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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

RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 1 Number 7

Contents for

JUNE 15, 1924

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RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. I, No. 7 JUNE 15, 1924 15c. PER COPY, $3 PER YEAR

Why the Detector Makes Music

Changing the Speed from 1,000,000 to 1,000 Cycles

By HORACE V. S. TAYLOR

IN the last issue of RADIO PROGRESS there was explained how radio frequency differs from audio and how the carrier wave, going at the high frequency, was able to carry on its back the lower speed of vibration. All this action happens in the broadcasting stations and through the air. But the next question is, when this reaches your aerial, how are the two speeds of vibration going to be separated, and why does the complicated wave send only the music to the telephones?

In the first place, as has been explained, the human ear drum cannot vibrate at anything like the high speed which the sending station puts on the air. Different broadcasters use different frequencies, or speeds of vibration, but the average is around 800,000 to 1,000,000 oscillations per second. This

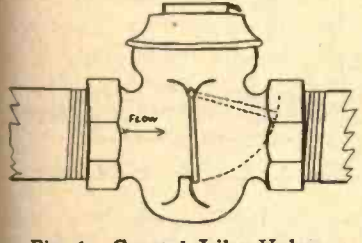


Fig. 1. Crystal Like Valve

is not only a good deal faster than the ear drum will work, but it is also a great deal speedier than the telephone diaphragm will follow. The result is that no one can possibly hear the carrier wave. To be sure, people sometimes talk about hearing it, but what they mean is that they hear the beats caused between the carrier wave and the oscillations from their own or a neighbor's set. This will be explained later.

What We Really Hear

It is the audio frequency waves which actually affect our ear drums. These vibrate back and forth at the rate of a few hundred cycles per second for the lower notes and three or four thousand for the highest notes on the piano. The whole business which the detector has to do is to skim these audio waves off the carrier wave and send them through the telephone to our ears.

Perhaps the best illustration of the action here is the team work, or lack of it, displayed in moving a heavy object. A while ago an automobile ran out of gasoline in the middle of the road. There were half a dozen passengers in it, and they all got out and tried to move it to the side of the street while they sent for some gas. Some of the fellows pushed and some pulled, and although they worked pretty hard, they did not succeed in moving the machine very far. The trouble was that the pushes and pulls came so close together that neither set of men could accomplish what they had in mind. Finally, one of the chaps said, "Instead of some of us pushing and some pulling alternately, suppose we cut out the pushes and leave only the pulls, and the machine will be moved easily."

Crystal Kills Pushes

Now, the trouble with radio frequency waves is that the pushes and the pulls, that is, the negative and positive halfs of the waves, follow each other so fast that neither side has any chance of moving the telephone diaphragm. If we can arrange some way of omitting all the pushes and leaving only the pulls, then the diaphragm will respond to the series of pulls. What we need

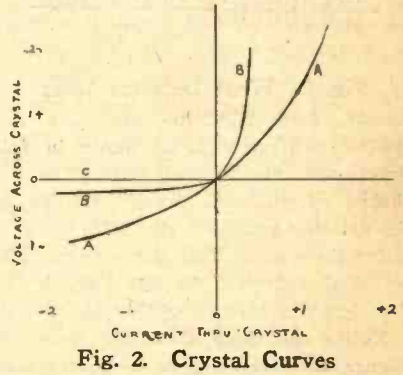


Fig. 2. Crystal Curves

evidently is some kind of a valve which will let the electricity flow in one direction and not in the other. Then by connecting it in series in the line, we will let all the pulls through to affect the diaphragm of the telephone, whereas the pushes will all be choked off and so will not interfere. We mention omitting the pushes. Of course, whether the positive half of a wave causes a push or a pull on the telephone diaphragm depends only on the polarity or direction in which it is connected. If the electricity reaching the telephone or loud speaker causes the diaphragm to move in, then by reversing the two leads, the same impulse will make an outward movement instead. So, in the above explanation, it must be under-

stood that whether we suppress the pulls and leave only the pushes, or the other way around, makes no difference at all, since the result can be reversed by interchanging the two leads to the telephone.

Crystal or Tube Detector

In discussing the detector action, either the crystal or vacuum tube may be used for illustration. The action of these two devices is essentially the same, although the actual mechanism is quite different. In other words, both pieces of apparatus will let a current through in one direction quite easily, whereas it chokes it off pretty effectively when this direction is reversed. It is like a valve in a water pipe. This may be illustrated in Figure 1. Here we have a valve located in a water pipe. When water flows in the direction of the arrow, from left to right, the clapper swings open, as shown in dotted lines, and permits the current to flow. If pressure is exerted in the reverse direction, from right to left, then the clapper swings down, as shown in full lines, and the current of water is choked off. This is exactly similar to the detector action in the radio set. It is for this reason that the vacuum tube is called a "valve" by the English; in America you rarely see this term.

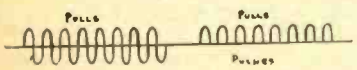


Fig. 3. What Detector Does

Notice one thing about the water in Figure 1. When the current starts to reverse against the direction of the arrow, it will take a short length of time for the clapper to swing down, and during this period water will actually flow in the reverse direction. The valve is not perfect in this respect, but for a short time allows the current to flow in either direction. The same thing holds true with the electric valve. Unfortunately, so far nothing has been discovered that completely restricts the flow of electricity in one direction, while it allows full freedom when reversed. This result is shown in Figure 2, which gives the characteristic curve of an average crystal. It will be seen that as the voltage on the crystal is made positive that the current flows through it, and that as the voltage is raised, the current increases a good deal faster than the voltage does, but when the voltage is reversed, although the current naturally reverses at the same time, still the amount of current, while not as great as before, amounts to quite an appreciable value. This is shown in curve "A." If we could get a crystal with a characteristic like curve "B" it would be very much more efficient. With such a crystal, when the voltage reversed, the amount of current passed would be negligible. So far no kind of detector, either crystal or tube, has been discovered with a curve shaped like that of "B." This means that there is still a chance of improving radio sets. The ultimate detector would be found when line "B" coincided with the zero line "C;" then no reversed current would flow at all, and all the pushes would be completely eliminated.

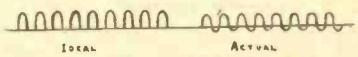


Fig. 4. How Crystal Fails

Straining Out the Pushes

Let us see how a radio wave looks before and after it goes through a detector. As just stated, this may be either a crystal or a tube set, for the action is very similar with the two. In order to make the matter a little simpler, for the rest of this article we will assume that we have a crystal set, but it must be understood that the same action occurs with a vacuum tube detector. First, we will show the radio wave before any audio frequency is impressed on it. This is called the carrier wave, and is a continuous oscillation up and down. The height of the wave, which is measured by its loudness, is governed partly by the strength of the sending station, that is, whether they are broadcasting with 100 or 1000 watts; partly by the distance through the air to the receiving station, and partly by the excellence of the receiving equipment. The spacing between peaks, which represents the time between successive impulses, is determined by the coils and condensers in the broadcasting set, and is specified by the government as 833,000 vibrations per second for a station like WDAP, Chicago, or whatever other figure the radio inspector assigns to the given station.

