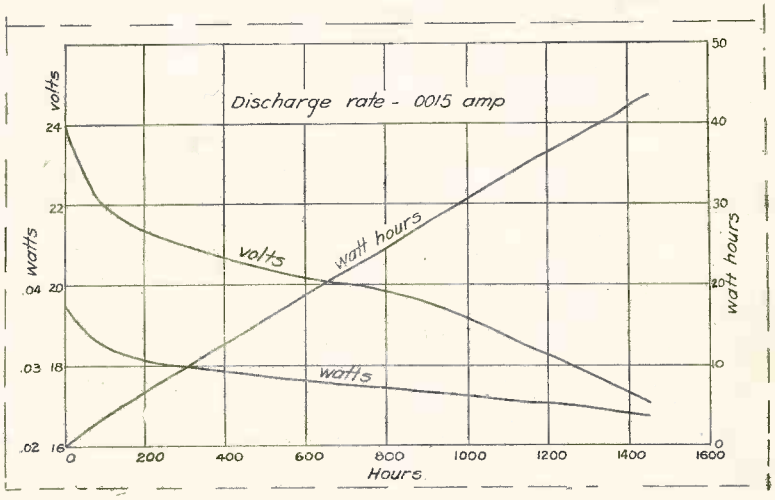



Fig. 1. Curves of 22½ Volt "B" Battery Running a One-Tube Set

### Platting the Zinc

The Re-Vi-Vo cell works on a different principle. When the outside circuit is completed through the filaments of the vacuum tubes, the current flows as before. In this case, however, the zinc which forms the negative pole, or electrode, is dissolved by the action of the electrolyte and goes into solution as zinc chloride. When the plate is charged again this action is reversed and the zinc is plated back on the electrode so that it is just as it was at the start. This action can be repeated indefinitely.

At the positive pole the action is somewhat different. The plus electrode is a carbon rod like that of an ordinary dry cell. This is surrounded by what is known as a depolarizer. This consists of an oxide of manganese. When the battery is being charged and discharged it gives off hydrogen gas at this pole, and if it were not for the chemical the layer of gas, which is an insulator, would prevent the flow of current. This oxide, however, absorbs hydrogen very easily, and so gets rid of its bad effect.

### Reversing the Cell

When the current is reversed through the battery on charge, the action is aided by the addition of other chemicals, which have been recently found to increase the efficiency a great deal. Because of them

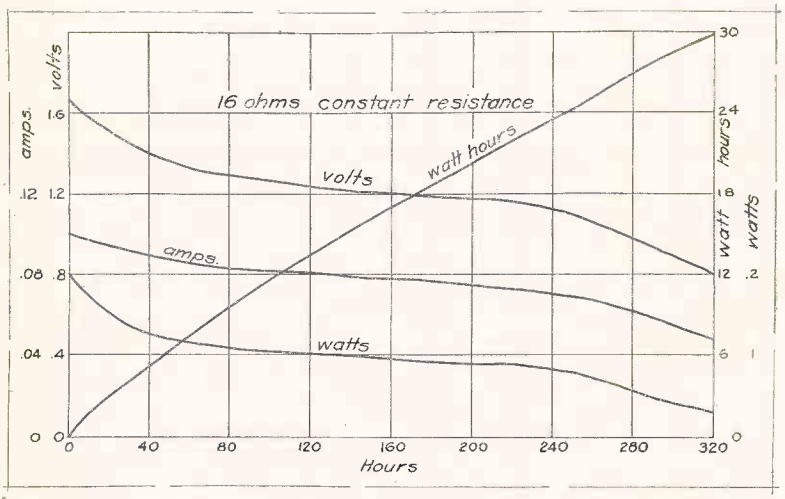



Fig. 2. The "A" Battery Gives Results Like This on Continuous Discharge

it is possible to charge and discharge the cell some six or eight times. Of course, the life of the cell can be extended considerably beyond this point, but if used further the amount of charge taken by the battery becomes less and so a point is reached where it hardly pays to use it further.

When it reaches such a state it is thrown away and a new one bought. However you will realize that it has replaced half a dozen ordinary dry cells in its life, and so has made the cost of batteries a small fraction of what it otherwise would have been.

### What the Curves Show

It is interesting to see how the pressure and current varies as such a battery is discharged. Fig. 1 shows the output curves for a 22-volt "B" battery. The horizontal distances represent the hours of burning the vacuum tubes. Distances up and down mean the amounts of volts, watts, and watt hours. The watts, you remember, are equal to the product of the volts, multiplied by the amperes, while the watt hours represent the amount of energy in watts multiplied by the number of hours which the battery has been used.

Volts and watts both fall off with the time as is the case with all batteries. The watt hours continue to increase since one watt flowing for two hours gives you twice as much total output as was had at the end of one hour. Thus on the curve you will see that at the end of 400 hours' burning, which would represent four months' use of an ordinary single tube set, the watt hours have reached thirteen. At 800 hours (twice as long) they now equal 25. This is not quite double, since the volts and watts have fallen off somewhat, and so the battery is not delivering power quite as fast as it was at the end of 400 hours.

A constant current has been used on this test, equal to .0015 amperes which is the same thing as 1½ milliamperes. This amount of current is what would be used in an average detector tube. Many detectors will use considerably less than this. The "B" battery pressure on such a tube is usually allowed to drop until it reaches two-thirds of its value when new. This would be 15 volts. However, the test in this case was stopped when the pressure was still up to 17 volts. If it had been run down to 15, the battery would have lasted for over 1,600 hours instead of only 1,450. This is a very good performance as it would be the equivalent of about 14 months' use.

### Life of "A" Battery Charge

Fig. 2 indicates what we can expect from an "A" battery. For testing this style it is usual to connect a fixed resistance across the terminals and read the values of volts, watts and watt hours as before. But in this case since the voltage drops off while the resistance is constant, the current will also fall in the same proportion that the pressure does. This same action would have occured in Fig. 1 if the resistance had been held at a single value right through the test. It was reduced, however, slightly from time to time so that the current would be maintained at a fixed value.

For this reason a curve of current is shown in Fig. 2. This varies from 1/10 ampere at the start down to 1/20 at the time the test was discontinued. As you recall the UV-199 tube takes .06 or 1/16 ampere to operate. This cell would have run such a tube for 280 hours. As a matter of fact, it would really operate longer than this because at the start the rheostat in series would have cut in enough resistance to reduce

Fig. 3. Everything Needed to Recharge "Bs"

the current to .06 instead of .10 and this extra amount of amperage would be available later on.

When used to operate a WD-11 or WD-12 tube the current would be adjusted to .25 or ¼ ampere. This would naturally use the cell up considerably faster. Its life in such a case would probably be somewhere around 60 or 70 hours. When it was reduced to a point where it could no longer furnish ¼

Continued on Page 16

# Hooking Up the Nameless Set

## *This Circuit Takes Advantage of Your Low Loss Parts*

By HARRY J. MARX

THE fight is on. One side preaches "low loss" morning, noon and night. The other camp cries, "Bunk, don't be fooled." Both sides are right to a certain extent.

In many sets there is no very great advantage in using low loss parts. If you should start trying to cut off the corners and substitute curves on the body of a truck which never runs more than fifteen miles an hour with the idea of following the air stream lines, you would get a low loss body. This would be foolish because no use of it could be made with that particular machine. The losses are so large in the mechanism itself that the air friction does not make any difference.

### Racing at 120 Miles an Hour

On the other hand when you discuss the racing car, which will go over 100 miles an hour, the air losses are very important. You would certainly be an "also ran" unless you paid very careful attention to this point. The other losses are kept down to such a low value that in comparison the windage is one of the main things.

If you have an ordinary garden variety of single circuit squealer and you substituted low loss parts, you will find it does as much good as stream-lining the truck. Of course, we would admit that you got ½ of 1% more loudness but that makes no difference. If, however, you have a highly developed set, which is as good in its design and manufacture as a racing car, then you will find by experiment that low loss parts will make a big difference. And furthermore, their use will increase your loudness and at the same time improve the selectivity of the radio. This is just the opposite from most possible changes in your set as in general when you increase the loudness you *decrease* the selectivity. Three years ago electrical efficiency was almost an unknown factor in most radio apparatus. At present the demand for efficiency of design covers almost all apparatus that is sold.

We have even seen a rheostat with the description "low loss." This is funny because the entire idea of a rheostat is to make a loss—that's all it's for. If you have a six-volt storage battery working a five-volt tube, you must throw away one volt in losses. It is just as if a manufacturer should hear so much about anti-friction bearings that he started advertising the braking lining which he made as "anti-friction brakes." Of course, a brake which had no friction or losses in it would not stop your car at all, and the more powerful the friction the more powerful the brake. So when you see a "low loss rheostat" you will know that the manufacturer is either ignorant or deceitful.

### Why They Failed

Many will recall that the first neutrodyne kits placed on the market were usually a failure in a completed set due to lack of finished design, and the quality of material used. No tuned radio frequency circuit can give better satisfaction than the quality of the apparatus used will permit. This does not mean just the variable condensers, but the air-core transformers as well. The quicker low loss design is applied to all inductance apparatus, sooner will more reliable performance be possible.

An increased knowledge of radio leads naturally to a desire to use better parts. To secure such parts is not always easy. It requires more than mere willingness to pay the price. A product of merit must first be found. Mere desire on the part of a manufacturer will not produce it. He must have at his command not only electrical and mechanical knowledge, but also experience, ability in design, and a willingness to pay for proper materials and workmanship, and last but not least an organization that will keep production up to the standard.

### Tuning in Molasses

The ideal circuit for tuned radio frequency amplification is one in which the resistance of all units is reduced to as low a value as possible. This of course means low loss inductances and variable condensers in particular. Since the losses are so low it will be easy to set the circuits into oscillation, for you will remember that it is resistance only which prevents a circuit from oscillating. In Fig. 1, the pendulum bob will swing freely back and forth as long as the tank is filled with air. By pouring in water enough resistance is inserted so that it will hardly swing any more. If molasses is substituted for water, the resistance is so high that the pendulum cannot oscillate at all, but when pushed to one side will slowly sink back again

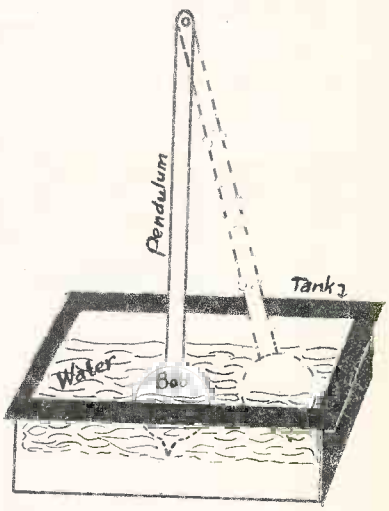



**Fig. 1 Shows Why New Principle is Needed**

to the center position without overshooting the mark.

In the same way a circuit with ordinary losses will not oscillate very easily. Of course, if the resistance were particularly high, then there would be *no* vibration any more than the pendulum dipping in molasses. In this set we must have some method of control to prevent such undesirable oscillating of the current. This control must be of such a type as to fulfill two conditions. First, it must not cause a sacrifice of efficiency in the circuit; this eliminates any plans for introducing resistances in the tuned circuits. Second, it must be effective over the entire normal operating wave frequency range.

antenna binding post at the upper left hand end, notice that the circuit goes through the primary or radio frequency transformer BT-3 on to ground. This ground connection is made after passing binding post B— and A+, but these, of course, do not interfere with the aerial waves reaching ground. This primary is the upper cord of the special coupler. The secondary of this coupler is tuned by condenser C-3 and its vibrations are impressed on the grid of tube VT-1, which is the first radio amplifier. The other end of the stator carries the oscillations through the 4½ volt tap of the "C" battery (shown a little to the right of the center of the cut) back through rheostat R-1 to the filament.

maximum position. In that event, by reducing the coupling, you can decrease the loudness to a point where it is comfortable without causing a change of tone as would occur if you reduced the voltage on the filament by adjusting the rheostat.

The output from VT-1 runs through the primary of radio transformer BT-2 up to the B+ terminal of the "B" battery. The secondary of this transformer is tuned by condenser C-2 which gives the input to the grid of the second step, VT-2, in the same way as was described for VT-1.

The output from BT-2 passes through the primary of radio transformer, BT-1, to the "B+" as before. The output

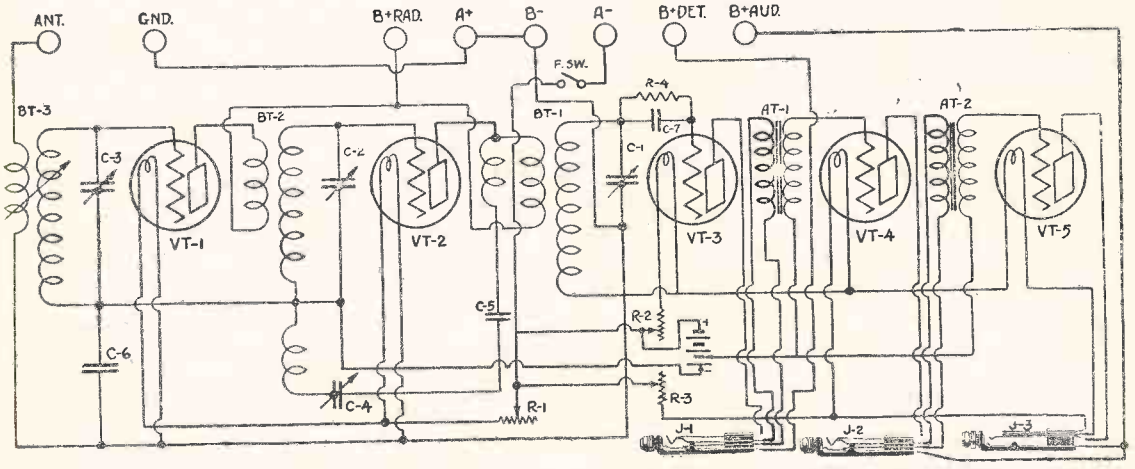



Fig. 2. This Shows Complete Hook-up of Nameless. BT-1 and BT-2 Are Special R. F. Transformers

### You Can Show Your Skill

It is well known that the point of greatest efficiency is just below oscillation, and since this point varies at different kilocycles the only way to meet the situation is by a variable method of control. Maximum efficiency in oscillation control over all frequencies combined with low loss transformers and condensers are the outstanding features of this "Nameless" Circuit. Their value demonstrated when attempting to go through heavy locals for distance, or building up weak signals from low or far distant stations. It is that the "Nameless" operator is ded the opportunity of showing his in the fine tuning that is denied n other sets.

now to Fig. 2. Starting at the

### Adjusting the Selectivity

This transformer BT-3 is adjustable for coupling by shifting the cord. When the two are close in line the coupling is tightest, and this gives the maximum power and loudness but the least selectivity. For ordinary work the coil may be left in this position. However, if you have trouble getting through some local station or are bothered by static or code interference, then by moving the upper coil so that it becomes more nearly at right angles, you will increase the selectivity and cut out interference. The only disadvantage is that at the same time you reduce the volume to some extent. If a local is on which you want to hear, it may come through so loud as to cause distortion of the tubes, provided this coupler is in

from the secondary of this transformer (tuned by Condenser C-1) runs to the detector grid through leak R-4 and grid condenser C-7 in the usual way. Two steps of audio frequency amplification follow the detector through jacks 1 and 2, just like any standard set.

### Getting Selectivity

The grids of the two first tubes, VT-1 and VT-2, are biased, as well as the two audio stages, thus decidedly reducing the plate current drain on the "B" batteries. A soft tube, UV-200 or C-300, is recommended for use as detector in socket VT-3. Three jacks permit plugging the receivers or loud speaker in at any audio stage.

As shown in Fig. 2 the last jack, J-3, is of the filament control type and operates the second step of audio, VT-5.

This tube is the only one which depends on this jack for control. Of course, the filament switch, F. SW., (in top center of cut) must be closed in order to get "A" battery voltage on any of the filaments.

There are three rheostats to operate the set. R-1 handles the two radio frequency tubes, R-2 takes care of the detector, and R-3 of the two audio tubes.

### Controlling the Oscillations

Notice that the transformer BT-1 has a third winding which is used for a reversed or opposition feedback to the grid circuit of the preceding tube. Likewise the transformer BT-2 has an additional coil (shown just below it) used for coupling this feedback to the grid circuit.

The idea is this. The powerful oscillations coming from the output circuit or plate, of VT-2 induce a voltage in the transformer winding of BT-1, shown at the left of the three coils. This is connected in series with the lowest coil of transformer BT-2 which again induces a voltage in the secondary which feeds the grid of this same tube. Thus we have a feedback from the plate to the grid very similar to an ordinary Armstrong tickler coil.

There are three differences, however. In the first place the leads are reversed in such a way that instead of building up an oscillation, as is usually done in a single tube squealer set, on the contrary, the feedback opposes the input and so reduces any vibrations which tend to occur. In the second place, instead of using a single tickler coil to transfer the energy from plate back to grid, two coils in series are employed. And thirdly, instead of using a variable coil to control the amount of tickler action the coils are fixed and two condensers are inserted in series between the two coils.

One of these condensers is C-5, which has a fixed value of .001 mfd. (microfarad) C-4 is in series with it and has an adjustable value up to a maximum of .00004 mfd. As a matter of fact, C-5 may be omitted without causing much change in the operation, as its only effect is to reduce the capacity slightly from that set by the adjustable condenser, C-4. This variable condenser controls the oscillation for all wavelengths from the panel. Thus the control of feedback at any frequency is accomplished without the introduction of any losses into the circuit.

### Laying Out the Panel

The layout of the front panel is shown in Fig. 3. The markings for the location of the various units to be mounted on this panel correspond to those given in the hook-up Fig. 2. The spacing shown for the variable condensers is somewhat important. If this is changed very much there is a chance of having a capacity action from one stage to another. This action comes from the fact that the stator of one condenser acts like a plate of a fixed condenser while the stator of the other behaves like the other plate, Thus the two stators will take a charge from one to the other and so cause feedback action which may make the set oscillate. The spacing shown has been worked out as being about right to minimize this effect. Center holes only are given; all mounting holes must be added to take care of the particular apparatus used by the fan.

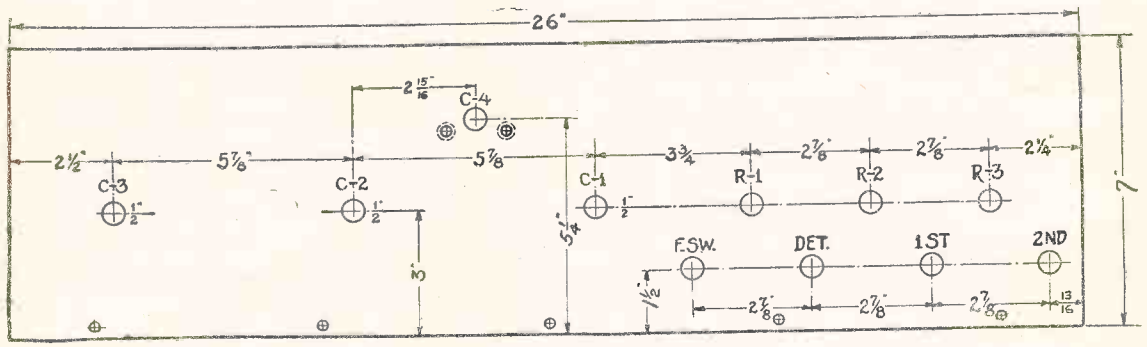



Fig. 3. Drilling Plan, Showing Centers of All Units Mounted on Panel

### List of Parts Required

1 Panel, 3/16 x 7 x 26.
1 Battery post strip, 3/16 x 1 x 6½.
1 Ant. and gnd. post strip, 3/16 x 1 x 2½.
1 Baseboard, ½ x 8 x 25.
C-1, 2, 3, 3 Low loss variable condensers, .00024 mfd.
C-4, 1 Three plate var. condenser, .00004 mfd.
BT-1, 2, 3, 3 Special low loss transformmers (Bremmer Tully recommended).
3 Dials, 4".
1 Dial, 2".
R-1, R-3, 2 Rheostats, 20 ohms.
R-2, 1 Rheostat, 6 ohms.
VT-1, 2, 3, 4, 5, 5 Standard tube sockets.
J-1, J-2, 2 Double circuit jacks, 3 or 4 springs.
J-3, 1 Single circuit fil. con. jack, 4 springs.
AT-1, 2, 2 Audio frequency transformers, 3½ to 1.
C-5, 6, 2 Fixed mica condensers, .001 mfd.
C-7, 1 Grid condenser with clips, .00025 mfd.
R-4, 1 Grid Leak, variable.
F. Sw., 1 Filament battery switch.
8 Binding posts.
1 Cabinet to fit.
Miscellaneous wire, terminals, screws, etc.

### Extras Necessary

6 volt "A" battery.
90 volt "B" battery.
4½ volt "C" battery.
5 vacuum tubes.
1 loud speaker.
Aerial and ground equipment.

The three special low loss transformers, the three low loss variable condensers and the small special three plate condenser can be purchased in a kit placed on the market by the Bremer-Tully Manufacturing Company of Chicago. The remainder of the apparatus

should conform to this high quality of apparatus design in order to obtain the desired satisfaction in the operation of the receiver.

After the front panel has been marked and drilled, Fig. 3, any engraving (if desired) should be done before assembly of the apparatus.

Lay out the base as shown in Fig. 4. Notice that the "C" battery is mounted in the set as this does not have to be renewed oftener than once or twice a year. The other two batteries are connected to their binding posts by leads in the ordinary way. Fig. 5 shows the relative position of the various units when properly mounted on the panel. This permits the shortest leads for connections. The 6 ohm rheostat should be located in the position marked as R-2. R-1 and R-3 are the 20-ohm units.

### Baseboard Layout

Although the illustration Fig. 5 shows the layout of the apparatus on the baseboard, still the relative position of each unit is important in avoiding interstage interference effects. Fig. 4 gives the dimensions for locating each unit. The position of the terminals of each piece of apparatus should be kept as indicated. This will make all the important leads as short as possible. The two binding post strips should be mounted on spacers and raised about one inch above the base.

The most convenient assembly system would be first to mount everything that goes on the front panel except the four condensers. Then mount just the sockets and the battery binding post strip on the baseboard. Fasten the panel to the baseboard and proceed to put in all filament wiring. It is a good idea to use soldering lugs for connecting leads to all terminals on sockets, transformers, condensers and binding posts.

### Making the First Test

When all the filament wiring has been finished and before doing any further wiring, insert five tubes in the sockets, connect an "A" battery to the proper posts and turn on the battery switch. Rheostat R-1 will control the first two tubes, R-2 takes care of the third or detector tube, while R-3 operates the filament of the fourth tube, VT-4. When a plug is inserted in jack J-3 the last tube (second audio step) will also be controlled by R-3. If these tests do not result successfully, trace and check all wiring before proceeding further.

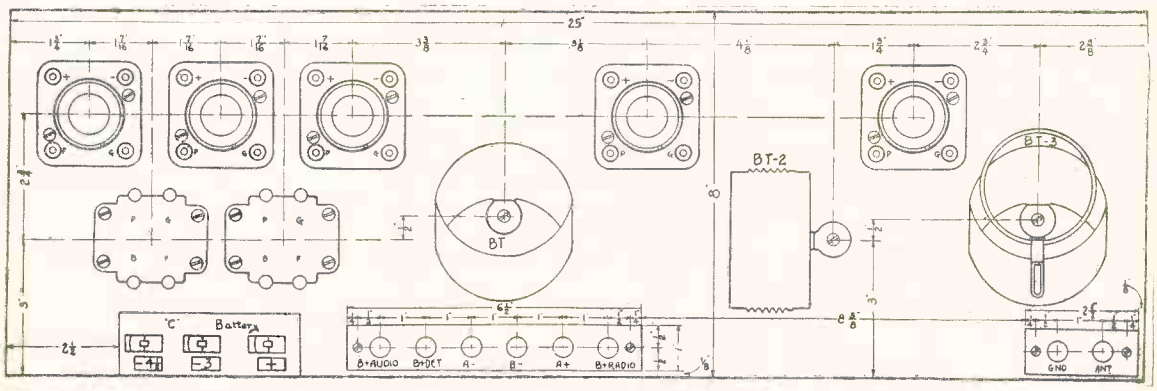



Fig. 4. This Gives Location of All Parts Assembled on Base

It is oftentimes easier to make a lot of connections if you have a definite order to go about it. While the following might be changed in any way to suit your convenience, still it has been found to be a very good order in which to proceed.

### What To Do First

1 Connect "P" post on socket VT-3 to top spring on jack J-1.
2 Hook up "P" post on socket VT-4 to top spring on jack J-2.
3 Connect "P" post on socket VT-5 to third spring from top on jack J-3.
4 Mount audio transformer AT-1 in the position shown.
5 Connect "P" on transformer AT-1 to second spring from top on jack J-1.
6 Hook up "G" on transformer AT-1 to "G" of socket VT-4.
7 Connect "B" on transformer AT-1 to third spring from top on jack J-2.
8 Connect bottom spring of jack J-2 to "B+DET" on binding post strip.
9 Mount audio transformer AT-2 in position shown.
10 Connect "P" on AT-2 to second spring from top of jack J-2.
11 Connect "G" on AT-2 to "G" on socket VT-5.
12 Hook up "B" on AT-2 to third spring on jack J-2.
13 Connect bottom springs of J-2 and 3 together and to "B+AUDIO" post.
14 Mount "C" battery in the position shown.
15 Connect "—A" on binding post strip to "+C" on battery.
16 Hook up "F" posts on AT-1 and 2 together and to "—3" on "C" battery.
17 Connect "+A" post to "GND" post.
18 Mount all condensers C-1, 2, 3 and 4. Fasten dials to read zero when plates are all out.
19 Connect stators on C-2 and 3 to "G" on VT-2 and 1, respectively.
20 Wire one side of grid condenser and leak C-7 and R-4 to "G" on socket VT-3.
21 Connect other side of grid condenser and leak to stator of C-1.
22 Connect rotor of C-1 to "+A" lead.
23 Mount transformers BT-1, 2, and 3 in the positions indicated.
24 Connect "G" and "F" of BT-1, 2 and 3 to stators and rotors of C-1, 2 and 3, respectively.
25 Hook up "1" on BT-1 to one side of condenser C-5. Connect other side of C-5 to stator of C-4.

26 Connect "P" on BT-1 and 2 to "P" on VT-2 and 1, respectively.
27 Connect "1" on BT-2 to rotor of C-4.
28 Wire rotors of C-2 and 3 together and then to "—4½" on "C" battery.
29 Connect condenser C-6 between rotor of C-3 and "+A" lead.
30 Hook up "B" on BT-1 and 2 together and run to "B+RADIO."
31 Connect "P" on transformer BT-3 to "ANT" post.
32 Wire "B" on transformer BT-3 to "GND" post.
33 Connect "—B" and "+A" posts on battery binding post strip.

Now insert the tube in socket VT-4 and light with rheostat R-3. Insert phones in jack J-2. Signals previously heard should be considerably louder than before. Repeat this same procedure with the second stage of audio. Volume should be uncomfortable on headphones.

### How to Get Plucking Noise

Now disconnect antenna and reconnect "P" post wire on transformer BT-1. Connect antenna to "P" post on transformer BT-2. Insert tube in socket VT-2 and light to almost full brilliancy with R-1. Set C-4 at about 20 and set C-1 and C-2 at 80. Rotate C-4 slowly slowly rotated towards zero, it should be found that the band on C-2 within which the set oscillates becomes gradually narrower until it approaches a width on the dial of only one division. Now as C-4 is rotated further towards zero it will be found impossible to cause the set to oscillate. Bring C-4 still further towards zero (about 15-20) and it will start to oscillate again. Just before this occurs the adjustment is in the most sensitive condition for this particular wavelength.

Always use C-4 as near to zero as possible without causing oscillation

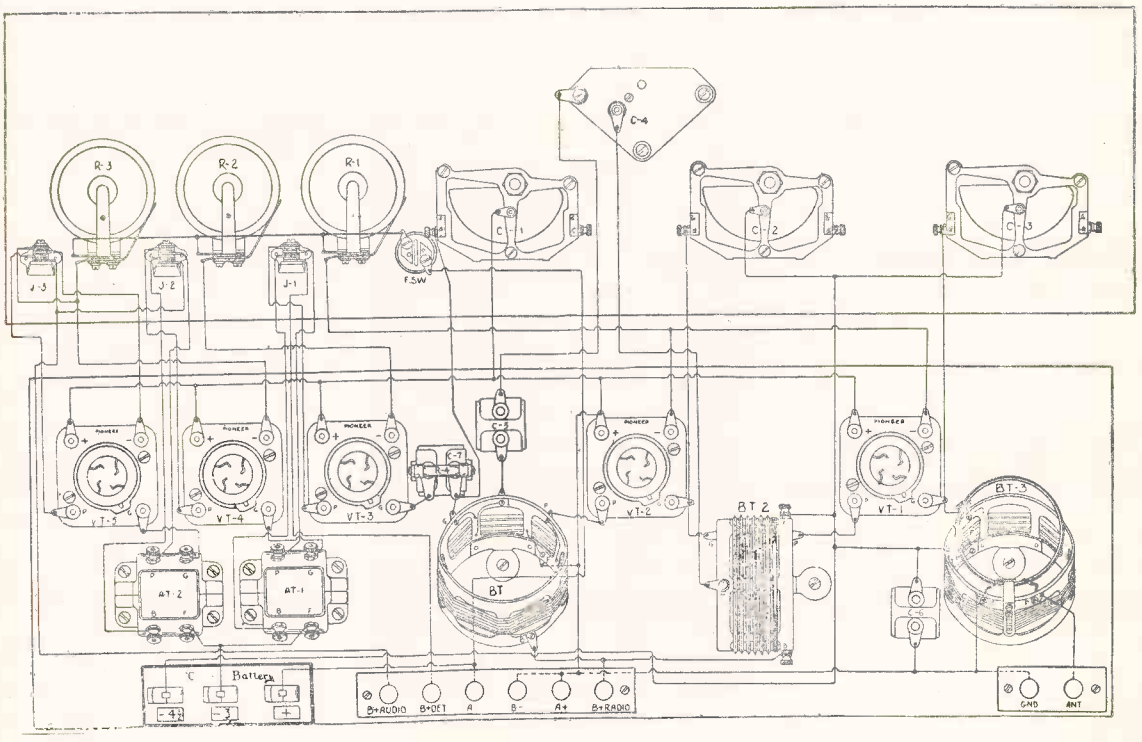



Fig. 5, View from Rear, Showing Both Panel and Base with Parts

### Progressive Testing

The set is now ready to test according to the progressive method. Connect batteries as required; when 90 volts are used hook up "B+RADIO" and "B+AUDIO" together and run a single lead to the "B" battery. Disconnect the "P" post lead from transformer BT-1 and connect the antenna lead-in to that post instead. Make the ground connection to the "GND" post. Insert phone plug in detector jack J-1; light the detector tube only with rheostat R-2, and tune with dial C-1. Local stations should be heard fairly clearly.

toward zero, at the same time rotating C-2 rapidly back and forth from 70 to 90. A sharp "plucking" noise will be heard as the set goes into and out of oscillation. If you happen to be tuned to a station a "carrier whistle" will be heard exactly as in a regenerative receiver when oscillating. Learn to be able to cause or prevent this oscillation at will, with the condenser dial C-4.

Repeat this procedure with C-1 at 30. Rotate C-2 between 20 and 35, at the same time adjusting C-4 for the same conditions as in previous test. Starting with C-4 from 30, as it is

when C-1 and 2 are in resonance. Repeat this procedure for every 10 divisions on C-1 and 2, until you are fully able to control the oscillation over the entire wavelength range. Don't add the fifth tube until you can handle four tubes to complete satisfaction.

### Further Tuning Details

Reconnect the "P" wire on BT-2 and connect the antenna to the "ANT" post. Add the fifth tube and set the adjustable primary on BT-3 to about 30 degrees. Repeat entire proceedure as in case of four tubes; the control will be

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# American Radio Relay League

### PARIS HOLDS FIRST RADIO CONGRESS

Amateur radio telegraph operators have perfected a system of international communication on rapid waves. They are now arranging for appointment of delegates to the first international congress of amateurs which is to convene in Paris from April 16th to 20th, according to the American Radio Relay League. Representatives of American and Canadian amateurs will leave New York on the S. S. "Mauretania" on April 1st, returning to this country on the S. S. "Berengaria" the first of the following month, after thirteen days in Paris and three in London.

The plans for the coming congress of the International Amateur Radio Union, (IARU) as it is called, have been underway since last year when Hiram P. Maxim, president of the A. R. R. L., on a visit to Europe was elected president of the temporary committee of organization. At this initial meeting representatives from eight different countries were present, and it was the unanimous desire that a permanent world association of amateurs be formed. The three leading radio societies of France have banded together to arrange for the coming meetings and announcements have been mailed to all the amateur societies of the world.