This continuous wave goes the same amount above and below the zero line. It is like a weight vibrating at the end of a spring. It goes just as much above the position of rest as it does below it. This is shown in the left-hand part of Figure 3. Now let us connect a detector into the set and see what happens.

The upper part, which we may call the pulls, comes through just as before, but the pushes have disappeared, that is, have been eliminated by the valve action.

Ideal Not Attained

As a matter of fact, Figure 3 shows the ideal condition corresponding to the curve "C" in Figure 2, which, unfortunately, is never attained. Figure 4 illustrates what actually happens with a detector. The perfect case would be that the pulls came through with full strength and the pushes were completely eliminated. Actually it will be seen that the pulls are reduced somewhat in strength and the pushes are not entirely suppressed, but come through in a small amount. Referring again to our crew of six men in the automobile, instead of all six pulling the machine toward the sidewalk, one of them decides he will not help, and so the pull is reduced to five. Worse than that, the sixth man turns around and pushes against the other five, and so neutralizes the effect of one of the pulls. This gives a result of only four instead of six men. As just pointed out, this is where some further improvement in radio may be looked for. The part of the curve shown below the line in this diagram not only does not help, but is a positive hindrance in pulling the telephone diaphragm up to the magnets.

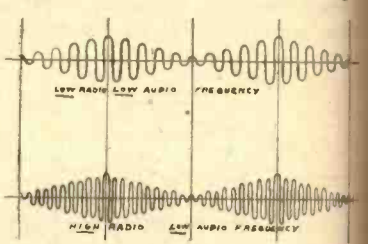


Fig. 5. Carrier Before Detector

While this imperfection of the detector is a very important point in any discussion looking toward the improvement of radio, it does not have any effect in explaining the further action of a crystal, and so to simplify the diagrams we are going to omit this small reversed part of the wave in the rest of this explanation.

Now suppose we take an actual radio wave, that is, an audio on top of a radio wave, as seen in Figure 5.

WEAF vs. KDKA

Here we have two different sending stations, the upper one at a low frequency or high wave length, like WEAF in New York, which runs at 492 meters, or 610 KC. The lower wave corresponds to a much higher frequency or lower wave station, like KDKA, East Pittsburgh, on 326 meters, or 920 KC.

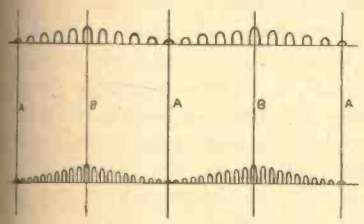


Fig. 6. Carrier After Detector

Both stations are singing the same note, as shown by the fact that the carrier wave rises and falls in intensity at the same speed. What happens when these two waves are run through the detector? Just as explained above, the lower part of the pushes will all be rubbed out and the pulls left just as before. Figure 6 shows how this looks.

Pushes Are Suppressed

When such a series of impulses is fed to the telephone, since only pulls are left and no pushes, all the little jerks being in the same direction, will succeed in moving the diaphragm. As mentioned above, it is too heavy to respond to each individual little jerk, but the effect of the sum total is that the diaphragm is made to vibrate. To be sure, all the impulses cause a pull, but when these impulses let up the natural spring of the metallic disk causes it to jump back again in the reversed direction. So we have a series of pulls and then letting go, then another series of pulls, and so on.

Receiver is Nervous

It is like our automobile men again. Assume that they are all nervous fellows and don't give a steady motion with their arms, but give a jerky action to the machine. As long as the jerks are all in the same direction. that is, towards the sidewalk, they will add up and get the machine in motion. When they all pause for breath it stops again, and this is the action described here. At "A" in Figure 6 the diaphragm springs back. At "B" it is sucked in. At "A" it jumps back again, etc. This action is repeated one for each *audio* wave. That is, the radio frequency has nothing at all to do with it. It will be seen that the upper curve in Figure 6 shows two audio vibrations, and the lower curve, although the radio frequency is much higher, still shows the same two vibrations. This is the same as saying that the pitch or tone of the singers is identical, no matter which station is broadcasting. If one should raise his voice and sing an octave higher, then, instead of two audio waves in the spaces represented by Figure 6, we should get twice as many, or four, since each octave doubles the audio frequency of the one below it.

This completes the action of the detector itself. Such a series of impulses as Figure 6 displays will operate a telephone pretty well. A further improvement would be to smooth out the jerky motion, and the way this is done will be explained in the next issue of RADIO PROGRESS.

IMPROVING THE LOUD SPEAKER

Not the least of many improvements that have been made in the last year in the radio art is the development by The Miller Rubber Company of an amplifying horn for use with any type of loud speaker unit, which can be manufactured in many forms to suit the requirements of loud speakers.

This horn is made from a plastic material having extreme lightness and stiffness, and is water proof so it will withstand moist atmosphere and all ordinary weather conditions. These properties are due to the composition, which is the result of long research conducted by some of the foremost chemists in the rubber industry. But the good features of this type of horn don't depend as much upon the composition as upon the structure which is given it by the process used in its manufacture.

This horn, while having a perfectly molded, solid surface adapted to reflect sound, is composed internally of a myriad small air-tight chambers. Such material cannot vibrate at any audio frequency within the range of voice or music. The delicate cellular structure just described supports the thin hard surface layer in such a way as effectively to damp any vibration which might come from the horn surface.

This invention is the result of an extensive research in which almost every known material and construction was thoroughly tested. This horn has now been adopted by some of the largest manufacturers of radio loud speakers and phonograph manufacturers in the country.

For accuracy in meeting manufacturers' specifications, this process cannot be surpassed.

Safety Hangs by a Hair

Radio Beacon is Operated Automatically When Fog Rolls In

By VANCE

SOME of the radio beacons, which have been recently installed, depend upon the quality of a human hair to start and stop their operation. Of course, those lighthouses, which are on shore and are near centers of population, have attendants all the time who control the starting of the radio signals. But many of the stations are located at inaccessible places, or along rocky shores far from cities, and the number is so great that it would mean a very large labor charge to keep twenty-four hour service going all the time. For such location, various automatic devices have been invented, which work with the reliability of a human being or more so.

Depends on Woman's Hair

The particular control which operates the radio fog signals at stations, such as have been just described, is the invention of Mr. F. C. Hingsburg of Baltimore, the assistant superintendent of the U. S. Lighthouse Service at that port. The device has for its main part several hundred hairs. It is found that the hair from a woman's head is more sensitive than the coarser kind from a man, and it has been easy to obtain plenty of long strands, owing to the recent hair bobbing fashion. About four hundred individual hairs are arranged side by side in a long line. The upper ends are attached to a long rod, which is adjustable in height. The lower end of the hairs are held in a clamp to which is attached a heavy weight, keeping the whole mechanism taut. This weight carries an electrical contact, connected to a battery. The contact has just above and below it a pair of mating contacts, which are connected to the radio mechanism. The upper one, when energized by the battery, turns the signal off, whereas the lower one turns it on.