#### America Took the Lead

Because this country has taken the lead in the development of two-way talking across the ocean through the arrangement of rapid wave tests with amateurs in Europe, South America and Australia, they are expected to play a big part in the affairs of the congress. At their annual meeting recently, directors of the A. R. R. L. voted to send as their delegates, President Maxim and Secretary Kenneth B. Warner. Although each country will have only one vote at the meeting, a general invitation has been extended to all amateurs who want to attend as private individuals, or in an advisory capacity.

As a result of this congress, the Union is expected to become a federation of national amateur associations. Its main objects will be the promotion of amateur interests in their respective countries and the suggestion of methods and regulations for bettering international private communication. Among the various topics on the list for discussion are the following: organizing the I. A. R. U.; a schedule of technical tests by amateurs; and the selection of an international auxiliary language. A secretariat has been established at 2 Rue de l'Eschaude—Saint Germaine, Paris, where advance arrangements are being made.

Joseph Krecht

### FAMOUS HOTEL ORCHESTRA

The Waldorf Astoria Hotel in New York, has long been regarded as one of the highest class hotels in the country. It has an equally famous orchestra, of which Joseph Krecht is the director. His aggregation of players has recently been broadcasting concerts of high class music for the benefit of the listeners in the Eastern part of the United States.

#### Will Your Club be Represented?

Interest in the international congress is so strong there that a number of the League divisions, convention organizations, and radio clubs, are making plans and raising funds for sending representatives of their own. The matter is also being brought to the attention of Canadian amateurs so that some means will be provided for sending an official delegate from that country. English amateurs are particularly hopeful that the congress may suggest methods of stimulating radio communication between them and the colonies.

The development of rapid wave communication among the amateurs of all countries during 1924 certainly requires starting some kind of an international association. The A. R. R. L., in the last few weeks has received reports that forty-two American amateur stations have been heard in the Philippine Islands and 180 by one operator in South Africa. These are fresh indications of the tremendous distances that may be covered, and give a good idea of what the art holds in the future for low power private transmitters.

### DRY CELL CAN BE RECHARGED

Continued from Page 10

ampere, it would, of course, be put on charge and the capacity brought back to about its initial value. This action, as already explained, can be repeated some six or eight times.

#### How to Recharge

In recharging this kind of battery, whether "A" or "B" type, it is necessary to use a chemical rectifier if your service is alternating current (AC). With direct current all that is needed is a lamp in series to reduce the value of voltage at the battery to a low enough figure so that only the right amount of current flows for the charge. With AC on the other hand, the chemical rectifier acts like a valve and prevents the negative impluses from discharging the cell as fast as the positive ones charge it up.

A resistance is also needed in this case for the same reason as with direct current. Without it the amperage would rise to such a high value that the dry cells would be overheated and injured.

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# DeForest Cures the Squeal

## *You Don't Need to Disturb Your Neighbors Any More*

By OLIVER D. ARNOLD

IF you were asked what was the most annoying thing about radio, you might say that it was having the batteries go dead the night you had special company to call. But if you have always been careful to keep the cells in good shape, so that this misfortune has never happened, then undoubtedly you would vote unanimously that the squeals of your neighbors were more disgusting than anything else.

Of course, static is a lot of bother too, especially during the times of thunderstorms. There is this to be said for it, however, that you know it can't be helped and that everybody else is bothered the same way. But when some regenerative set starts to broadcast down the street in a way which is quite unnecessary and does no one any good, not even the owner, then it makes you want to wring his neck and let him die among his dials.

### It Can't be Helped

In a national contest recently to find some way of preventing the squeals from a regenerator getting out on the air, there were hundreds of suggestions made. However, there was not one of any value except some form of using an extra tube ahead of the detector. Such an extra bulb is used as a radio frequency amplifier, and as such a unit will pass oscillations from grid to plate, but not back again, it works very well to prevent the noise. Of course, the objection is that it requires an extra tube and its accessories, and so this solution is far from popular.

There are countless inventors working on this problem, and it is not at all sure that the answer will ever be found.

However, the DeForest Company has obtained a partial solution. If you have a set with more than one tube, you can use one as a means of suppressing the aerial oscillations, and at the same time let it do its business as an audio amplifier. Of course, this does not answer the original problem, which was to find some kind of squeal suppressor for a *single* tube regenerative set.

It may be noted here that there are various ways of reducing this squeal on a single tube, but they all cut down the music in the same proportion as the noise. By turning down the filament rheostat it is easy to kill the oscillations, but as just explained, the program which you want to hear is affected in the same way. Of course, the real way to stop squealing with a single tube set is to reduce the tickler action by turning down the feedback knob. There are so many people who do not understand about this, however, that a fool-proof attachment, which could be installed on any set to prevent radiation would be a great advantage to the rest of the broadcast listeners.

### How the Trouble Starts

A sketch of our old friend, the one lung squealer, is shown in Fig. 1. This will illustrate the cause of the trouble. The action of such a set is briefly this. The aerial waves go through the condenser C, which is used for fine tuning, to the stator of the variocoupler S. Taps switch T, picks out the proper tap and is adjustable for coarse tuning. From there the primary waves run to ground.

The secondary circuit also uses the stator of the variocoupler for a coil. The oscillations run through the grid leak and grid condenser to the grid and and then to the filament. The output

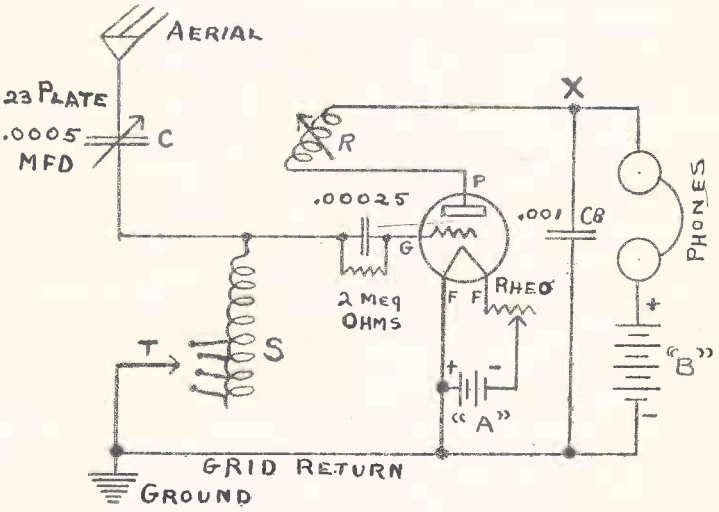



Fig. 1. This Shows How Squeal Starts in Most Sets.

of the tube runs from the plate P, to the adjustable rotor of the variocoupler R, to the point X, where the high frequency oscillations return to the filament through by-pass condenser Cb, while the audio waves thread through the phones and "B" battery to the filament.

### What Makes the Birdie

The "birdie" or whistle is caused by the action of the feedback coil R, on the secondary S. The output from the plate is several times as loud as the input owing to the action of the tube

itself. The oscillations from this output are impressed by coil R, upon the input through S. The amount of this action is adjustable and is controlled by turning the feedback knob connected to the rotor. When the two coils, rotor and stator, are at right angles, then no regeneration occurs since the magnetism from one coil does not pass through the other, but when they are turned into line then the feedback action is greatest and in that case an oscillation, which is once started is fed back again to itself from plate to grid indefinitely.

This disturbance naturally reaches the aerial since it is connected through condenser C, direct to coil S. Any whistles which an oscillating set makes for itself are immediately spread out into the ether by the antenna. Since these whistles are the same kind of radio waves exactly as the music which the neighbors are trying to pick up, it is impossible for them to tune out one and not the other. No receiving set can possibly have enough intelligence to throw away one kind of broadcasting and yet pick up another kind on the same wave frequency from the same direction. That is why even the most expensive sets are disturbed by oscillating regenerators just as much as are the cheapest crystal sets.

### Two Tube No Better

If you have a two tube regenerative receiver it will be no easier on your neighbor's ears than a one lunger. Such a set is illustrated in Fig. 2. The action here is similar to that of Fig. 1, as far as cause is concerned. The effect is not quite as bad, however. You will see that the primary which consists as before of the stator of the variocoupler does not use the entire number of turns of L1, but only those that lie between the adjustable tap switch and the ground. By turning this switch so as to reduce the primary to some five or ten turns the amount of energy in a squeal will be cut down to a small percentage of what it was in Fig. 1. For this reason hook-up 2 is much better than hook-up 1.

In order to tune this set the condenser is taken out of the aerial line and connected in parallel across stator L1. Here it tunes the secondary much sharper than was done before. This is a second advantage of this hook-up. The output circuit from the plate is just the same as before. Notice, however, that instead of the phones being connected to binding posts, we are using jack 1, to attach a phone plug.

Tube 2 is an ordinary audio amplifier hooked up through transformer T. The output of this step runs through jack 2, back to the "B" battery as usual. The two middle contacts of the three or four spring jack are left open ready to add a third tube which would be the second step of audio. Whether this third tube is already connected or not makes no difference in the operation of the parts already described.

### Making the Changes

This apparatus just described forms a very popular form of two or three circuit regenerative set. This is what DeForest uses as a start to get a non-squealing hook-up. Referring to Fig. 3, you will see what changes have been made. In the first place the aerial and tap switch are disconnected from the stator of the variocoupler L1. Instead the aerial runs to the detector of Tube 2. In series with the aerial is preferably a tuning coil L4. This is used for adjusting the wave frequency of the aerial to that of the station you wish to pick up. If you are after a broadcaster, which has a fast vibration, as shown by a large value of kilocycles (kc.) then you must make this coil small by adjusting the tap switch. If it is a slow vibration you are looking for, then the smaller kc. are picked up better by having a large number of turns. This coil may be any adjustable inductance, but a good one may be made by winding 70 turns of No. 22 or No. 24 DCC wire on a 3-inch form and taking a tap off every ten turns.

This coil may be omitted as far as the general action of the set is concerned. In that case the aerial will run direct to the grid of Tube 2. This will cut down the loudness somewhat, and will reduce the sharpness of the tuning. The advantage would be that one less control would be needed.

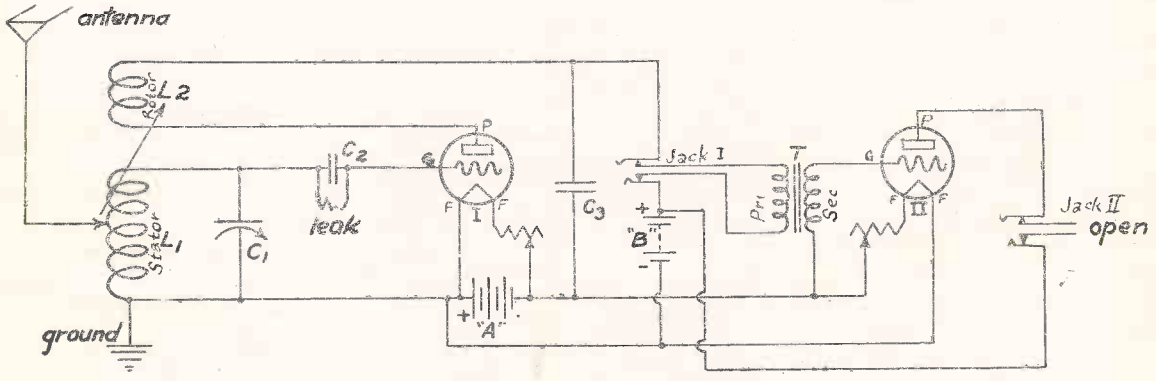



Fig. 2. An Ordinary Two-Tube Set W hich Will be Apt to Wreck Your Neighbor's Peace

### Getting the Waves Across

Some means must be arranged for getting the radio waves across from the second to the first tube. This is found in a wire joining the plate of Tube 2 with coil L1. A small condenser C4 is inserted in this line. This has a value of .00005 mfd. Such a small unit is not usually found in radio stores, but may be made by connecting two .0001 mfd. in series. This does not need to be adjusted after being once set. However, a variable condenser such as used for neutralizing a neutrodyne set may be employed in this position. If it is adjustable try by experiment until you get the best results, and then leave it there.

Another change is inserting a radio frequency choke coil L3 between the plate of the amplifier and the jack. This may consist of any good RF choke coil. A honey comb coil with 100 or more turns would do, or a two-layer bank-wound coil of the same size. The capacity effect of such a coil should be as low as possible so as not to by-pass any of the high frequency waves.

### Why Use a Choke

You may wonder why it is necessary to use a choke coil in series with the phones or loud speaker which will be plugged in jack 2. The inductance of a phone is so very high that at first sight it seems silly to add to it. However, the trouble is that the phones or speaker will be connected through a long phone cord and this latter has so much leakage capacity from one of the conductors to the other inside the cord that the choking action of the phones themselves is mostly lost.

One other change completes the set. That is the simple one of soldering the two middle springs of jack 2 together. This is necessary so that when locals are being received on the detector only, and so the phone plug is removed from jack 2, there will still be a path for the "B" battery current to reach the plate of tube 2. When the speaker is inserted in jack 2, then of course, the short circuit between the two middle springs has no effect as they are now disconnected from the outside springs by the action of the plug.

### Tracing the Waves

The way the circuit operates is this: A radio frequency wave striking the aerial is brought down through loading coil L4, which is tuned to its frequency, and then is impressed on the grid of tube 2. The latter acts as a radio frequency amplifier, and so the same vibration in a larger edition comes out from the plate of tube 2. Here it tries to divide, but is unable to get through the choke coil L3, and so runs to the left through condenser C4, to the stator L1, and tuning condenser C1. From there it returns to the filament again. The sharp tuning of the set is accomplished by adjusting condenser C1.

From now on the action of the waves are just as they are in the hook-up of Fig. 2. That is, the vibration which has been tuned by L1 and C1 is impressed through grid condenser and leak on the grid of detector tube 1 and the output from the plate goes through the tickler or rotor, L2, to jack 1. If the phones are plugged into this jack, then tube 2 will not be used as an audio amplifier although it is working on radio frequency. If the phones are withdrawn from Jack 1, then the audio oscillation is amplified by transformer T, which feeds it to audio amplifier 2. The increased signal comes out through the plate and loud speaker, which is plugged into jack 2 as usual.

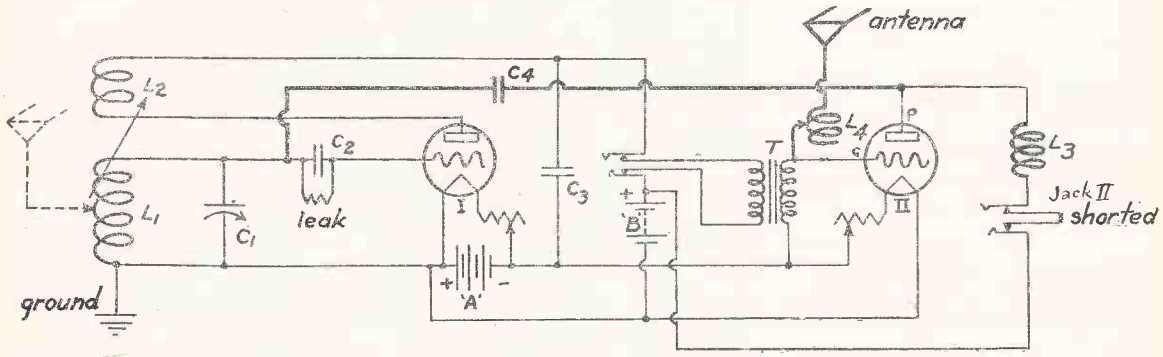



Fig 3. After Four Changes, as Shown, This Becomes a Non-Squealer

### Why It Does Not Squeal

Let us see the action now when the tickler is turned up so high that the set oscillates. Of course, a squeal will be developed, which will sound as bad as usual. Naturally, the rotor and stator L1 and L2, of the variocoupler, will be set into violent vibrations just as they were in Fig. 2. But observe that while before the aerial was attached directly to L1 at the present time, it is no longer connected. This unwanted oscillation must first go through condenser C4, over to the plate of tube 2. As already explained condenser C4, is a very small capacity and so it reduces the amount of the oscillation to a small value.

The latter is then fed to the plate of tube 2. Remember that a vacuum tube is a valve which allows vibrations to go from grid to plate, but not backwards. That is why this small vibration is reduced almost to nothing in going from the plate to the grid of the amplifier tube. Notice we say, "almost to nothing." To be accurate, a tube does allow a small percentage of its vibrations to go backward from plate to grid. This small amount is carried by the condenser action of the tube in which the plate acts like one pole and the grid the other of a tiny air condenser.

### They Die Outside the House

Owing to this action, it can not be said that this hook-up gives absolute zero radiation from the aerial when the tickler is turned so high that the detector breaks into violent vibrations. However, the amount is reduced so greatly that ordinarily nothing can be heard from such a set outside of the house where the offending squealer is being operated. And this is good enough for anybody.

This scheme as well as preventing radiation will also increase the selectivity of the set to some extent. This is because the coupling between the aerial and the tuner is much smaller than before. The loudness should be just as great and sometimes is even better than before. As applied to a three tube set, another step of audio is added to jack 2 in the usual manner. The short circuit

Continued on Page 22

# Please the Eye as Well as Ear

## *Several Steps From Junk Pile to Piece of Furniture*

By ALFRED N. GOLDSMITH, B.S., PhD., Fellow I. R. E., Chief Broadcast Engineer, Radio Corporation of America

THE amateur receiving set of fifteen years ago would astonish many modern fans. Mounted on a board were coils, condensers, primitive detectors, and a variety of electrical switches and parts, all connected by straggly wiring which had apparently been spun over the equipment by a disorderly and demented spider. A multitude of adjustments helped confuse the user and gave him plenty of excitement, since he rarely knew what was going to happen when any particular knob was turned.

To the inquiring and experimental turn of mind, such sets were quite satisfactory. Certainty of operation and good looks were neither present nor desired. Of course, there were some exceptional sets which were both carefully constructed and easy to handle, but they were probably accidents, and not as highly regarded by the average experimenter as the "junk pile" variety of set.

Naturally radio could be of interest only to a small group in the community under such conditions, and radio receivers of this primitive type were not able to render a public service nor yet to beautify the homes of their owners. An occasional message of no general interest was all that one could hope to receive on the frequencies or wave lengths devoted to commercial traffic.

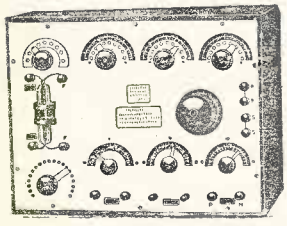


Fig. 1. A Nine Control Set

For instance, if you hear a message "Your wire of the thirtieth received. Ship us three dozen boxes," it may mean a lot to the man addressed but it will hardly be wildly exciting to you.

### Radio Starts a Fight

Amateur operation was unorganized and their transmitting sets were chiefly noted for their amazing capabilities in producing bad interference. As to appearance, a radio set in the home in those happily distant days caused a constant fight. Mother naturally tried to have it located in some remote and far away corner of the garret, where the eye would not be continually offended by it, while the boys wanted it in the living room where it would be handy.

Two early factors combined to produce somewhat better looking radio receivers. One was the commercial ship set designer, who was forced to build reasonably rugged and neat-appearing sets. The other was the mature amateur with a mechanical turn of mind, who was able to build apparatus of fairly attractive appearance. Accordingly the panel type of set came into existence. In this style, all parts were mounted on a vertical panel of insulating material which also formed the front of a wooden cabinet. Such sets came into wide use and were found so easy to wire and to maintain in good condition that they have survived up to the present.

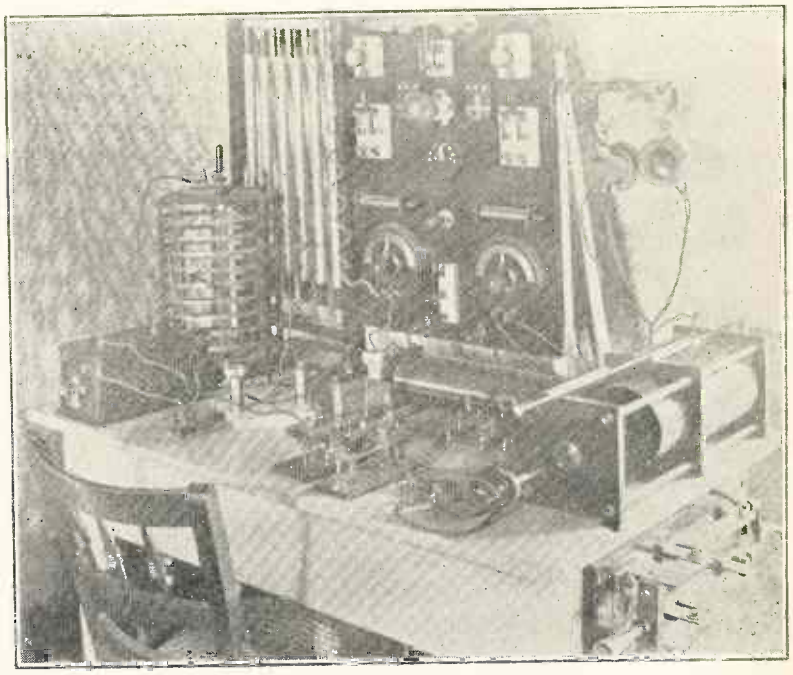


Fig. 2. This Set Worked, but Imagine the Looks of It.

One of the changes which did not show outside, but helped to improve the sets was stiff or busbar wiring. Instead of flexible and rambling cables, stiff wires

were bent sharply into correct shape and used to connect the various parts of the set. Such wiring was not only neater but more permanent. It is now generally in high-grade receivers.

### Nineteen Knobs to Twirl

The panel type of set had another advantage—all adjusting knobs were concentrated into a single place (the panel), and were therefore readily accessible. The knobs could be arranged symmetrically and all metal parts polished, thus presenting a good appearance. But such receivers always look like scientific apparatus rather than furniture, and they do not merge readily into a handsome living room any more than would an uncovered sewing machine. There is also the temptation to multiply adjustments on such sets past all reasonable limits. It is recalled that at a certain radio exhibit in Boston, a receiver costing $100 was shown which was provided with no less than nineteen adjustments. It would take a radio Sherlock Holmes to pick up the right station on such a set. An old style set with nine controls is shown in Fig. 1.

Another problem encountered in the panel type of set was the best location of the binding posts or terminals, the batteries, and the loud speaker. A binding post on the front panel stands out like a sore thumb and often leads to frowsy wiring. If placed at the back of the set, they were not easy to get at and required special construction of the box. They could not be eliminated, however, since the self-contained unit type sets did not then exist. Storage batteries were always required with the earlier sets in the absence of the present efficient dry battery radiotrons like UV-199 and WD-11 and 12. Plate batteries took the form of large assemblies of individual dry cells or flashlight units and were very unsighty and difficult to locate in an unobtrusive position.

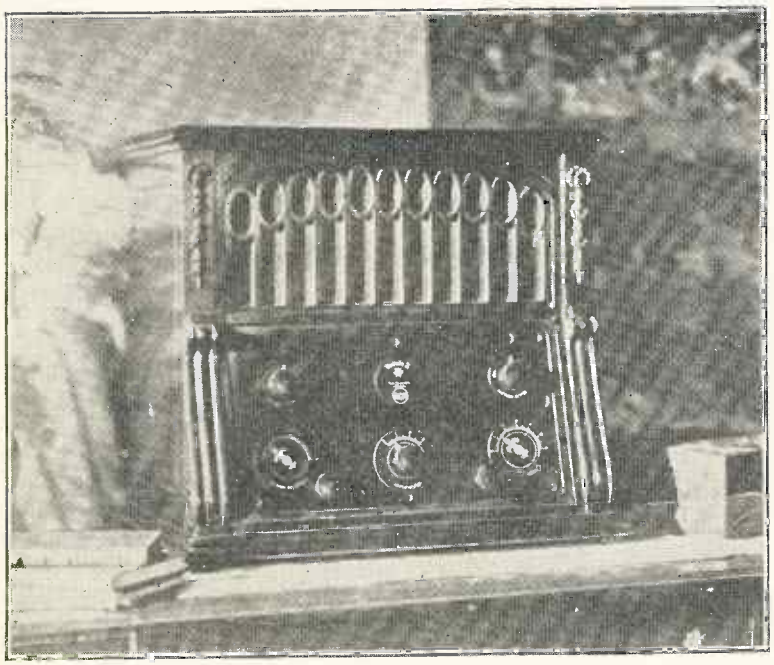


Fig 3. This Set is Self-Contained; Only Outside Connections Are Aerial and Ground

The telephone headset also was not particularly ornamental, and the loud speakers which later succeeded the headset were still not a delight to the eye. Panel type sets therefore look ship-shape, scientific, and business-like, but they are not particularly artistic nor in full keeping with the rest of the domestic furnishings.

### A Horrible Example

The photographs accompanying this article show various types of receivers under discussion. They indicate clearly the problem of adopting radio design to the beauty of the music produced and to the atmosphere of the home.

Fig. 2 shows a sending and receiving outfit of the old type. The induction coil is at the extreme left and behind it the sending helix. The five vertical tubes behind it are high voltage condensers made of glass with tin foil on the inside and outside. The receiving apparatus is on the panel with the tuner at the right. Such equipment could doubtless be made to bring in a concert very nicely, but just imagine such a set up installed in the corner of your parlor.

As long as radio was an experimenter's pastime and nothing more, the development of receiver cabinets was slow. But when broadcasting became a great public service, and in place of a few thousand experimenters there came into existence millions of daily listeners, the problem of appearance became more serious.

It seemed inconsistent to have a delightful concert, played by a leading orchestra, come out of an arrangement that reminded one of the oldest swinging horn phonographs, such as our grandfathers used. There was the same discrepancy between a tastefully furnished living room and a crude piece of machinery placed in the midst of it. An artistic unity was demanded by the broadcast listeners, and this has now been achieved in a variety of ways.

### Gathering Them In

The first step was to place the batteries, terminals, loud speaker, and all the flock of external parts into the receiver cabinet so that (except for the antenna and ground), the entire set was self-contained. Fig. 3 illustrates such a design. This disposed of the outside parts formerly scattered all over a table or desk top. It also enabled the builder to mount such accessories once and for all in the most favorable position.

The panel mounting for the control handles still has to exist in one form or another (although it has been simplified and improved in appearance in well-designed modern sets), so it was natural that the next step was to design a suitable wooden cabinet to contain the whole receiver. This should conceal the operating panel unless it was desired to uncover it when adjusting for different wave frequencies.

Fig. 4 shows such a receiving set. When out of use the hinged door closes up and conceals the dials and knobs. If you want to pick up a program the act of swinging open this door turns on the "A" battery and lights the filament. The center handle, near the bottom, is used to rotate a large loop which is concealed in the lower half of the cabinet. By turning this loop so that its axis points at an unwanted station it is tuned out completely, even though it may be very powerful. At once the entire field of elaborate design was opened up, and both plain and "period" cabinets were tried in a great variety of shapes and sizes. Both the vertical and the horizontal or console type have been used. Cabinets resembling phonographs have disputed the field with those resembling jewel chests or desks or grandfather clocks.

Fig. 4. Even Aerial and Ground Not N eded Here, as Loop is Concealed in Base

### You Must Look Inside

Since the field of art is involved here, it is to be expected that no general answer will be found. Indeed it is well that every radio listener should be able to find a type of cabinet which pleases him best, but he must pay attention of course, to the grade of apparatus enclosed inside. You must remember that there is some danger of getting all cabinet and no set. But there is is no longer any reason why the most delicate artistic taste should be jarred by the beautiful radio sets which are now available for home use.

The era of radio as a household necessity and a public service has come. The high quality of the concerts and the charm of the home alike require that all but the cheapest radio receivers shall be attractive additions to the home. Masterpieces of music should find their source in artistic furnishings for positions for easy use and best tone.

## HOOKING UP NAMELESS SET

Continued from Page 15

identical but slightly more critical. When working on waves of higher kc., between 20 and zero, it may be necessary to turn down the filaments of RF tubes very slightly to control oscillation. Remember, the condition of greatest sensitivity is just before the set breaks into oscillation. As you become familiar with the sounds the set makes under different working conditions, you will more easily interpret results and get maximum efficiency.

In order to operate the set without readjusting C-4 for maximum efficiency at every wavelength, that is for reception up to 1,000 miles or so, find the position of C-4 at which no oscillation occurs over the entire range. This can be done by balancing the set for the highest wave frequency and then it will not unbalance above this point. Note this position of C-4 and you can always return to it for perfect balance. It is better to secure maximum amplification by turning C-4 further toward zero than towards the higher values. A slight detuning when C-4 is adjusted can readily be compensated for on the main dials. If oscillation cannot be completely controlled on the highest wave frequencies with C-4, turn down the RF filaments slightly by means of R-1.

Use both hands when tuning. Dials C-1, 2 and 3 are used to select the station. Dial C-4 increases the volume. If an oscillation click is heard when C-1, 2 and 3 are tuned to resonance, readjust C-4 until only a slight hiss is heard. This is the point of greatest selectivity at that dial reading.

Record dial readings and wave frequency of every station received. List stations in order of kilocycles (kc.). The dial reading of any station desired may then be closely estimated from its kc. compared with stations already recorded.

## DE FOREST CURES SQUEAL

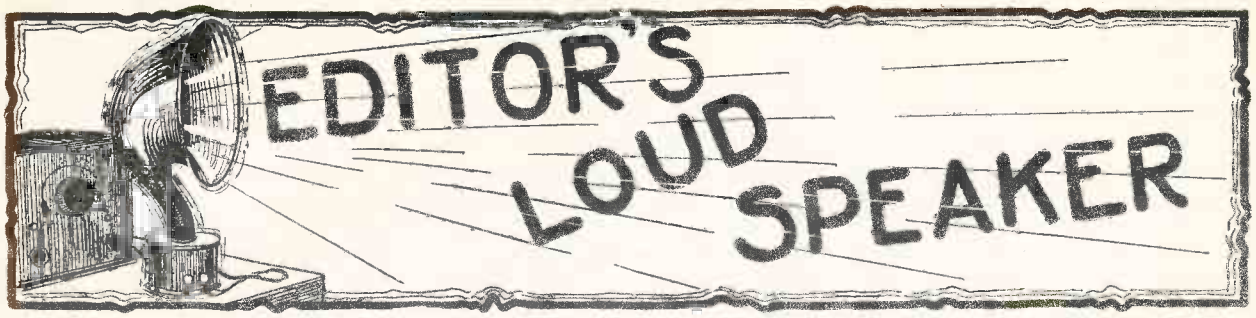
Continued from Page 19

on the middle springs is of course, removed since when the plug is withdrawn from this jack the circuit for "B" battery current will be completed through the primary of the second audio transformer (not shown.)

If you live in a congested part of the city or in an apartment house district, where the noise your set makes is likely to disturb the peace of mind of those living around you, we recommend that you try out this modification and then get your neighbors to do the same for you.

## SOVIET IS ON THE AIR

Russian radio, although practically unheard of abroad, has taken big strides during the past year. Many large stations under the control of the Union of Soviet Socialist Russia now broadcast regularly.




## DO YOU USE MATCHED TUBES?

A good many people seem to think they can not have a matchless set unless they use "matched tubes." Just what is meant by this term?

It is a hard thing to explain why they should be matched, since you will find that any good tubes will work just as well. Indeed, this idea is really wrong. There are three different uses for tubes in any ordinary set. Of course, the one which is most necessary of all is that of detector. Such a unit, whether a crystal or a tube takes the high frequency waves of 550 kilocycles up to 1200 kc. and reduces that speed of vibration down to the audio range of 20 to 5000 vibrations or cycles a second.

The audio amplifiers take this low speed vibration and multiply the loudness by anywhere from four to ten, depending on how efficient your parts are. You can easily see that there is no matching between a detector and an amplifier. You might just as well take a cheer leader at a football game who is making the wierd sounds known as a college yell, and try to "match" him with the megaphone which he uses partly to yell through, and partly to wave through the air as a baton.

Since the detector and amplifier are not at all alike, perhaps the two steps of amplification should use tubes which are just alike. This is a good idea if one of them is a very sensitive tube and you want to make the other one just as good. But here the idea is not necessarily to have them alike, but that they shall both be just as good as possible.

### Matching Your "B" Batteries

It is something like your "B" batteries in this regard. If you have one block of 45 volts, which you have found by testing with your meter is right up full on pressure, and which holds its voltage well over several weeks or months, then you naturally want your second block of 45 volts to be just as good. But if, on the other hand, you found that the first block was rather poor and did not hold up very well you would naturally feel discouraged. Such a "B" battery might not last more than a couple of months. In that case would you try to match the first lot, which you had found to be poor, with another section equally poor? Of course not. You would rather buy a second section as good as possible, even though it did not match the first.