Hair Has Been Treated

The hair, which is used, has received a special treatment, in which all oil and grease has been removed. Such fibres have the peculiar property that while they do not change in length very much for ordinary changes in dryness and humidity of the air, yet when they are wet they increase their length considerably. This apparatus, which has been described, and which is called the humidity valve, is installed outdoors, near the station, but with a roof overhead to protect it from the rain. As long as the weather stays dry, or even in a pouring rain, the hairs are short and the upper contact is made alive from the battery with the result that the radio signal is not working. But as soon as a fog rolls in it will, of course, pass underneath the roof which protects the valve from the rain, and will make the hairs damp. Immediately they stretch

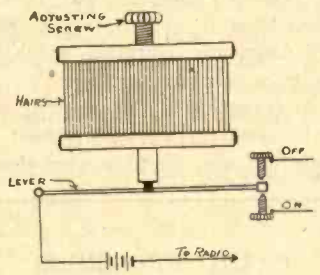


Fig. 1. Hairs Stretch in Foggy Weather and Close Contact

and drop the lever, and so close the lower contact. This sets the radio signal in operation, with the result that the sailors off the shore can get their bearings or direction from the lighthouse in question. This apparatus of the radio compass is the same standard device, which has been described before.

As soon as the fog lifts, the hairs dry off and the humidity needs to drop only five percent before the lever strikes the upper contact. This puts voltage on the shutoff mechanism with the result that the operation of the station stops.

The same sort of humidity valve is used at some of the other stations to operate a fog bell. Such an installation makes no use of radio but is very successful in giving warnings to the mariners. For such use, a large bell weighing one-half ton is mounted in an iron tower and the valve, just described, turns on and off the electric motor which drives the hammer.

Signal That Works at Night

In this connection may also be mentioned the sun valve, the invention of Mr. N. G. Dalen, of Sweden, who won the Nobel Prize for his ingenuity. This device consists of four brass rods. Two of them are polished and two covered with lamp black. Since they are all made of the same metal and of the same length there is no difference in their action, in expanding on a warm day and contracting on a cold one through the influence of the temperature. But when the sun shines, the rods which have the lamp black coating absorb the heat much more readily than those which are polished, and so they increase their length with the increased temperature, even though the day may be quite cold. It is the difference in the length of the two black and the two polished rods, which tips the lever and so closes the contact and thus starts the mechanism to work. The machinery which is operated in this way, of course, may be anything, either a radio warning signal, or an electric light or even an acetylene lamp.

Protecting Our Coasts

It is by keeping up with the latest inventions in such automatic devices, and in radio itself, that our lighthouse service is able to protect the tremendously long coast lines of our shores and so keep the number of ship wrecks down to the very low value, which has been obtained in recent years.

Saying Hello to London

We May be Able to Do It in a Short While

ALMOST a year ago the engineers of the American Telephone and Telegraph Co. and the Radio Corporation made a joint experiment in trying to call up London on the telephone. Of course, they did this by radio, as no telephone cable has ever been stretched under the Atlantic. This test was so promising that development work has been pushed ever since, and recently the British Post Office has appointed a committee to investigate the subject. This committee has lately recommended that their Post Office build a two hundred kilowatt Radio Telephone plant at their new station at Rugby, England. The size of this station will be appreciated more when it is remembered that the biggest broadcasters of the United States are not allowed by the government to use more than one kilowatt at the present time. In other words, the new station will be a good many times larger than all the biggest United States stations put together.

Chatting Across the Pond

If this work is carried out, it is the expectation that under favorable atmospheric conditions during the winter months, it will be possible to connect telephone subscribers in the United States to telephone subscribers in London, and in this way permit them to talk to each other as they do over ordinary telephone circuits. In doing this the subscribers at each end would be connected to their own radio stations by the wire telephone lines. Atmospheric conditions, however, vary tremendously from winter to summer and during the different hours of each day. To determine the effect of such changes, the engineers of the American Telephone and Telegraph Company, in co-operation with the Radio Corporation, have been transmitting speech weekly from America to England, and have been measuring static interference and the strength of signals received from a number of British telegraph stations. The British Post Office, to co-operate in this work erected a special form of receiving antenna, and pending the erection of a telephone transmitting station, have been carrying out careful measurements of the energy which they receive under various conditions from the telephone transmitting station in America, and also from certain telegraph stations.

Talking Since 1915

The tests which will be possible when the British transmitting station is completed will form another important step in the work which has been carried on for many years in the development of radio telephony across the Atlantic Ocean. The first successful telephone transmission across the Atlantic was in 1915, when engineers of the American Telephone and Telegraph Company succeeded in talking by radio telephone from the United States Naval Station at Arlington, Virginia, across the Atlantic to Paris, while the same messages were heard 5,000 miles to the westward at Honolulu.

Another step in this work which created much interest took place January 14, 1923, at which time Mr. H. B. Thayer, President of the American Telephone and Telegraph Company, and other officials of that company, talking from their offices at 195 Broadway, New York City, were heard by a group of well-known engineers and others assembled at New Southgate, England. These tests were made possible by co-operation between the American Telephone and Telegraph Company and the Radio Corporation of America. The tests were very successful, the voices being clear and distinct, and easily recognized by the men at the receiving end who were acquainted with the speakers. The circuit remained very constant during the two hours for which speech was transmitted. Reception was carried out a part of the time through loud speaking receivers, and reporters present took down many of the messages verbatim.

The tests which have already been carried out, and the additional tests which will be made if the new British station is erected, will give information as to the practicability of establishing transatlantic telephone service, the best operating methods to be employed, the attitude of the public toward such a service, and many other factors necessary to be determined before the opening of any regular commercial service could be undertaken. The difficulties of the technical problems to be overcome are well indicated by the fact that atmospheric conditions often change so greatly that the amount of power required at one time to give audible speech in England may be 10,000 times as great as that required a few hours before.