### A Tall and a Short Man

This case is different from working units in parallel. The filaments must be matched for voltage. That is, you can not use a 5-volt UV-201A in parallel with a 3-volt UV-199. If you try to do this it will either burn out the UV-199, or else not light up the 201A bright enough to get good results. It is like two men holding up a pail of water. Let us suppose that one is a tall one, and the other quite short. They may hold up the pail by putting it on the middle of a board while a man supports each end. In that case the two men are in parallel and the tall one holds his end so high that the short one can not equal it. The result is that the pail is tipped over and the water spilled. In such a case the men ought to be matched for height.

Instead of this suppose the short one stands on the ground and the tall one is an acrobat, and climbs up on his shoulders. The man on top easily holds the pail of water level and it does not spill. Here there is no advantage at all in making the two men both short in order to be alike. Of course, if they are both tall, the pail would be held still higher.

### How About RF Tubes?

You may think that radio frequency tubes will require matching more than those of audio frequency. However, the principle is just the same. These units are used to increase the amplitude or volume of the high speed radio wave before they have been reduced to audio by the detector. If by luck you happen to have a poor tube as the first step don't try to match it with another poor one in the second stage. Get the best one possible although it is different from the first.

This does not mean that tests on tubes are worthless. By no means. Even the best tubes obtainable are apt to vary somewhat from the high standard many of them reach. And considering the flood of manufacturers who are just starting out to make vacuum tubes, it is easy to see that many of these devices at present in the retail stores are somewhat inferior in their operation. That being the case, it is a very good thing for you to test your tubes or have your dealer do so before you buy them. A trial to see whether the filament lights or not is not enough. Two other tests should be run. First to see if the plate current or so-called "emission" is up to standard, and second whether the tube will oscillate easily as it should.

If these two values are found to be correct, then there is no need for further matching. If they are not up to standard in some of the tubes you now own you may still continue to operate them with good results until you find a noticeable falling off in loudness or clearness of your music. But don't try to match the worn ones with new tubes, which would have the same low values on tests.

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## SNAPPING ON ANOTHER LIFE

The style of vacuum bulbs known as the UV-201A and the UV-199 are said to have nine lives. This is *not* as you may have suspected because of the cat calls and squeals which they sometimes give out. No, it is for the reason that after they have been killed by too high voltage on the filament they may sometimes be brought back to life.

We say "sometimes," because it often happens that no improvement can be made in them. If you understand the theory of the thing, you will see why it is. The filament of course is nothing more than a short piece of wire, which is heated very hot by the passage of the current from the "A" battery. The action of the hot filament in giving out electrons or small particles of negative electricity, depends only on the temperature and surface of the filament. In other words, the current from the "A" battery which runs through it is used only to make it hot.

If you could heat up your filament by sticking it in a gas flame, or by dropping it into the family cook stove, it would give out its electrons just the same way it now does. Such a method of heating would be awkward to say the least, and so we prefer to stick to our old friend the "A" battery to warm it up just as we have always done.

But notice that we said the emission of current depends on temperature and surface. Spoil the surface and you spoil all. It has been found after a long series of tests, that the metal Tungsten which is the material used in making ordinary electric lights, is only a fair electron radiator. It happens that another metal, Thorium, is more than one thousand times as efficient. So if we coat a filament with thorium (make it thoriated) and run it at the same temperature, it will give out one thousand times as much current.

The vacuum tube can not use such a large amount of current to the plate, and so the thoriated filament can be run at a much lower temperature. This is quite an advantage, because if we try to heat up such a filament to the temperature needed for a plain Tungsten wire it burns the Thorium off in short order. Notice how bright the pure Tungsten filament of a UV-200 detector is operated, and compare it with the dim light given out by a 199 or 201A.

Fortunately, the alloy which is used for a base for the filaments in these latter tubes, is able to absorb a certain amount of thorium all through its mass. It is only the part on the surface, however, that does any good in shooting off the plate current. Now let us see what happens if we run our tube too hot.

### A Sharp Hard Blow

If we accidentally let our screw driver slip while wiring up that new hook-up and unfortunately connect the "B" battery to the "A" battery wires for an instant, it will put 45 or 90 volts across the low voltage filament. This will heat it up so hot that it will glow like an electric arc for an instant. It will be only an instant, because if our screw driver does not keep on skidding and slip *off* the "B" battery right away the filament will be completely burned at the stake and give up the ghost. The result of such a misfortune is $3.00 in the till of the radio store.

If, however, our screw driver *does* slip off the "B" battery before completing the wreck, it will have burned off all the thorium from the *outside* of the filament. For that reason the tube will not work in the set at all as either detector or amplifier. The reason is that no "B" battery current will flow and so, of course, the phones will not be operated. This is the point when you throw the tube away unless you know how to bring back its life.

The way to accomplish this result, is merely to run it for half an hour with "B" disconnected. The "A" battery forcing current through the filament heats it up as usual, and at that temperature some of the thorium which is still left on the inside of the filament will work its way to the surface. If the "B" battery had been left connected its high voltage would tend to tear off these particles as fast as they came to the surface. In the absence of this high pressure, the little pieces of thorium accumulate at the surface until it is back almost to normal at the end of half an hour. The tube may now be used just as it was before. Of course, its reserve capacity and its ultimate life will have been shortened somewhat, but it will work very nicely.

If, instead of a sudden blow of "B" battery voltage, you have been operating your tube right along with the filament turned too high, then thorium is gradually cooked or evaporated off the surface. The difference, however, is here. In this case you are giving the filament plenty of time for the thorium to circulate around inside the mass of the metal, and so when the surface is finally stripped of this element, there is no more left on the inside to take its place. In such a case there is no use in trying to treat or reactivate the tube. When it stops working it is dead for the last time.

# Building Sets by the Thousands

## *It Is Different From Hooking Up a Set At Home*

By C. W. RADOS, Arlington Heights, Mass.

ARE you one of the hundreds of thousands of people who like to "tinker," to experiment, to build receiving sets? Your greatest thrill comes when during your experimenting, you get your signal in a little bit better. The music may be only a bit louder, or the voice just a little clearer, but it is your reward for experimenting.

Usually the fan who "fools around" with his set gets a great deal of satisfaction out of the fact. He may even look down a bit on the person who has to buy his set and call in a man to fix it every time something goes wrong. The experimenter-builder likes to make his own parts and construction. Yet even the best mechanic has to purchase parts he cannot build—tubes, amplifying transformers, telephones, and the like. To these experimenters, as well as the people who buy their sets, it might prove interesting to learn how the professional sets are made.

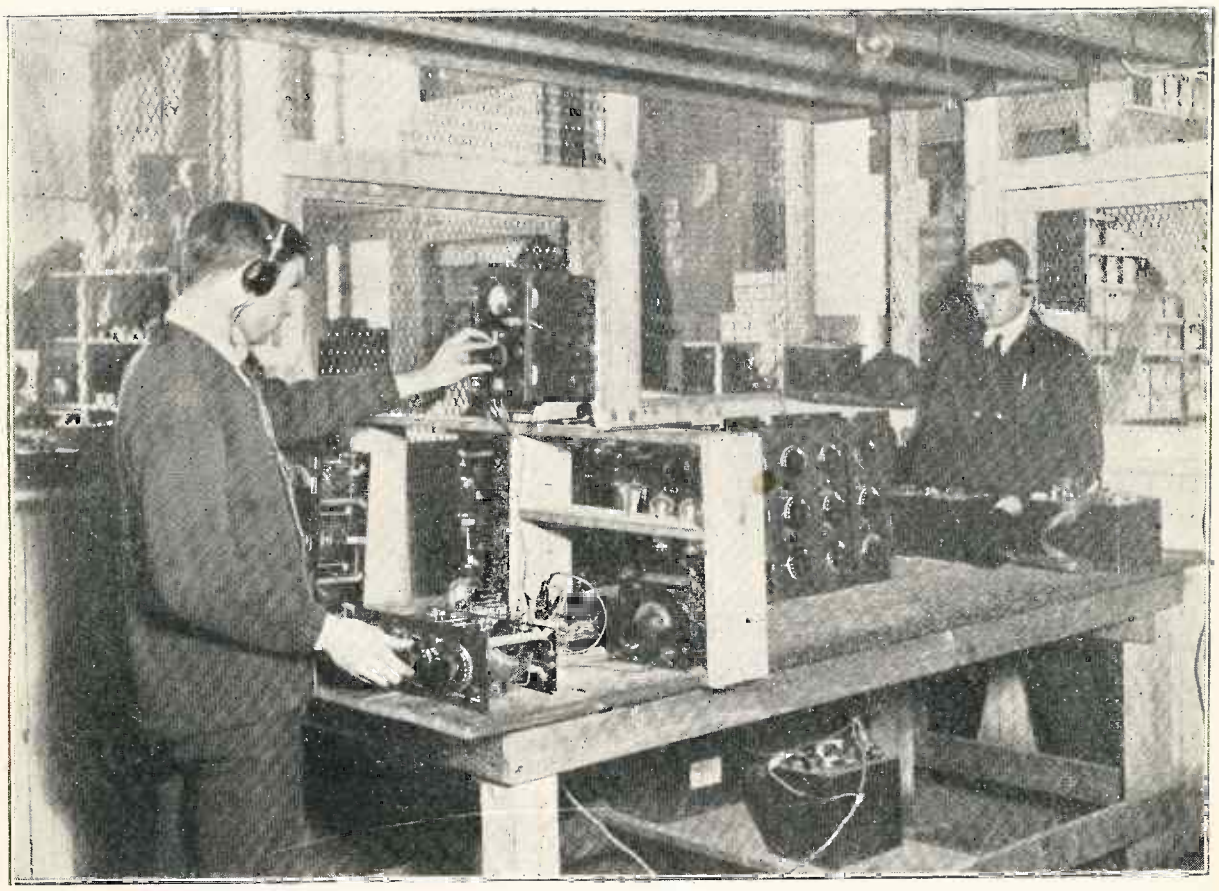

Fig. 1. This Testing Laboratory Keeps the Sets Up to Standard. A Wave Meter is Checking the Selectivity

### The Three Divisions

A visit to a large radio factory in the east was recently made for the purpose of getting fresh information. We found that the factory was divided into three general groups: office, research and testing, and manufacturing.

The office was similar to any office and was busy. Here all the orders for supplies, construction, etc., were given. One man, a cripple, by the way, spent all of his time answering questions sent by the listeners. Another was an expert trouble man who was kept busy by people who brought in their sets (faulty) to

be corrected free of charge. Other radio manufacturers have similar service and so it is seen that they spend much money for which they get no immediate return.

### When Money Means Nothing

Going on to the research room, we found it in charge of an engineer, not a "radio engineer" who did not even go through high school, but a graduate of a university engineering school. Such a man directs testing and experimenting of circuits and instruments. He has a room filled with instruments and the best electrical measuring apparatus that money can buy. The research man's job is to develop new equipment and to improve upon old circuits and instruments. The

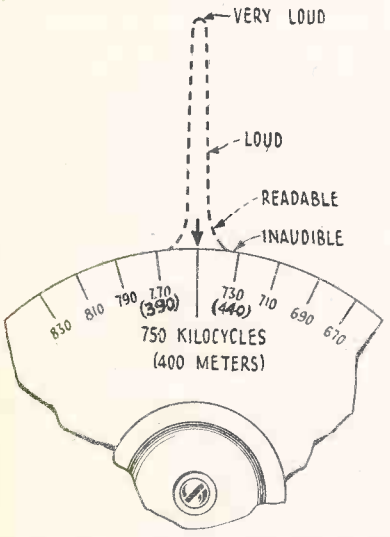


Fig. 2. This is the Curve the Laboratory Wants

research engineer is not bothered about time or money. He is asked, for instance, to design a portable three tube set which will work on a loop. About a month later he comes around and says, "well we have made up four or five sets and lent them out for a few weeks. We may have to change a few details before we are through, and ready to manufacture."

Then about two weeks later he comes into the office with a set of blueprints and is through with that particular job. His time for the design of that set was just six weeks, which is fast work. On the other hand, the average listener reads his magazine Friday, buys the parts Saturday, and has the set working Sunday. Well and good.

### Three Months is Quick Work

But when the design is brought into the office, the advertising manager and the production man have to get together. One has to write up some advertising and it will be at least six weeks before he can see it in the radio magazines because they all require some such time limit. Say six weeks until the advertising gets out to the magazines and dealers. That with the six weeks development makes twleve weeks or three months from the time it is started until the public can even hear of it. The average listener would have three sets built and discarded in that time. Of course after the receiver is designed, work can be started in the factory if the production manager gives his consent.

The set designed may work very well electrically, but if it is going to cost four hundred dollars to build or is going to require German tubes it can be seen that many of them will not be sold. So the production manager gives his O. K. if it can be sold at a reasonable price and if there are not too many disadvantages to it.

The factory proper will start on the construction after the winders, machinists, engravers, and the like have found out what to do. The stock room must have all the parts called for or else a couple of weeks must be spent waiting for parts to be delivered. After all the materials and help are ready, construction starts; that is, if the factory is not already rushed with other business.

### $2,000 for $40

Granted then, that the factory puts out one set at last, only three months after the research department was notified. This set goes to the test room and as it is the first turned out commercially it is an object of curiosity. It is tested thoroughly and if it comes up to specifications it is allowed to be sold. This first set may have cost the company two thousand dollars, although it will sell for perhaps forty dollars.

When the sets begin coming along in volume, they go through the test room, which protects the public from faulty sets. Photograph Fig. 1 shows such a laboratory at the Amrad factory. Here the sets are hooked up with "A" and "B" batteries and ground. An aerial is not used for picking up outside programs as, of course, this work must be done eight hours a day, and as you are well aware broadcasting stations do not run so continuously. Another objection to picking up music from the outside for testing is that it is not always the same. Perhaps one number is a loud band piece which comes in fine. Following that we have a violin solo, which is not nearly so loud. The set which is tested on the latter would perhaps be pronounced not nearly so good since the volume of tone would be much less. Of course this is not a good way of rating the receivers.

### An All Day Program

Instead a special sending station at the factory is used to give out radio waves continuously from morning to night. These all have the same intensity and so they should be heard with equal loudness on every set coming through. Another advantage of this method is that the sharpness of tuning of the sending station is the same and so any variation between one set and another will be caused by a difference in the manufactured product. The man shown at the left of Fig. 1 is testing the receiver on the table in comparison with a wave meter. His left hand rests on the wave control and he reads the deflection of

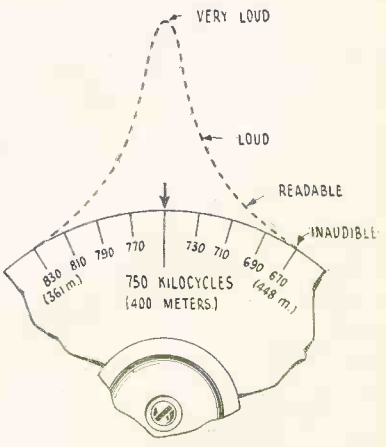


Fig. 3. If a Radio Has This Curve it is Sent Back

the miliammeter mounted right over the dial, which he turns.

Sets are usually tested at several different wave speeds. One of the standard points is 750 kilocycles. If the inspector gets a deflection on the meter way across the scale at 750 kc., and it drops off very sharply as he turns each side to 730 and 770, then the set under test is a sharply tuned one. See Fig. 2. On the other hand, if he gets a sizable reading of the meter at these two points and he must turn as far as 670 and 830 kc. before he gets the meter needle to drop to zero as Fig. 3 shows, then the set is tuned very

broadly and something is wrong which will require it to be sent back to the factory and rebuilt. All sets not coming up to standard are sent back and only the good ones go through to the stock room. Some manufacturers give their parts a very thorough testing while others give only a very slight test.

### Testing Rheostats and Coils

With certain parts, such as rheostats, for instance, only a slight test is necessary. As you will see from Fig. 4, such a unit has only two terminals, T1 and T2, and arm, "A," sliding over the resistance wire, is the only moving part. Provided the wire is not broken the device is O. K., and this can usually be told by inspection. On the other hand, a unit like the radio transformer, Fig. 5, requires several tests before it is passed. The resistance of the primary is measured, and also that of the secondary. The ratio of transformation is a very important property of such a unit. The losses at high frequency must be kept down, and if the company making such a device is putting out high class apparatus, these losses must be measured.

With a complete set a careful test is necessary, but if the set is a very cheap one the purchaser must understand that the maker cannot afford to spend too much time at this point.

Batteries, meters, rheostats and sockets are the important parts in a test room. With transformers, tubes, telephones, loudspeakers, etc., the part is plugged in or put in a socket. By means of meters connected to the socket, the inspector can tell at a glance if the part is properly built. With head phones a constant frequency buzzer is used to test the tone. The buzzer acts as a transmitting station by sending out radio waves continually. These are very weak, of course, but are sufficient to be used for testing. After testing the parts are stocked and are ready to be sold.