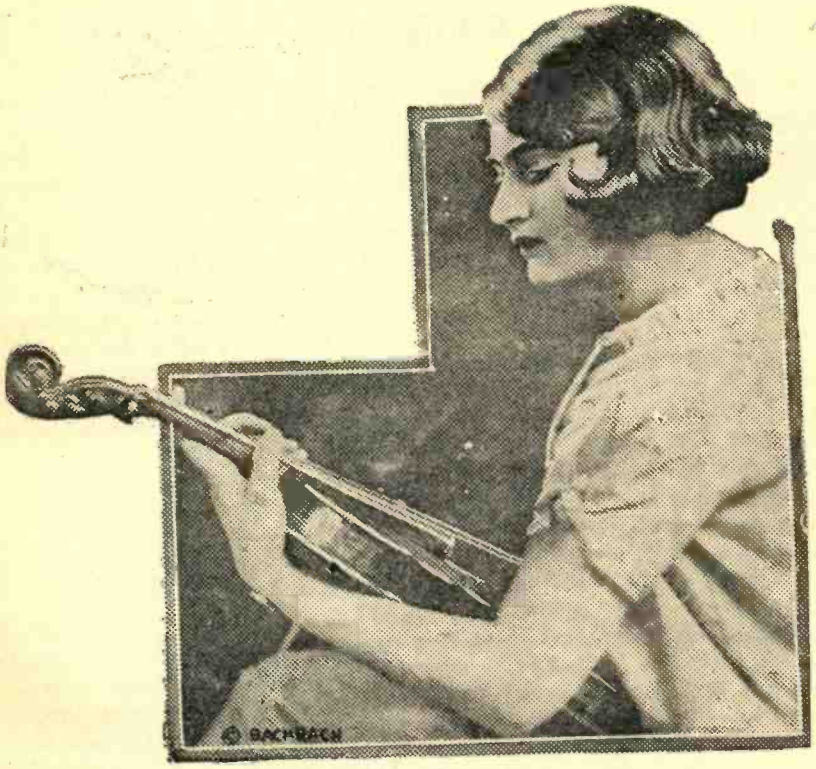
Briefly, the news from London indicates that preparations are well under way for transmission from London to New York, and that when completed two-way talking, at least experimentally, will be possible. It will be remembered that transmission from New York to London was successfully accomplished in January, 1923, the answers from London being telegraphed by cable.

FRENCH CELESTE ADDED TO WLW

A French celeste (ever meet one?) has been added to the musical equipment of The Crosley WLW studio in Cincinnati. Its beautiful bell-like tones record through the microphone with perfect clarity and the harmonics are such as to give pleasing tones regardless of the composition played.

The celeste is built like a piano with similar keyboard and one pedal for expression. The little felt hammers strike upon steel bars and the scale ranges from an octave below middle C to three octaves above. This instrument was imported by Wurlitzer. It will be played by distinguished soloists.

Pictures of Popular Performers



Miss Mary Skolnick

It is a well-known fact that when you read a book it gives some satisfaction to know how the author looks, and in the same way when you hear a good performance coming in over the radio it seems more life-like if you can visualize the appearance of the artist. Two of the popular entertainers at Station WBZ, Springfield, are shown here.

As a violinist of prominence, Miss Mary Skolnick has pleased thousands of her listeners. She has already appeared in a great many concerts through Massachusetts, and has proved quite popular. In the local recitals the ease of her playing and the graceful way which she handled her instrument were quite marked. As she is continuing her musical studies, there is no doubt but that she will be heard from later in the concert world.

One of the instruments which reproduces much better over the radio than it does in the phonograph is the piano.

Miss Katherine Gravelin

But it takes a good performer to get the music over to the critical broadcast listener. Miss Katherine Gravelin is one of the popular pianists at Station WBZ. She acquired her technique at the Springfield Conservatory of Music. The Conservatory may well be proud of her finished work, as she plays with ease and a delightful interpretation of the classical masters which she prefers. In the piano recitals which she is giving in the East, the high quality of her performances has been commented on.

ADVANTAGES OF VERTICAL AERIAL

EVERETT SCANLON.

What is the advantage of a vertical aerial? This type of construction has two improvements over the ordinary horizontal style. The first is because for a given length of wire it brings in more energy and the second is that it does not have such a high natural wave length as the same amount of wire would possess if laid out in the ordinary way. As is well known, the L type of aerial must be limited in length to something like 125 or 150 feet, because with longer wires than this it is difficult to tune the set down as low as 275 meters, but with the vertical type as much as 200 feet can be used without trouble.

The vertical aerial systems are the umbrella aerial, the vertical loop aerial, and for peak reception the balloon aerial. It has been found that this vertical antenna works with nearly the same intensity, whether it be a comparatively fine wire or one of heavy gauge. This is because it gets so much energy that it is not affected by resistance nearly as much as the conventional type.

On a test which was made recently the loudness of the two styles was compared. The vertical aerial, two hundred feet high brought in five times the volume of the regular horizontal type, which was 100 feet long and 30 feet high. Another thing noticed was the lack of directional effect with the former. All points of the compass came equally loud, but with the conventional type the volume fell off distinctly in one direction.

The Fly Power of a Loop

The Outside, Inside and Loop Aerials Are Compared in Results

By OLIVER D. ARNOLD

MANY people ask the question, Why is it necessary to use radio amplifiers, if a loop aerial is employed? The answer is to be found in the fact that the amount of power collected by a loop is almost infinitestimal. Dr. W. R. Whitney, the Research Chemist of the General Electric Co., recently explained the amount of energy coming in to your set is so small that you would have to run it continuously day and night for thirty-five years in order that it would equal the amount of energy used by an ordinary house fly in climbing up a wall for a distance of one inch. Read this sentence over again, and you will understand why a loop will not operate an ordinary set without radio amplifiers.

Radio Amplifiers Boost the Volume

By connecting two or more stages of radio amplification the power coming in over the loop is intensified perhaps as much as one hundred times, and this is enough to operate a good receiving set. Such an amount of power compares favorably with that received by an ordinary outside aerial. Even such an aerial scoops up a very small proportion of the signal strength radiated from the broadcasting station. Take station WDAP, for instance, in Chicago; it has an output as large as any in the United States; that is, one kilowatt, which means the same thing as 1000 watts. This station can be heard practically all over the United States with an ordinary two-tube set.

How much power has this 1000 watt station? It is just enough to light twenty ordinary size 50 watt electric light bulbs. Just think of it, only twenty small electric lights shining in Chicago to be used to illuminate the whole United States! That is the actual amount of energy liberated at this station, and it must be remembered that so far the government has not allowed any broadcaster to use more than one kilowatt, although in Canada stations larger than this are in operation.

In receiving radio waves the size of the aerial naturally plays an important part. Just as a big scoop will pick up more flour than a small one, so a big aerial will gather in more energy than a little one. On this theory the best aerial would be one a mile or two long, as this would get in tremendously more than the ordinary size, but unfortunately another consideration comes in. The length of the aerial plays a very important part in deciding what wave length you are receiving. The wave length of

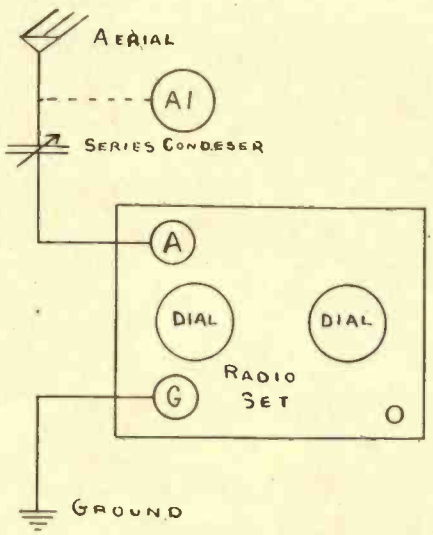


Fig. 1. Series Aerial Condenser

any aerial is always at least four or five times the length of the wire from ground through the set and lead-in to the end of the aerial. This cuts down the distance between the free end of the aerial and the ground to a possible maximum of 150 or 175 feet, if it is desired to get the ordinary broadcasting range of 250 to 550 meters. If it is desired to get only the code message from abroad of, say 10,000 meters, then much longer antennas can be employed.