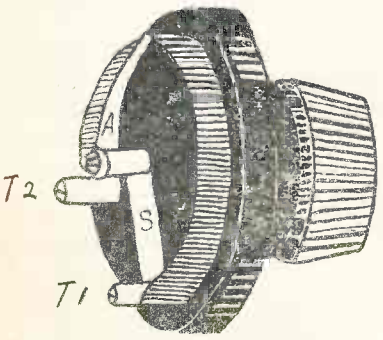


Fig. 4. This Unit is Not Tested at Laboratory

### Some Queer Orders

Many unusual orders are received. Sometimes a factory gets a request for an airplane radio set or a portable automobile set or some other odd requirement. These orders are different because they are only one of a kind and are usually placed by persons who have a serious use for them.

For instance, a western factory recently received an order for a number of radio telephone transmitters and only one receiver. The transmitters were to be used to report the conditions of electric power lines. These lines from the power house to the city were hundreds of miles long over hill, river, forest, and mountain. By placing a complete radio telephone in a small shed every few miles the guard could telephone back to the office by radio.

### Pitched Out the 2nd Story

During the world war, one radio factory was asked to build in a small box a complete radio transmitter and receiver for the U. S. Signal Corps. One of the requirements for durability was that the outfit could be thrown out of a second story window and still work unimpaired. These unique orders may take several weeks to fulfill as getting under way is a slow process.

Thus it is seen that the manufacture of radio sets is a slow, careful process and one which the average fan cannot easily duplicate. Even the cheapest of sets, tubes, condensers, and other parts have a great deal of work put into them.

The fan should remember, however, that we get nothing of value free in this world and that the more one pays for a radio set the better it will probably be. Patronize the reliable manufacturer and radio stores and you will help yourself as well as everyone else in radio the most.

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## 140 MILES OF WIRE

The completion of a direct telephone line between station WBZ, Springfield, Mass., and the studios of the twin-stations, WJZ and WJY, New York City, is announced by the Radio Corporation. So WBZ will be able to take part in the simultaneous broadcasting of feature events with the other four stations already linked together.

WGY, Schenectady, and WRC, Washington, have both been connected by WJZ and WJY for several months. With the New York studios as the heart of the system, special programs from Schenectady have been relayed to WJZ, WJY, and WRC, and unusual events in Washington have been sent over the wires to WJZ, WJY, and WGY. The system has been used most often, however, in relaying New York programs to the other two stations.

Fig. 5. A Radio Transformed Must be Carefully Tested

The addition of WBZ to the chain will enable that station to broadcast numbers from New York, Washington, or Schenectady, and will also permit the other four stations to transmit programs originating in either Springfield or Boston. Thus each of the five stations has a "remote control studio" in four different cities. The WJZ-WJY-WGY-WRC-WBZ system now covers the entire eastern half of the United States with easy "local reception."

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## TUNE YOUR SET LIKE A PIANO

Continued from Page 8

have a definite value depending upon what particular wave you are listening to.

In conclusion, then, when you see your long distance radio friend silently turning a dial with a distraught air, you may feel sure that his anxious face does not indicate that he is afraid of losing a single word of the speaker. He is merely absorbed by the delicate task of adjusting the electrical stiffness or electrical mass of his receiving circuits so that they will allow the maximum current to flow and thus set up the greater possible voltage across condenser, coil and grid.

# Fone Fun For Fans

### Broadcasting to Neighbors

"Hello, Bill, how are you getting along with your wife nowadays?"

"Well, before we were married I talked and she listened. Then after marriage she talked and I listened. Now we both talk and the neighbors listen."—Selected.

### No Imitations Wanted

Wife—"Would you like some nice waffles this morning, dear?"

Hub—"No, thank you, Helen. They look too much like fried crossword puzzles, and I'm fed up on those."—Boston Transcript.

### Debutanting

He—Do you like codfish balls?

She—I don't know. I've never been to any.—The Progressive Grocer.

### Better and Better

"Your new medicine has helped me wonderfully," wrote the grateful woman. "A month ago I could not spank the baby, and now I am able to thrash my husband. Heaven bless you."—Frivol.

### One Left Out

The Bore—Did I tell you of my adventure in Patagonia?

His Victim (having listened to about twenty adventures)—Interesting yarn?

The Bore—You bet!"

His Victim—Then you haven't told me.—London Humorist.

### Handicapped

"Poor ole Bill. 'E's so short-sighted 'e's working 'imself to death."

"Wot's 'is short sight got to do with it?"

"Well, 'e can't see when the boss ain't looking, so 'e 'as to keep shoveling all the time."—London Humorist.

### As You Were

"Clarence," she called. He stopped the car and looked around.

"I am not accustomed to call my chauffeurs by their first name, Clarence. What is your surname?"

"Darling, madam."

"Drive on, Clarence."—The Daily News.

## BIRTHS AND DEATHS

During the three years beginning with 1922, 626 stations discontinued broadcasting and 1079 new stations were licensed, as follows:

| | Stations in Operation | New Stations | Stations Discontinued |
|---|---|---|---|
| 1922 | 563 | 556 | 71 |
| 1923 | 542 | 264 | 285 |
| 1924 | 531 | 259 | 270 |

## FIVE MILLION POUNDS USED

The Copper and Brass Association in its survey of the radio industry show that five million pounds of copper were used during 1924 in the manufacture of radio equipment.

## NEW WAVES FOR CODE PRACTICE

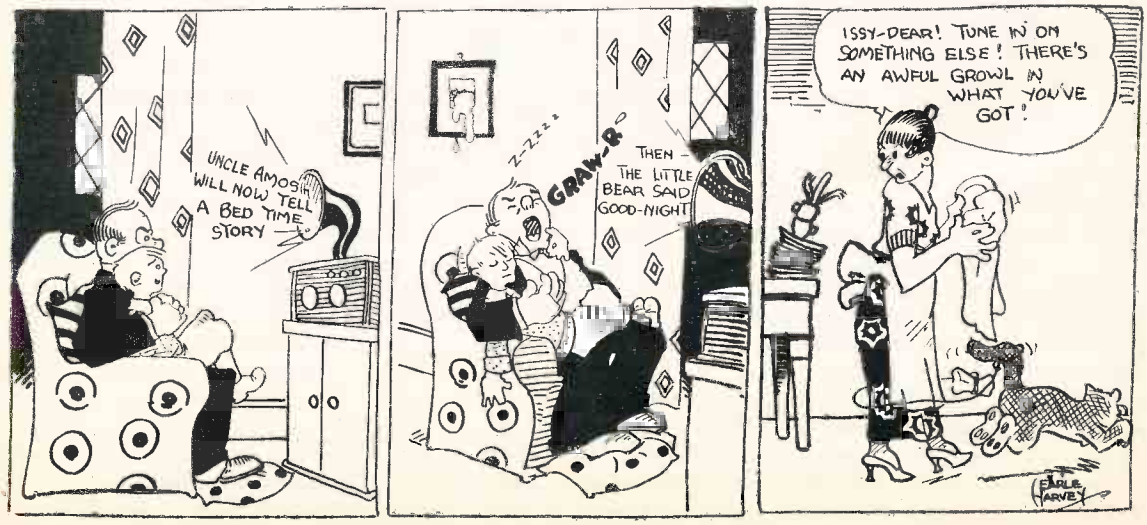
Secretary Hoover of the Department of Commerce has just announced that amateurs are now authorized to use another band of waves. These run from 399,000 to 400,000 kilocycles. The wave lengths corresponding are .7496 meter to .7477.

Right there is another lesson on why it is better to use vibration speeds, which work out in whole numbers rather than meter lengths, which have to be carried before decimal places.

Few people realize the immense number of possible operating channels that lie in these high wave speeds. While the band now assigned to amateurs is only nineteen one-thousandths of one meter in width, its extremes are separated by just one thousand kilocycles. The secretary pointed out that if it ever became feasible to conduct broadcasting on these frequencies, it would be possible to place within this band 100 broadcasting stations and give to each the present separation of ten kilocycles, and said further that all the stations in the world could operate in the upper half of the one meter band. The art has, of course, not developed to make this possible but the amateurs now have an opportunity to see what they can do.

## A LARGE INDUSTRY

The American Radio Association reports that there are 3,000 manufacturers, 1,000 distributors and 27,000 dealers of radio apparatus in the United States.



# Rx DR RADIO PRESCRIBES.

NOTE: In this section the Technical Editor will answer questions of general interest on any radio matter. Any of our readers may ask not more than two questions, and if the subjects are of importance to most radio fans they will be answered free of charge in the magazine. If they are of special interest to the questioner alone, or if a personal answer is desired, a charge of fifty cents will be made for each answer. This will entitle the questioner to a personal answer by letter. However, if the question requires considerable experimental work, higher rates will be charged.

*Question.* In the new Deresnadyne described in the February 15 issue, what is the use of Plug P2?

*Answer.* When using an outside aerial and ground this should be inserted in Jack J4. This then puts the coil L1 in circuit. In case you wish to use a loop instead of an outside aerial, then remove plug P2 and leave it disconnected. The loop should be connected with one terminal to J4 and the other one to the ground terminal. If you prefer instead of using a jack an ordinary binding post may be substituted. The same thing applies to Plug P1 and Jacks J1, J2 and J3.

*Question.* Please describe the paddlewheel coil as used in the new Deresnadyne.

*Answer.* In the paddlewheel framework there are eight slots each 1/32 inch wide. The diameter at the depth is 2¼-inch, the outside diameter is 3-inch. No. 22, D S. C. wire is used. The regular transformers have a 14-turn primary wound in the end slot which is 7/16 inch deep. The seven secondary slots are ⅜ inch deep and have 12 turns each, all connected in series. The plate and grids are taken off the two outside ends. All windings in the same direction.

The first coil consists of 84 turns (no two windings). The start is the ground connection. The selectivity tap is on the 4th turn, the medium tap is on the 9th turn and the power tap on the 16th turn. The other end is the grid terminal.

*Question.* When I try to drill a hole at a marked point in my panel I find the drill runs off to one side. How can I drill a straight hole?

*Answer.* This is a rather common trouble. The best way to do it is to prick punch where you want the hole to be located by hitting a prick punch a light tap with a hammer. Such a punch costs about 10c. Then drill a small hole, about No. 35 or No. 40, which you will find goes in easily without running off to the side. After this hole is made the large size drill will follow it easily and truly. Another advantage of this method is that the big drill takes considerable less strength to operate when the small hole has first been made.

*Question.* What is meant by a pickle bottle coil?

*Answer.* This is the name given to a coil or coupler which has no winding form in it. It is wound by getting a six or eight sided bottle, such as pickles come in and putting a short strip of tape on each of the flat sides. Then the coil is wound on top of these strips. After finishing the winding the tape is wrapped over the coil and fastened. Next the glass bottle is broken so as to withdraw it and the result is a coil which stands alone without any winding form.

Such a coil is supposed to be particularly efficient.

*Question.* I have seen the statement made that a battery charger improves the operation of a set. Is this true?

*Answer.* Strictly speaking, it is not. If the filament of a vacuum tube has impressed on it the proper voltage then it works at its most efficient point. This pressure is five volts for the UV-200 and the UV-201A. Whether this pressure

Continued on Page 30

## DRY CELL CAN BE RECHARGED

Continued from Page 16

A 100-watt lamp is used on a 110 volts for charging "A" battery cells. This will give about one ampere on direct current and so will require sixteen or eighteen hours for a complete charge. Any number of cells up to 60 can be filled at the same time by connecting them in series. As the number increases, however, the charging rate is reduced, since the back or bucking force from the batteries gets large enough to beat back some of the current. The remedy for this condition is either to reduce the resistance by using a 150 or 200-watt lamp or else to increase the length of time which the batteries are allowed to be on the line.

### When Your "B's" Run Out

From 1 to 4 blocks of 22-volt battery or 1 or 2 of 45, can be charged with a rectifier from 110 volts AC. A 15-watt lamp is big enough to use with a 22-volt "B," or a 50 with 90 volts of "B." The time taken will be ten to fifteen hours, depending on how much current flows.

The hook-up for charging a battery is very simple. It is desirable to use a series current tap for this purpose. It is screwed into any lamp socket and one cord attached to the "B" battery. The other cord runs to the rectifier. The only other connection necessary is a wire from the other pole of the rectifier to the "B" battery. You must be careful in making this hook-up to get the rectifier connected with the proper polarity. This will be explained in the directions which come with each separate make of unit.

# New Products of Special Interest

### BOILING YOUR CONDENSERS

In some positions on a radio set the exact value of capacity in a condenser is not of very serious moment. For instance, the by-pass which is connected across the telephones in order to let the high frequency waves run from the tickler coil back to the "B" battery, is specified by some authors as .001 mfd., while others think that .002 mfd. is better. It is certain that in such a position a unit which varied as much as 15 or 20 per cent or more from the rated value would not maks much difference in the operation of the set.

In other locations, however, the capacity should be fairly exact. A grid condenser, say, which changed its capacity very materially would throw out the adjustment of the set. It also might require a readjustment of the grid leak. If such a change took place without your discovering it, it is quite possible that your set would not work as you expected, and it would be difficult for you to find the cause.

One of the causes for such change in capacity in many condensers, is the weather. If a cold, damp day affects your spirits and leaves you depressed, it is not unreasonable of a fixed condenser to be affected too. As a matter of fact, it often happens that the so-called "fixed" units are really quite variable, depending on temperature and humidity.

A new condenser has just been developed by the Sangomo Electric Company, of Springfield, Ill., which gets around any such difficulty. In laboratory tests, the manufacturers report that they have boiled their condensers for hours at a time without their getting a bit tender or changing their capacity in the least. Then to be quite fair, they froze them solid in a cake of ice, and still no change resulted when measured on


Fig. 1. This Condenser May be Frozen in Cake of Ice

accurate instruments. Such a unit may have terminal wires soldered to it without causing any damage.

The way they get such very good results is by sealing the whole unit in a case of brown bakelite. This material is then heated to a high temperature, after which the bakelite sets and can not be softened by any further application of heat, cold or solvents. Notice the neat appearance which it makes as shown in Fig. 1. The relative size is indicated by comparing with the fingers of the hand which holds the condenser.

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### DR. RADIO PRESCRIBES

Continued from Page 29

comes from a fully charged battery and considerable resistance cut in with the rheostat or from a battery nearly empty with only a small rheostat resistance, it makes no difference to the tube. If the bank teller gives you a dollar in change from the top of a big pile of bills, it is worth no more to you than if it is the last one on the bottom, provided it is still $1.00.

Of course, when the battery is on its last legs, the voltage falls off fairly rapidly, and this requires occasional adjustment of the rheostat to hold the filament pressure constant. If such adjustment is made it is a bother and on the other hand, if you neglect it, then the reception will suffer. For that reason, it is a convenience to have a device for charging your battery at home. However, to claim that the set works better with it is a mistake.

*Question.* Why is it that high ratio transformers are sold at a bigger price than the same line of low ratio units?

*Answer.* In either case the transformer uses the same amount of iron. Usually the primary winding is apt to be the same also. The ratio means the number of turns in the secondary divided by the primary. Thus if there are 5000 primary turns and 17,500 secondary the ratio is 17,500 divided by 5000, which equals 3½ to 1. If this transformer is to have a 6 to 1 ratio it will need 30,000 turns in the secondary. Comparing this with the 17,500 of the lower ratio you will see that quite a bit more wire is needed and a much longer time for winding. This is the reason for the higher price.

## UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

Abbreviations: W.L., wave length in meters; K.C., frequencies in kilocycles; W.P., wattpower of station.

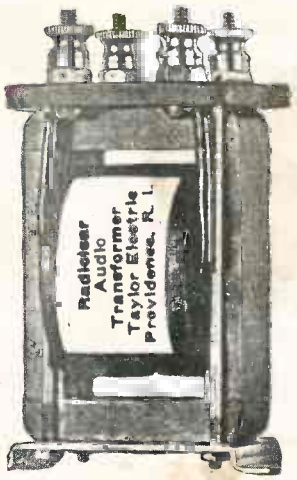
| | K.C. | W.L. | W.P. |
|---|---|---|---|
| KDKA—Westinghouse Elec. & Mfg. Co., E. Pittsburg, Pa. | 970- | 309- | 1000 |
| KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O. | 1200- | 250- | 500 |
| KDYL—Newhouse Hotel, Salt Lake City, Utah | 900- | 333- | 500 |
| KDYM—Savoy Theater, San Diego, Cal. | 1070- | 280- | 100 |
| KDZB—Frank E. Siefert, Bakersfield, Cal. | 1430- | 210- | 100 |
| KDZE—Rhodes Dept. Store, Seattle, Wash. | 1110- | 270- | 100 |
| KFAB—Nebraska Buick Auto Co., Lincoln, Neb. | 1250- | 240- | 200 |
| KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz. | 1000- | 300- | 500 |
| KFAE—State College of Washington | 860- | 349- | 500 |
| KFAF—Western Radio Corp., Denver, Colo. | 1080- | 278- | 500 |
| KFAJ—University of Colorado, Boulder, Colo. | 1150- | 261- | 100 |
| KFAU—Boise High School, Boise, Idaho | 1090- | 275- | 500 |
| KFBK—Kimball Upson Co., Sacramento, Cal. | 1210- | 248- | 100 |
| KFCF—Frank A. Moore, Walla Walla, Wash. | 1170- | 256- | 100 |
| KFCL—Leslie E. Rice, Los Angeles, Cal. | 1270- | 236- | 500 |
| KFDM—Magnolia Petroleum Co., Beaumont, Tex. | 950- | 316- | 500 |
| KFDX—First Baptist Church, Shreveport, La. | 1200- | 250- | 100 |
| KFDY—S. Dak. Ste. Col. Ag. & Mech. Arts, Br'kngs., S. Dak. | 1100- | 273- | 100 |
| KFEQ—Scroggin & Co. Bank, Oak, Nebr. | 1120- | 268- | 100 |
| KFEX—Augsburg Seminary, Minneapolis, Minn. | 1150- | 261- | 100 |
| KFFV—Graceland College, Lamoni, Iowa | 1200- | 250- | 100 |
| KFGC—Louisiana State Univ., Baton Rouge, La. | 1120- | 268- | 100 |
| KFGD—Oklahoma College for Women, Chickasha, Okla. | 1190- | 252- | 100 |
| KFGH—Leland Stanford Junior Univ., Stanford Univ., Cal. | 1100- | 273- | 500 |
| KFGX—First Presbyterian Church, Orange, Tex. | 1200- | 250- | 500 |
| KFHJ—Fallon & Co., Santa Barbara, Cal. | 833- | 360- | 100 |
| KFHR—Star Elec. & Radio Co., Seattle, Wash. | 1140- | 263- | 100 |
| KFI—Earl C. Anthony, Los Angeles, Cal. | 640- | 469- | 1500 |
| KFIF—Benson Polytechnic Institute, Portland, Ore. | 1210- | 248- | 100 |
| KFIQ—First Methodist Church, Yakima, Wash. | 1170- | 256- | 100 |
| KFIZ—Daily Com'lth & Seifert Rad, Corp., Fondulac, Wis. | 1100- | 273- | 100 |
| KFJF—National Radio Mfg. Co., Oklahoma, Okla. | 1150- | 261- | 225 |
| KFJM—University of No. Dak., Grand Forks, No. Dak. | 1080- | 278- | 100 |
| KFKB—Brinkley-Jones Hosp. Assoc., Milford, Kans. | 1100- | 273- | 500 |
| KFKQ—Conway Radio Laboratories, Conway, Ark. | 1200- | 250- | 100 |
| KFKU—University of Kansas, Lawrence, Kas. | 1090- | 275- | 100 |
| KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb. | 1040- | 288- | 1500 |
| KFLR—University of New Mexico, Albuquerque, N. Mex. | 1180- | 254- | 100 |
| KFLV—Swedish Evangalical Mission Church, Rockford, Ill. | 1310- | 229- | 100 |
| KFLZ—Atlantic Automobile Co., Atlantic, Iowa | 1100- | 273- | 100 |
| KFMQ—University of Arkansas, Fayetteville, Ark. | 1000- | 300- | 500 |
| KFMT—George W. Young, Minneapolis, Minn. | 1140- | 263- | 100 |
| KFMX—Carleton College, Northfield, Minn. | 890- | 337- | 750 |
| KFNF—Henry Field Seed Co., Shenandoah, Iowa. | 1130- | 266- | 500 |
| KFOA—Rhodes Dept. Store, Seattle, Wash. | 660- | 454- | 500 |
| KFOC—First Christian Church, Whittier, Cal. | 1270- | 236- | 100 |
| KFON—Echophone Radio Shop, Long Beach, Cal. | 1280- | 234- | 100 |
| KFOU—Hommel Manufacturing Co., Richmond, Cal. | 1180- | 254- | 100 |
| KFOX—Technical High School, Omaha, Nebr. | 1210- | 248- | 100 |
| KFPG—Oliver S. Garretson, Los Angeles, Cal. | 1260- | 238- | 100 |
| KFPR—Los Angeles County Forestry, Los Angeles, Cal. | 1300- | 231- | 500 |
| KFPT—Radio Service Corp. of Utah, Salt Lake City, Utah. | 1150- | 261- | 500 |
| KFPX—First Presbyterian Church, Pine Bluff, Ark. | 1240- | 242- | 100 |
| KFPY—Symons Investment Co., Spokane, Wash. | 1130- | 266- | 100 |
| KFQB—Searchlight Publishing Co., Fort Worth, Tex. | 1180- | 254- | 100 |
| KFQC—Kidd Brothers Radio Shop, Taft, Cal. | 1300- | 231- | 100 |
| KFQM—Texas Highway Bulletin, Austin, Tex. | 1120- | 268- | 100 |
| KFQU—W. E. Riker, Holy City, Calif. | 1280- | 234- | 100 |
| KFQX—Alfred H. Hubbard, Seattle, Wash. | 1290- | 233- | 500 |
| KFQZ—Taft Radio Co., Hollywood, Calif. | 1330- | 226- | 250 |
| KFRB—Hall Bros., Beeville, Texas | 1210- | 248- | 250 |
| KFRU—Etherical Radio Co., Bristow, Okla. | 760- | 395- | 500 |
| KFRW—United Churches of Olympia, Olympia, Wash. | 1360- | 220- | 100 |
| KFSG—Echo Park Evangelistic Asso., Los Angeles, Calif. | 1080- | 278- | 500 |
| KFUM—W. D. Corley, Colorado Springs, Colo. | 1240- | 242- | 100 |
| KFUO—Concordia Seminary, St. Louis, Mo. | 550- | 545- | 500 |
| KFUT—University of Utah, Salt Lake City, Utah. | 1150- | 261- | 100 |
| KFUU—Colburn Radio Laboratories, San Leandro, Calif. | 1340- | 224- | 100 |
| KFWA—Browning Bros. Co., Ogden, Utah. | 1400- | 214- | 500 |
| KFWB—Warner Bros. Pictures, Inc., Hollywood, Cal. | 1190- | 252- | 500 |
| KGO—General Electric Co., Oakland, Cal. | 830- | 361- | 2000 |
| KGU—Marion A. Mulrony, Honolulu, Hawaii | 833- | 360- | 500 |
| KGW—Portland Morning Oregonian, Portland, Ore. | 610- | 491- | 500 |
| KHJ—Times-Mirror Co., Los Angeles, Cal. | 740- | 405- | 500 |
| KHQ—Excelsior Motorcycle & Bicycle Co., Seattle, Wash. | 1100- | 273- | 100 |
| KJR—Northwest Radio Service Co., Seattle, Wash. | 780- | 384- | 500 |
| KJS—Bible Institute of Los Angeles, Los Angeles, Cal. | 1020- | 294- | 500 |
| KLDS—Reorg. Church of Jesus Christ of Latter Day Sts., Ind., Mo. | 1120- | 268- | 250 |
| KLS—Warner Bros. Radio Supplies Co., Oakland, Calif. | 1240- | 242- | 250 |
| KLX—Tribune Publishing Co., Oakland, Calif. | 590- | 509- | 500 |
| KLZ—Reynolds Radio Co., Denver, Colo. | 1130- | 266- | 250 |
| KNT—Walter Hemrich, Kukak Bay, Alaska | 1140- | 263- | 100 |
| KNX—Los Angeles Express, Los Angeles, Cal. | 890- | 337- | 500 |
| KOA—General Electric Co., Denver, Colo. | 930- | 322- | 1000 |
| KOB—New Mexico Col. of Agriculture, State Col., N. Mex. | 860- | 349- | 500 |
| KOP—Detroit Police Dept., Detroit, Mich. | 1090- | 278- | 500 |
| KPO—Hale Bros., San Francisco, Cal. | 700- | 428- | 500 |
| KQV—Doubleday-Hill Electric Co., Pittsburg, Pa. | 1090- | 275- | 500 |
| KSAC—Kansas State Agric. College | 880- | 341- | 500 |
| KSD—Post-Dispatch, St. Louis, Mo. | 550- | 545- | 750 |
| KTHS—New Arlington Hotel Co., Hot Springs, Ark. | 800- | 375- | 500 |
| KTW—First Presbyterian Church, Seattle, Wash. | 833- | 360- | 750 |
| KUO—Examiner Printing Co., San Francisco, Cal. | 1220- | 246- | 150 |
| KUOM—State Univ. of Montana, Missoula, Mont. | 1230- | 244- | 500 |
| KWH—Los Angeles Examiner, Los Angeles, Cal. | 833- | 360- | 250 |
| KYQ—The Electric Shop, Honolulu, Hawaii | 1110- | 270- | 100 |
| KYW—Westinghouse Elec. & Mfg. Co., Chicago, Ill. | 560- | 535- | 1500 |
| KZKZ—Electrical Supply Co., Manila, P. I. | 1110- | 270- | 100 |
| KZM—Preston D. Allen, Oakland, Cal. | 833- | 360- | 100 |
| KZRQ—Far Eastern Radio, Manila, P. I. | 1350- | 222- | 500 |
| WAAB—Valdemar Jensen, New Orleans, La. | 1100- | 273- | 100 |
| WAAC—Tulane University, New Orleans, La. | 1090- | 275- | 100 |
| WAAF—Chicago Daily Drovers Journal, Chicago, Ill. | 1080- | 278- | 200 |
| WAAM—I. R. Nelson Co., Newark, N. J. | 1140- | 263- | 250 |
| WAAW—Omaha Grain Exchange, Omaha, Neb. | 1080- | 278- | 500 |
| WABA—Lake Forest University, Lake Forest, Ill. | 1320- | 227- | 100 |
| WABI—Bangor Railway & Electric Co., Bangor, Me. | 1250- | 240- | 100 |
| WABL—Connecticut Agric. College, Storrs, Conn. | 1090- | 275- | 100 |
| WABN—Ott Radio (Inc.) La Crosse, Wis. | 1230- | 244- | 500 |
| WABO—Lake Avenue Baptist Church, Rochester, N. Y. | 1080- | 278- | 100 |
| WABX—Henry B. Joy, Mount Clemens, Mich. | 1180- | 254- | 250 |
| WAFD—Albert B. Parfet Co., Port Huron, Mich. | 1290- | 233- | 250 |
| WAHG—A. H. Grebe Co., Richmond Hill, N. Y. | 950- | 316- | 500 |
| WAMD—Hubbard & Co., Minneapolis, Minn. | 1230- | 244- | 100 |
| WBAA—Purdue University, West Lafayette, Ind. | 1100- | 273- | 250 |
| WBAN—Wireless Phone Corp., Paterson, N. J. | 1230- | 244- | 100 |
| WBAO—James Millikin University, Decatur, Ill. | 1090- | 275- | 100 |
| WBAP—Wortham-Carter Publishing Co., Fort Worth, Tex. | 630- | 476- | 1000 |
| WBAV—Erner & Hopkins Co., Columbus, Ohio. | 1020- | 293- | 500 |
| WBBP—Petoskey High School, Petoskey, Mich. | 1400- | 214- | 100 |
| WBBG—Irving Vermilya, Mattapoisett, Mass. | 1210- | 248- | 500 |
| WBBL—Grace Covenant Church, Richmond, Va. | 1310- | 229- | 100 |
| WBBM—Atlas Investment Co., Chicago, Ill. | 1330- | 226- | 200 |
| WBBR—People's Pulpit Assoc., Rossville, N. Y. | 1100- | 273- | 500 |
| WBES—Bliss Electrical School, Takoma Park, Md. | 1350- | 222- | 100 |
| WBS—D. W. May, Newark, N. J. | 1190- | 252- | 100 |
| WBT—Southern Radio Corp., Charlotte, N. C. | 1090- | 275- | 250 |
| WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass. | 900- | 331- | 1500 |
| WCAD—St. Lawrence University, Canton, N. Y. | 1140- | 263- | 250 |
| WCAE—Kaufmann & Baer Co., Pittsburg, Pa. | 650- | 461- | 500 |
| WCAH—Entrekin Electric Co., Columbus, O. | 1130- | 266- | 200 |
| WCAI—Nebraska Wesleyan Uni., Uni. Place, Nebr. | 1190- | 275- | 500 |
| WCAL—St. Olaf College, Northfield, Minn. | 890- | 337- | 500 |
| WCAP—Cheaspeake & Potomac Tel. Co., Wash., D. C. | 640- | 469- | 500 |
| WCAR—Southern Radio Corp. of Texas, San Antonio, Tex. | 1140- | 263- | 100 |
| WCAU—Durham & Co., Philadelphia, Pa. | 1080- | 278- | 500 |
| WCAX—University of Vermont, Burlington, Vt. | 1200- | 250- | 100 |
| WCAY—Milwaukee Civic Br'dcstng Assoc., Milwaukee, Wis. | 1130- | 266- | 250 |
| WCBC—University of Michigan, Ann Arbor, Mich. | 1310- | 229- | 200 |
| WCBD—Wilbur G. Voliva, Zion, Ill. | 870- | 345- | 500 |
| WCBI—Nicoll, Duncan & Rush, Bemis, Tenn. | 1250- | 240- | 150 |
| WCUW—Clark University, Worcester, Mass. | 1260- | 238- | 250 |
| WCCO—Washburn Crosby Co., Minneapolis, Minn. | 720- | 416- | 500 |