Use of Series Condenser

If the aerial you have is so long that you have difficulty in getting stations with a wave length shorter than 300 meters, it is possible to add a series condenser in either the aerial or ground and so reduce the wave length. Figure 1 shows the series condenser connected in the aerial lead. The arrow means that the condenser is adjustable, but it is not absolutely necessary that such be the case. A variable condenser, if used, should be of a capacity of .0005 mf. or 23-plates. While it may give sharper tuning than a fixed condenser, it will introduce one additional control, and this is a disadvantage. A fixed condenser of .00025 will be the right size for most sets if the adjustable feature is not required.

In a good many sets this small fixed condenser is included in the radio itself, and a binding post is brought out as shown at dotted line, A-1. This is used for a long aerial, whereas binding post A is connected to a short aerial. In such a case the tuning of the set is accomplished by the dials in the regular way, no matter which post is in use.

Condenser in Ground

If desired, the condenser may be inserted in the ground lead as shown in Figure 2 instead of in the aerial. It gives the same results in the matter of cutting down the wave length and also in operation. However, there is the objection that with such a connection the set itself is not connected directly to ground and so it is not a ground potential. This has the disadvantage that body capacity is much more in evidence, and in such a hook-up it sometimes happens that as you bring your hands near the telephone cord the tuning will be changed. For this reason the hook-up of Figure 1 is usually better than that of Figure 2.

Loop Omits Condenser

When using a loop for an aerial, the series condenser is never used. There is no advantage in building a loop with more wire than is necessary to tune to the lowest wave length you wish to get.

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Broadcasting by Battery

WDAR, Lit Brothers, Get Better Results Than with Motor Generator

THE "Storage Battery Station of the East" is the new name of Broadcasting Station WDAR, Lit Bros., Philadelphia, which recently changed its source of sending power from motor generators to storage batteries.

The results obtained, in increased strength and clearness of signals, are reported as astonishing. Letters and telegrams commenting on the vast improvement were received by the station from "listeners in" all over the country.

Station WDAR is one of the first big broadcasting stations in the East to equip for operation with Storage Batteries. Heretofore the almost universal practice has been to use motor generators for supplying the large filament current and high plate voltage required by the main oscillator and modulator tubes of the transmitting set.

WDAR, who has led the way in making other recent innovations in broadcasting, decided that the time had come for improving the quality of broadcasting by eliminating the commutator hum and other objectionable features of motor generator power. After a thorough test of storage batteries available for this purpose, they selected Philco Diamond-Grid Batteries.

By using storage batteries the commutator hum of the motor-generator is eliminated from the carrier wave. This hum is the result of disturbances set up by the high-voltage direct-current generator every time one of the commutator segments makes or breaks conection with the brush which carries the current to or from it. In other words, the direct current delivered to the plate circuit of the transmitting tubes, if represented by a line would be a line made of small ripples. On the other hand, the direct current delivered by a storage battery is free of ripples and may be represented by an absolutely straight line.

The new broadcasting power equipment of Station WDAR consists of a 1760-volt battery made up of 880 cells of a new type of Philco Diamond-Grid Battery designed especially for radio broadcasting and receiving services.

The cells are made up in pressed-glass containers mounted in supporting trays

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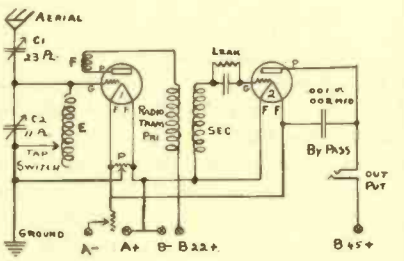
Add 500 Miles to Your Range

By the Use of One Radio Frequency Tube You Can Do It

By CHARLES H. M. WHITE, Consulting Engineer

FEW people who have not actually tried one stage of radio-frequency amplification realize what a great reaching out power one well designed stage can have. If radio engineers could get the same multiple amount of reaching out power for every additional stage of radio frequency amplification, after the first, marvelous distance would become ordinary. But, sad to relate, the degree of amplification per tube falls off greatly after more than one tube is added. For instance, if one stage of radio-frequency amplification gives a multiplication of six, then the second stage will give only 4, and the third about 2. Experimental work is being continually conducted to make the second and successive stages of short wave radio-frequency amplification as effective as the first stage, but as yet not much has actually been accomplished. This fact is one reason why short wave radio-frequency amplifiers are rarely ever built in more than three stages for average use. As far as volume from local stations is concerned the single circuit regenerative receiver can not be improved on very much in reference to volume per tube, but this receiver does not have as good sensitivity as a one-stage radio frequency receiver. A great deal of the efficiency of the single circuit regenerative receiver can be laid to the fact that its tuning circuit is extremely simple, in this way using almost all of the energy that comes in through the aerial.

Many radio fans who now operate single circuit outfits and are anxious to get away to some other form of hook-up, can do well by taking advantage of this conversion. The receiving set outlined here, as far as the circuit with tube No. 1 is concerned, is a regular single circuit regenerative receiver with the condenser C-2 added, and a potentiometer P; notice also the removal of the ordinary grid leak and condenser to the circuit of tube No. 2. The tuning coils E-F are nothing more than a standard vario-coupler using the coil F as the rotor. By so doing we can obtain negative or positive feedback as needed to add stability or sensitivity to the receiver. Please observe that in this receiver the condenser C-2 is an eleven plate variable and does the actual fine tuning, while C-1, which has 23 plates, becomes a coupling condenser. If the antenna were coupled directly to the



grid of tube No. 1, it would be next to impossible to make tube No. 1 oscillate or approach oscillation since the energy required to maintain the antenna in a condition of oscillation would be excessive. Therefore the condenser C-1 proportions this transfer of antenna energy, thereby allowing tube No. 1 to approach oscillation as is necessary to obtain extreme sensitivity. A tube must approach oscillation in order to be sensitive for radio-frequency amplification.

There are but few extra parts to be purchased. The radio-frequency transformer must be of a good standard make. There are several excellent transformers of this type for short wave amplification. A good fixed grid leak is highly recommended for the grid leak unit. As a matter of personal protection I always recommend that every amateur equip his tubes with Radeco Safety fuses, which readily slip on the filament terminal of any standard vacuum tube. The enormous number of tubes lost yearly by radio fans who are just shifting things around is appalling, and any reliable device that does not alter the operation of the receiver and prevents this loss is heartily recommended. In experimental work I always use these fuses on my tubes and have saved a lot of money during the past year.

The way the circuits work is this. The radio-frequency comes in from the aerial and through condenser C-1. The bigger this capacity is, the louder, but less selective will be the music. Then it goes through the primary coil E, which has the coarse adjustments for wave lengths, made by the tap switch. The fine adjustments are controlled by condenser C-2 in parallel. Then the waves go directly to ground. The secondary circuit oscillates between the grid and the filament. Coil E forms the main part of the secondary, as well as the primary. The oscillations go from the grid, through Coil E, then the tap switch, then potentiometer P and direct to the filament. The potentiometer is used to adjust the voltage on the grid, or the grid bias, as it is called. When it is way over to the left as shown a negative bias is put on the grid, whereas when the potentiometer arm is shifted to the right the grid voltage is positive. By trial a grid bias is found, which just prevents oscillations.

The output from the first tube, which is the radio amplifier, runs from the plate through the tickler coil F, where the energy is fed back to the secondary and then over to the primary of the radio transformer. This completes the operation of the first tube.

The second tube is the detector. The amplified radio frequency wave comes out from the secondary of the radio transformer and goes through the grid leak and condenser, direct to the grid. The output of radio and audio frequency flows from the plate P to the by-pass condenser. This allows the radio frequency to return direct to the filament, but since the low speed audio frequency

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How Many Stations In Your State?

Some Parts of Country Way Ahead of Others

IT is rather interesting to see the distribution of sending stations throughout the United States. Since the first broadcasting was done from Station KDKA, East Pittsburgh, by Mr. Frank Conrad, it naturally followed that the East would be the center of activity along radio lines. But the West Coast is not at all behind, and California has almost as many stations as any state in the Union.

The number of stations, of course, is continually changing. The revised list is published by the government once a year, but all changes, both of new stations and old ones which have been abandoned, are brought up to date every month in a leaflet, which is put out by the Government at Washington. In looking over the list we find that there are only twenty states which have as many as ten or more sending stations. The other thirty states (including Alaska and the District of Columbia) vary from one to nine each.

Here is a list of states, which we have rearranged in order of number of broadcasters. Run your eye down the column and see where your own state stands in the list.

Texas	42
Pennsylvania	41
California	39
Ohio	30
Illinois	29
New York	29
Missouri	28
Washington	24
Iowa	23
Louisiana	18
Michigan	18
Oregon	17
Nebraska	15
New Jersey	15
Massachusetts	14
Minnesota	14
Colorado	12
Kansas	12
Indiana	10
Wisconsin	10
Florida	9
Rhode Island	9
Arkansas	8
District of Columbia	8
Oklahoma	8
Georgia	7
Montana	7
Idaho	6
Utah	6
Virginia	6
South Dakota	5
Alabama	4
Connecticut	4
Maine	4
North Dakota	4
South Carolina	4
Alaska	3
Arizona	3
Maryland	3
Mississippi	3
New Mexico	3
North Carolina	3
Vermont	3
West Virginia	3
Wyoming	3
Delaware	2
Kentucky	2
Nevada	1
New Hampshire	1

ADD 500 MILES

Continued from Page 13

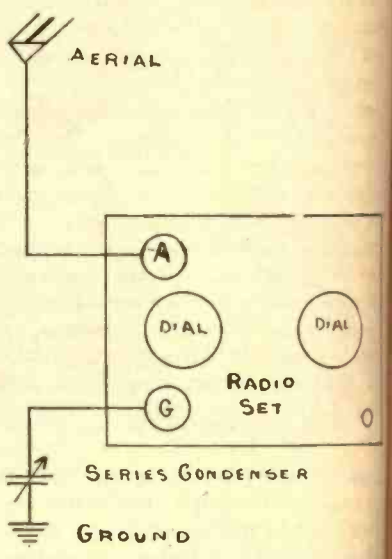
will not pass such a small condenser, it is forced through the telephone jack, and then to the "B" battery.

The operation of this receiver is just a little more complex than the single circuit regenerative type. As mentioned before, do not attempt to use the condenser C-1 for tuning because it is not so designed. Place this condenser at one setting, put the potentiometer slider as near the negative terminal as possible and still allow adjustment. Then, the coil F should be revolved until the tube No. 1 oscillates, and, after that the potentiometer is so moved as to stop this oscillation and control the radio-frequency amplification. To obtain greater selectivity the condenser C-1 should be so moved that its capacity is reduced, and, when more volume is desired, C-1 should be adjusted to more capacity. In this way the operator has as much control of his sensitivity and selectivity as in any loose coupled circuit. Of course, when C-1 is changed it will be necessary to readjust C-2, E and P. Several radio fans who have converted their receivers to this form are very enthusiastic over the results they have obtained at a small cost. Dollar for dollar investment this receiver will favorably compare with any of the present one-stage radio frequency receivers and in the terms of miles range per dollar it rates among the best.

FLY POWER OF LOOP

Continued from Page 11

This is because the loop occupies a small space and a few more turns of wire does not give any greater dimensions. In this respect it is unlike a straight aerial where increasing the wire increases the size proportionately. The loop aerial is



tuned by an adjustable condenser to be sure, but it is connected in parallel directly from one side of the loop to the other, instead of in series. This parallel connection increases the wave length rather than reduces it.

Some Sending Station Stories

LEARNING TO SAY FORE

Station WJZ, New York, has taken up the subject of golf and is teaching radio fans how to play. One of the foremost golf authorities in the country, Innis Brown, editor of "The American Golfer," will deliver a series of talks on the rules and first principals of the ancient game which has become so universally popular. The first of these talks was given a short time ago, and the next one carries on the subject in continuous order, without making it necessary to have heard the preceding one to enjoy and benefit by it. Mr. Brown has had a long and remarkable athletic record, and will be remembered by WJZ fans as the man who announced the football games last season. He will present the points of golf rules and practices which cannot be picked up by the beginner on the links, and which are still secrets to far too many players.

BROADCASTING THE BEANS

"Cooking by Radio" may seem impossible, but through the new feature service inaugurated by station WJZ housewives may plan their meals according to the "Daily Menu" which that station broadcasts at 4:05 o'clock every day but Sunday. What to get to eat is a question which has bothered the ladies since cooking first became customary, and particularly during the summer months are the appetites of the human race hard to please. Planning a menu which affords proper variation while retaining a maximum of attractiveness is a considerable task, and the possibility of planning the meals by radio is offered as assistance by WJZ.

DID YOU HEAR THE CASTANETS?

The Spanish programs which are being broadcast from Westinghouse Station KDKA at Pittsburgh are proving extremely popular with the inhabitants of Central and South America, judging from the number of letters which are received daily requesting the continuance of these concerts. In the past, government officials have sent out notices for all local stations to shut down while KDKA was transmitting.

LOTS OF LEPER LISTENERS

The Molokai representative of the Mutual Telephone Company sends word that KDKA's concerts are being received regularly and furnish entertainment for the Kalaupapa Leper Settlement, Kalaupapa. Of the some six hundred inhabitants of the settlement more than four hundred were present when the first signals were received. The colony is located on a narrow point of land surrounded on three sides by the ocean and backed up by steep cliffs, 1,300 feet high.

TRAVELING THROUGH CANADA

Letters are received regularly from the various radio operators on board the Canadian National Transcontinental trains to the effect that KDKA's concerts are received very clearly and distinctly and are enjoyed by all the passengers. The Canadian National Railways is the only railroad company on the continent equipped with radio receiving sets for the comfort and enjoyment of the passengers traveling over its road.