| | K.C. | W.L. | W.P. |
|---|---|---|---|
| WCEE—Charles E. Erbstein, Elgin, Ill. | 1090- | 275- | 500 |
| WCK—Stix, Baer & Fuller Dry Goods Co., St. Louis, Mo. | 1100- | 273- | 100 |
| WCM—Texas Markets & Warehouse Dept., Austin, Tex. | 1120- | 268- | 250 |
| WCN—Foster & McDonnell, Chicago, Ill. | 1130- | 266- | 500 |
| WCTS—C. T. Sherer Co., Worcester, Mass. | 1120- | 268- | 100 |
| WCX—Detroit Free Press, Detroit, Mich. | 580- | 517- | 500 |
| WDAE—Tampa Daily News, Tampa, Fla. | 1100- | 273- | 250 |
| WDAF—Kansas City Star, Kansas City, Mo. | 820- | 366- | 500 |
| WDAG—J. Laurence Martin, Amarillo, Tex. | 1140- | 263- | 100 |
| WDBE—Gilham-Schoen Electric Co., Atlanta, Ga. | 1080- | 278- | 100 |
| WDBR—Tremont Temple Baptist Church, Boston, Mass. | 1170- | 256- | 100 |
| WDBY—North Shore Congregational Church, Chicago, Ill. | 1160- | 258- | 500 |
| WDWF—Dutee W. Flint, Cranston, R. I. | 680- | 441- | 500 |
| WDZ—James L. Bush, Tuscola, Ill. | 1080- | 278- | 100 |
| WEAF—American Tel. & Tel. Co., New York, N. Y. | 610- | 492- | 2000 |
| WEAI—Cornell University, Ithaca, N. Y. | 1180- | 254- | 500 |
| WEAJ—University of So. Dakota, Vermilion, So. Dak. | 1080- | 278- | 100 |
| WEAM—Borough of North Plainfield, No. Plainfield, N. J. | 1150- | 261- | 250 |
| WEAN—Shepard Co., Providence, R. I. | 1110- | 270- | 100 |
| WEAO—Ohio State University, Columbus, Ohio. | 1020- | 294- | 500 |
| WEAP—Mobile Radio Co., Mobile, Ala. | 1140- | 263- | 100 |
| WEAR—Goodyear Tire & Rubber Co., Cleveland, Ohio. | 770- | 389- | 1000 |
| WEAU—Davidson Bros. Co., Sioux City, Iowa. | 1090- | 275- | 100 |
| WEAY—Iris Theater, Houston, Tex. | 833- | 360- | 500 |
| WEBH—Edgewater Beach Hotel Co., Chicago, Ill. | 810- | 370- | 1000 |
| WEBJ—Third Avenue Railway Co., New York, N. Y. | 1100- | 273- | 500 |
| WEBL—Radio Corp. of America, United States (portable). | 1330- | 226- | 100 |
| WEBM—Radio Corp. of America, United States (portable). | 1330- | 226- | 100 |
| WEBW—Beloit College, Beloit, Wis. | 1120- | 268- | 500 |
| WEEI—Edison Electric Illuminating Co., Boston, Mass. | 630- | 476- | 500 |
| WEMC—Emmanuel Missionary Col., Berrien Springs, Mich. | 1050- | 286- | 500 |
| WEW—St. Louis University, St. Louis, Mo. | 1210- | 248- | 100 |
| WFAA—Dallas News & Dallas Journal, Dallas, Tex. | 630- | 476- | 500 |
| WFAV—University of Nebraska, Lincoln, Neb. | 1090- | 275- | 500 |
| WFBB—Eureka College, Eureka, Ill. | 1250- | 240- | 100 |
| WFBG—William F. Gable Co., Altoona, Pa. | 1080- | 278- | 100 |
| WFBH—Concourse Radio Corp., New York, N. Y. | 1100- | 273- | 500 |
| WFBI—Galvin Radio Supply Co. | 1270- | 236- | 100 |
| WFBK—Dartmouth College, Hanover, N. H. | 1170- | 256- | 100 |
| WFBL—Onondoga Hotel, Syracuse, N. Y. | 1190- | 252- | 100 |
| WFBM—Merchant Heat & Light Co., Indianapolis, Ind. | 1120- | 268- | 250 |
| WFBR—Fifth Infantry Maryland N. G., Baltimore, Md. | 1180- | 254- | 100 |
| WFBY—U. S. Army 5th Corps Area, Ft. Benj. Har'sn, Ind. | 1160- | 258- | 100 |
| WFI—Strawbridge & Clothier, Philadelphia, Pa. | 760- | 395- | 500 |
| WGAQ—W. G. Patterson, Shreveport, La. | 1140- | 263- | 150 |
| WGAZ—South Bend Tribune, South Bend, Ind. | 1090- | 275- | 250 |
| WGBA—Jones Electric & Radio Mfg. Co., Baltimore, Md. | 1180- | 254- | 100 |
| WGBB—Harry H. Carman, Freeport, N. Y. | 1240- | 244- | 100 |
| WGBG—Breitenbach's Radio Shop, Thrifton, Va. | 1330- | 226- | 100 |
| WGBS—Gimbel Bros., New York. | 950- | 316- | 1000 |
| WARC—Am. Rad. & Research Corp., Medf'd H'lsde, Mass. | 1150- | 261- | 100 |
| WGN—The Tribune, Chicago, Ill. | 810- | 370- | 1000 |
| WGR—Federal Telephone Mfg. Corp., Buffalo, N. Y. | 940- | 319- | 750 |
| WGST—Georgia School of Technology, Atlanta, Ga. | 1110- | 270- | 500 |
| WGY—General Electric Co., Schenectady, N. Y. | 790- | 380- | 1500 |
| WHA—University of Wisconsin, Madison, Wis. | 560- | 535- | 500 |
| WHAD—Marquette University, Milwaukee, Wis. | 1000- | 275- | 500 |
| WHAG—University of Cincinnati, Cincinnati, O. | 1290- | 233- | 100 |
| WHAM—University of Rochester, Rochester, N. Y. | 1080- | 278- | 100 |
| WHAR—Seaside Hotel, Atlantic City, N. J. | 1090- | 275- | 100 |
| WHAS—Courier Journal & Louisville Times. | 750- | 400- | 500 |
| WHAV—Wilmington Electric Specity Co., Wilmington, Del. | 1130- | 266- | 100 |
| WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y. | 790- | 380- | 500 |
| WHB—Sweeney School Co., Kansas City, Mo. | 820- | 366- | 500 |
| WHDI—Wm. Hood Dunwoody Ind. Inst., Minneapls, Minn. | 1080- | 278- | 100 |
| WHEC—Hickson Electric Co., Inc., Rochester, N. Y. | 1160- | 258- | 100 |
| WHBF—Beardsley Specialty Co., Rock Island, Ill. | 1350- | 222- | 100 |
| WHBH—Culver Military Academy, Culver, Ind. | 1350- | 222- | 100 |
| WHK—Radiovox Co., Cleveland, O. | 1100- | 273- | 100 |
| WHN—George Schubel, New York, N. Y. | 830- | 361- | 500 |
| WHO—Bankers Life Co., Des Moines, Iowa. | 570- | 526- | 500 |
| WIAD—Howard R. Miller, Philadelphia, Pa. | 1200- | 250- | 100 |
| WIAK—Journal-Stockman Co., Omaha, Nebr. | 1080- | 278- | 250 |
| WIAS—Home Electric Co., Burlington, Iowa. | 1180- | 254- | 100 |
| WIK—K. & L. Electric Co., McKeesport, Pa. | 1280- | 234- | 100 |
| WIL—St. Louis Star, Benson Radio Co., St. Louis, Mo. | 1100- | 273- | 250 |
| WIP—Gimbel Bros., Philadelphia, Pa. | 590- | 508- | 500 |
| WJAD—Jackson's Radio Eng. Laboratories, Waco, Texas. | 850- | 353- | 500 |
| WJAG—Norfolk Daily News, Norfolk, Nebr. | 1110- | 270- | 250 |
| WJAN—Peoria Star, Peoria, Ill. | 1100- | 273- | 100 |
| WJAR—The Outlet Co., Providence, R. I. | 980- | 306- | 500 |
| WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa. | 1090- | 275- | 500 |
| WJAZ—Zenith Radio Corp., Chicago, Ill. (portable) | 1120- | 268- | 100 |
| WJJD—Supreme Lodge, L. O. Moose, Mooseheart, Ill. | 990- | 303- | 500 |
| WJY—Radio Corporation of America, New York, N. Y. | 740- | 405- | 1000 |
| WJZ—Radio Corporation of America, New York, N. Y. | 660- | 454- | 1000 |
| WKAQ—Radio Corporation of Porto Rico, San Juan, P. R. | 880- | 341- | 500 |
| WKAR—Michigan Agric. Col., E. Lansing, Mich. | 1050- | 286- | 500 |
| WKY—WKY Radio Shop, Oklahoma, Okla. | 1090- | 275- | 100 |
| WLAL—First Christian Church, Tulsa, Okla. | 1200- | 250- | 150 |
| WLBL—Wisconsin Dept. of Markets, Stevens Point, Wis. | 1080- | 278- | 500 |
| WLIT—Lit Bros., Philadelphia, Pa. | 760- | 395- | 500 |
| WLS—Sears, Roebuck Co., Chicago, Ill. | 870- | 345- | 500 |
| WLW—Crosley Radio Corporation, Harrison, O. | 710- | 422- | 1500 |
| WMAC—Clive B. Meredith, Cazenovia, N. Y. | 1090- | 275- | 100 |
| WMAF—Round Hills Radio Corp., Dartmouth, Mass. | 833- | 360- | 500 |
| WMAF—Round Hills Radio Corp., Dartmouth, Mass. | 833- | 360- | 100 |
| WMAH—General Supply Co., Lincoln, Neb. | 1180- | 254- | 100 |
| WMAK—Norton Laboratories, Lockport, N. Y. | 1130- | 466- | 500 |
| WMAQ—Chicago Daily News, Chicago, Ill. | 670- | 448- | 500 |
| WMAY—Kingshighway Presbyterian Church, St. Louis, Mo. | 1210- | 248- | 100 |
| WMAZ—Mercer University, Macon, Ga. | 1150- | 261- | 100 |
| WMBF—Fleetwood Hotel, Miami Beach, Fla. | 780- | 384- | 500 |
| WMC—Commercial Appeal, Memphis, Tenn. | 600- | 500- | 500 |
| WMH—Ainsworth-Gates Radio Co., Cincinnati, O. | 710- | 422- | 750 |
| WMH—Ainsworth-Gates Radio Co., Cincinnati, O. | 920- | 326- | 750 |
| WMU—Doubleday Hull Electric Co., Washington, D. C. | 1150- | 261- | 100 |
| WNAC—Shepard Stores, Boston, Mass. | 1070- | 280- | 500 |
| WNAD—University of Oklahoma, Norman, Okla. | 1180- | 254- | 250 |
| WNAP—Wittenberg College, Springfield, Ohio. | 1210- | 248- | 100 |
| WNAT—Lennig Bros. Co., Philadelphia, Pa. | 1200- | 250- | 100 |
| WNAX—Dakota Radio Apparatus Co., Yankton, S. Dak. | 1230- | 244- | 100 |
| WNJ—Radio Shop of Newark, Newark, N. J. | 1290- | 233- | 150 |
| WNYC—City of New York, New York, N. Y. | 570- | 526- | 1000 |
| WOAI—Southern Equipment Co., San Antonio, Texas. | 760- | 395- | 500 |
| WOAN—James D. Vaughn, Lawrenceburg, Tenn. | 1060- | 283- | 500 |
| WOAW—Woodmen of the World, Omaha, Nebr. | 570- | 526- | 1000 |
| WOC—Palmer School of Chiropractic, Davenport, Iowa. | 620- | 484- | 1500 |
| WOI—Iowa State College, Ames, Iowa. | 1110- | 270- | 500 |
| WOO—John Wanamaker, Philadelphia, Pa. | 590- | 508- | 500 |
| WOQ—Unity School of Christianity, Kansas City, Mo. | 1080- | 278- | 500 |
| WOR—L. Bamberger & Co., Newark, N. J. | 740- | 405- | 500 |
| WORD—People's Pulpit Association, Batavia, Ill. | 1080- | 278- | 500 |
| WOS—Missouri State Marketing Bureau, Jefferson City, Mo. | 680- | 441- | 500 |
| WPAJ—Doolittle Radio Corporation, New Haven, Conn. | 1120- | 268- | 100 |
| WPG—Municipality of Atlantic City, Atlantic City, N. J. | 1000- | 300- | 500 |
| WPSC—Pennsylvania State College, State College, Pa. | 1150- | 261- | 500 |
| WQAA—Horace A. Beale, Jr., Parkesburg, Pa. | 1360- | 220- | 500 |
| WQAC—Gish Radio Service, Amarillo, Tex. | 1280- | 234- | 100 |
| WQAM—Electrical Equipment Co., Miami, Fla. | 1120- | 268- | 100 |
| WQAN—Scranton Times, Scranton, Pa. | 1200- | 250- | 100 |
| WQAO—Calvary Baptist Church, New York, N. Y. | 833- | 360- | 100 |
| WQAS—Prince-Walter Co., Lowell, Mass. | 1190- | 252- | 100 |
| WQJ—Calumet Rainbow Broadcasting Co., Chicago, Ill. | 670- | 448- | 500 |
| WRAA—Rice Institute, Houston, Tex. | 1170- | 256- | 100 |
| WRAK—Economy Light Co., Escanaba, Mich. | 1170- | 256- | 100 |
| WRAL—Northern States Power Co., St. Croix Falls, Wis. | 1210- | 248- | 100 |
| WRAM—Lombard College, Galesburg, Ill. | 1230- | 244- | 100 |
| WRAV—Antioch College, Yellow Springs, Ohio. | 1140- | 263- | 100 |
| WRAX—Flexon's Garage, Gloucester City, N. J. | 1120- | 268- | 100 |
| WRBC—Immanuel Lutheran Church, Valparaiso, Ind. | 1080- | 278- | 500 |
| WRC—Radio Corporation of America, Washington, D. C. | 640- | 469- | 500 |
| WREO—Reo Motor Car Co., Lansing, Mich. | 1050- | 286- | 500 |
| WRK—Doron Bros. Electrical Co., Hamilton, O. | 1110- | 270- | 200 |
| WRM—University of Illinois, Urbana, Ill. | 1100- | 273- | 500 |
| WRR—Dallas Police & Fire Dept., Dallas, Tex. | 1150- | 261- | 200 |
| WRW—Tarrytown Radio Research Laboratories. | 1100- | 273- | 500 |
| WSAB—S. E. Missouri State Tech's Col., Cape Gir'du Mo. | 1090- | 275- | 100 |
| WSAC—Clemson Agric. Col., Clemson College, S. C. | 890- | 337- | 500 |
| WSAD—J. A. Foster Co., Providence, R. I. | 1170- | 256- | 100 |
| WSAG—Gospel Tabernacle, St. Petersburg, Fla. | 1130- | 266- | 500 |
| WSAI—United States Playing Card Co., Cincinnati, O. | 920- | 326- | 500 |
| WSAJ—Grove City College, Grove City, Pa. | 1310- | 229- | 250 |
| WSAP—The City Temple, New York, N. Y. | 1140- | 263- | 250 |
| WSAR—Doughty & Welch Electric Co., Fall River, Mass. | 1180- | 254- | 100 |
| WSAV—Clifford W. Vick Radio Const. Co., Houston, Tex. | 833- | 360- | 100 |
| WSB—Atlantic Journal, Atlantic, Ga. | 700- | 428- | 750 |
| WSL—J. & M. Electric Co., Utica, N. Y. | 1100- | 273- | 100 |
| WSOE—School of Engi'rng of Milwaukee, Milwaukee, Wis. | 1220- | 246- | 100 |
| WSUI—State University of Iowa, Iowa City, Iowa. | 620- | 484- | 500 |
| WSY—Alabama Polytechnic Institute, Auburn, Ala. | 1200- | 250- | 500 |
| WTAB—Fall River Daily Herald Pub. Co., Fall R'vr, Mass. | 1130- | 266- | 100 |
| WTAC—Penn. Traffic Co., Johnstown, Pa. | 1430- | 210- | 100 |
| WTAM—Willard Storage Battery Co., Cleveland, O. | 770- | 389- | 1500 |
| WTAQ—S. H. Van Gorden & Son, Osseo, Wis. | 1180- | 254- | 200 |
| WTAR—Reliance Electric Co., Norfolk, Va. | 1150- | 261- | 100 |
| WTAS—Charles E. Erbstein, Elgin, Ill. | 990- | 302- | 1000 |
| WTAT—Edison Illum'ting Co., Boston, Mass., (portable) | 1230- | 302- | 100 |
| WTAW—Agric. & Mech. Col. of Texas, Col. Station, Tex. | 1110- | 270- | 250 |
| WTAY—Oak Leaves Broadcasting Station, Oak Park, Ill. | 1200- | 250- | 500 |
| WTIC—Travelers Insurance Co., Hartford, Conn. | 860- | 349- | 500 |
| WWAD—Wright & Wright, Philadelphia, Pa. | 1200- | 250- | 100 |
| WWAE—Lawrence J. Crowley, Joliet, Ill. | 1240- | 242- | 500 |
| WWAO—Michigan College of Mines, Houghton, Mich. | 1230- | 244- | 250 |
| WWI—Ford Motor Co., Dearborn, Mich. | 1130- | 266- | 250 |
| WWJ—Detroit News, Detroit, Mich. | 850- | 353- | 500 |

# When the Earthquake Struck Salem

A large five-tube radio set was on the table in the living room of Mr. James Bancroft. He had been working on the set, and had foolishly left it right on the edge. The earthquake jarred the table enough so that it toppled off to the floor.

Of course, the tubes were wrecked. When he replaced them he also found that one transformer was injured. But the work that he had been doing on the set was that of replacing the second audio step with a RADICLEAR transformer. This unit had not been damaged at all by the shock.




When you examine the sturdy construction of the RADICLEAR audio transformer you will not be surprised that it was not damaged at all, although the ordinary type was injured. The heavy bakelite connection board at the top is so rugged that the terminals do not shake loose.

You can not see the inside wires, but owing to the good design and careful workmanship this part is just as substantial as the outside. Of course, all this plays its part in the unusually clear and loud music which these transformers give.

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In this connection, you may be interested to know that the AUDION crystal is just as good in a crystal set as is the RADICLEAR transformer in the more ambitious hook-up. Although this crystal sells for only 25c, it comes packed in cotton in a wooden box. This allows it to reach you in as good condition as when it was tested at the factory. Use the coupon in ordering one.

The Taylor Electric Company,
1206 Broad Street,
Providence, R. I.

Please send me the following by parcel post. (Mark which one you want.)
Radiclear Audio Transformer @ $3.95
Amplifier set complete @.....$6.00
(Socket to fit.....tube)
Audion Crystal @ 25c.
Gold Plated Cat Whisker @ 15c.

☐ I enclose $.... to pay for these. (These above prices include the postage.)

☐ Send them to me C. O. D. I will pay the above price plus postage. (Indicate which way you wish to pay.)

Name.....

Address.....

## TAYLOR ELECTRIC CO.

**1206 Broad Street**

**Providence, R. I.**