NEW PLAYS FROM SCHENECTADY

From three hundred manuscripts submitted in the WGY radio drama contest, eleven plays, in addition to the prize winning drama, have been selected for production by the WGY players, and special prizes have been awarded the authors. The winning play, "A Million Casks of Pronto," was written by Miss Agnes Miller of New York and this was presented at the Schenectady station of the General Electric Company, Friday evening, June 6. Miss Miller was awarded a cash prize of $500.

In writing for radio production, each author had in mind the peculiar requirements of what is expected to be a new branch of dramatic art. Those plays were selected which best tell their story by sound, that is the voice of the character and sound devices which may be made to carry a situation convincingly and unerringly to the listener. The radio dramatist must write as though to a blind audience.

The following is a list of plays written in the WGY Radio Drama competition, which will be presented by the WGY players:

"The Happiness Experts," a comedy drama, written by George Leber, Pittsburgh, Pa.

"Bootleg," a drama, by Zeh Bouck, New York.

"The Man Who Would Not Be King," a historical drama, by Dr. John J. Kallen, New York.

"The Fiend," a melodrama, by Charles U. Read, Upper Sandusky, Ohio.

"The Path of Glory," comedy drama, by Dr. Goodman Lipkind, Schenectady, N. Y.

"Out of the Past," a romance, by Miss Esther Swartzberg, Schenectady, N. Y.

"If the Storm Comes," a drama, by Anthony Speizia, Woodhaven, L. I.

"Hand Up," a farce, by John Kendrick Stafford, Troy, N. Y.

"The Much Abused," a comedy, by Harry H. Stevenson, Schenectady, N. Y.

"They Just Disappear," a mystery drama, by Harry H. Stevenson, Schenectady, N. Y.

"The Last Minute," a comedy, by Harold M. Sherman, Marion, Ohio.

THE NEW COMMUNITY SCHOOL

Oakland, California, mothers are "going to school" with their children, but unlike the children they don't have to leave their homes. While engaged in the morning home duties, mothers listen in by radio as KGO, the Pacific Coast Station of the General Electric Company broadcasts its morning educational program, Tuesday and Thursday at 10:20 o'clock.

If the experiments now being made by the Oakland Public Schools are successful, a single speaker may inspire and instruct hundreds of teachers and classes assembled under normal conditions in public schools scattered over a wide area in city and country.

Instead of traveling from one school to another teaching, instructors of the

Oakland Public Schools now speak in the studio of KGO, and radio loud speakers installed in twenty schools in the city, reproduce what is said. Teachers and pupils assemble in class rooms in the regular manner with not more than two classes in any one place. Tests already made indicate that classes will average seventy pupils each.

The program of each broadcast is developed by a special committee working under the direction of Dr. Virgil Dickson of the Oakland Public Schools. Musical numbers by school orchestras are being placed between speakers on the program as a stimulus for the minds of teacher and student listeners. Only eighth and ninth grade classes have been used in experiments thus far made, but it is the opinion of the committee that eventually all grades may be included.

THREE GUESSES WHO THEY ARE

Who are the Gold Dust Twins? This is the question that is agitating radio fans throughout the country. Each Wednesday evening at 8:30 P. M., this (presumably) ebony hued duo take control of the microphone at WEAF and make even the most blase of radio adherents sit up and take notice. For without a doubt the twins are a hit. Already WEAF is being deluged with applause cards, requests for return engagements and guesses as to the identity of the entertainers. As indicating how good they really are, some of the fans assert that McIntyre and Heath have gone in for radio; others pick Miller and Lyles, while still others name Eddie Cantor, Al Jolson and similar big names among the bright lights of the stage. Whoever they are, these boys undoubtedly are bully entertainers. Their program is original from start to finish, a half hour of snappy comedy and genuine melody. Meanwhile, your guess is as good as any. Listen in on WEAF any Wednesday night 8:30 to 9:00 and try to name the Gold Dust Twins. Don't forget the lad at the piano, a real genius who brings out the silvery tones of the instrument to the best advantage.

MEET THE OMNI-ORAL

Throughout the past year there has been a marked tendency among both radio listeners and the radio press to demand something "new and better" in broadcasting. From time to time Broadcast Central, New York, has presented various broadcast novelties, but a more radical change has been considered essential if public interest in broadcasting is to be maintained, particularly during the summer season.

In a sincere effort to bring a desirable innovation to the broadcast field, Station WJY is trying out a scheme of program presentation which, to the best of our knowledge, is totally unique in radio history. Here is the plan in brief, Station WJY is offering a new and heretofore untried form of broadcast entertainment. Each week includes four evening performances which, for lack of a better term, have been styled "Omni-Oral Production." Each performance is of two hours duration, the invisible curtain rising at 8:30 o'clock on Tuesday, Thursday, Friday, and Sunday.

The basic principle of the "Omni-Oral Productions" is to give a radio performance which is a unified whole, in which each act, although complete in itself, is an integral and coherent part of the entire performance. While the Omni-Oral Production is primarily designed to please the listener who tunes to WJY at 8:30, and remains so tuned until the conclusion of the program at 10:30, each act is in itself as fully attractive and entertaining as any feature of similar nature on present-day programs.

Each performance is opened with an instrumental overture, allowing the invisible audience a "tuning-period" of five minutes. Next comes a prologue, appropriate to the general nature of the evening's production and explaining the locale of the acts which are to follow. Then come the various episodes which comprise the evening's performance, each of from fifteen-minute to a half-hour duration, each one varying from its predecessor in type, but dove-tailing in atmosphere and color with all the others. To the announcer is assigned the responsibility of creating the mental-picture scenery which will aid the listener in "attending" the new type performance.

WJY is presenting this idea with a completely open mind; if it does not meet with popular favor, it will be abandoned; if it proves to be at least a step in the right direction it will be continued. But in order to determine how the intangible audience reacts, it is essential that public interest in the innovation be aroused.

WJY is most anxious to receive any comments from you, on the merits and demerits of the plan. Address WJY, Broadcast Central, New York City.

BROADCASTING BY BATTERY

Continued from Page 12

of 20-volt units. The glass containers have high and low water-level lines molded on the side so that a glance tells whether or not cells are in need of water. The cells are tightly sealed with a new form of cover having a spray-proof filler-vent which condenses and feeds back into the cell any spray that tends to pass out during charging.

Red and White Balls

One cell in each 10-cell tray unit, called a pilot cell, is provided with a visible built-in charge indicator. This charge indicator, which does away with the usually sloppy hydrometer, consists of two balls of different densities enclosed in a hard rubber cage. During ordinary operation the white ball is at the bottom and the red ball floats on top of the liquid in the cell. When the red ball sinks, it is time to recharge. The charging current is kept on until both red and white balls come to the surface. Then the charge is cut off. These balls rise and fall as the specific gravity of the electrolyte solution changes during charge and discharge of the battery. This accurate and reliable charge indicator removes the uncertainty and guess work from the charging and use of a storage battery.

Uses Lamp in Charging

The photograph shows the way a large installation of "B" battery looks. Notice that they are carried in individual trays which makes them easy to handle. The switches behind each section are the ones used for charging and discharging. When the switch handle is down as illustrated, all the cells of the batteries are connected in series, which gives a total voltage equal to the sum of all the trays, or 1760 volts. When, however, the handles are thrown up it breaks up the battery into small individual parts and all the various sections are in parallel so that they can be charged from a 110 volt direct current line. The lamp which is shown underneath the switch, is used as a resistance to limit the current to the battery.

Charging Batteries on the Farm

Farmers With 32-Volt System Charge Their Radio Batteries

ALL types of storage "A" and "B" batteries may be readily and successfully recharged from a 32 volt farm lighting system. This will save the bother of transportating the batteries to a regular charging station and the expense of recharging at home amounts to only a few cents per charge.

We are attaching a diagram showing how the "A" and "B" radio battery may be recharged by merely using the house lighting receptacles connecting with a cord and 32 volt lamp in series with the battery.

How to Find the Positive

Select the socket which is most convenient for charging the battery. Then screw in an attachment plug, being careful that the two wires do not touch each other. Next determine the polarity (plus and minus) of the charging wires by placing the ends of the attachment leads in a glass of water. These wires should have the insulation scraped off the ends for an inch or so. Of course, you must be careful not to let the two wires touch, or else you will get a short circuit and blow the fuses. Pure water is a rather poor conductor and so the amount of electricity carried from wire to wire through the water will be very small. Notice the two ends of the wires. One will show a lot of bubbles, while the other will have little or none. It is the negative lead which gives off the large quantity of bubbles. These bubbles are hydrogen gas and come from breaking up the water into oxygen and hydrogen. Water is composed of two parts of hydrogen and one of oxygen; that is one reason why the hydrogen has a great many more bubbles. The other is that oxygen is absorbed rather easily into the body of the water. After determining which is the positive, and which is the negative lead, put some kind of a distinguishing mark on the positive (red paint is often used) and always use this particular socket when charging.

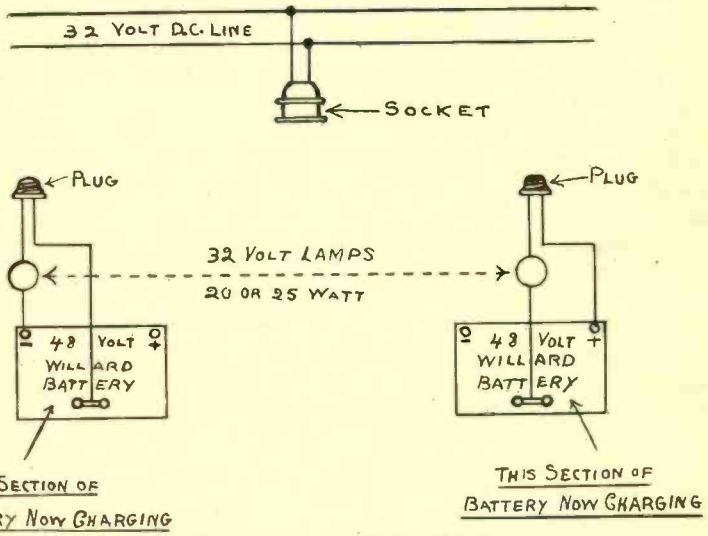


Fig. 2. Charging a 48 Volt "B" Battery

To recharge the batteries, the positive of the charging line must go to the positive of the battery. This should be easy as you have marked your charging line, and the positive poles of "A" and "B" batteries are also plainly marked.

This Wrecks the Battery

It is quite necessary to connect the charging plant with the right polarity, that is, positive to positive, for if you make a mistake here it will not charge your cells, but will discharge them even further than before. If this action is continued long, the polarity of the battery will be reversed; that is the terminal marked plus will really be the minus, and once this has occurred the

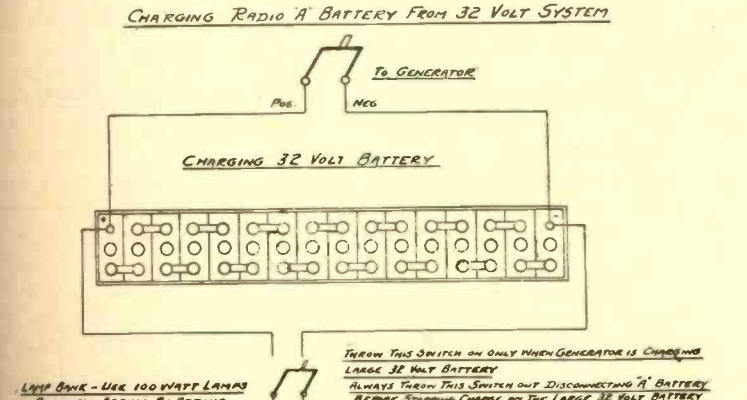


Fig. 1. This Shows How to Charge "A" Battery

battery is practically ruined. Such a change loosens the act of material of the plates and it drops to the bottom of the cell, where it is of no further value.

separators and plates will last longer if the gravity is not quite so high and since it is unnecessary with radio batteries lower values are often used.

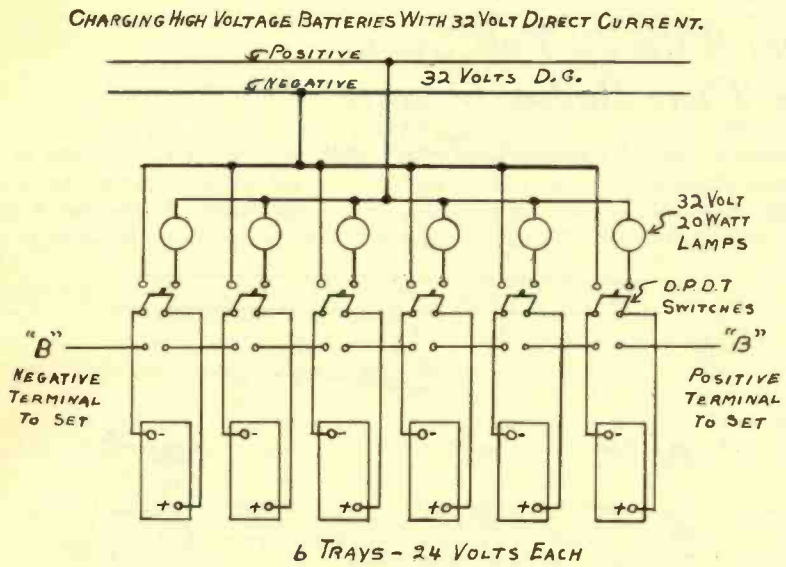


Fig. 3. Charging "B" Battery of 144 Volts

When recharging Willard "B" batteries, use a 32 volt 25 watt lamp for the CBR type and a 32 volt 20 watt lamp for the CSR type. It is possible to recharge only 24 volts of "B" battery at one time. Therefore, we would recommend the buying of 24 volt "B" batteries where the charging device is that of a 32 volt house lighting system. The accompanying diagram shows the manner in which a 48 volt "B" battery may be recharged, that is by charging only half or 12 cells at one time, then shifting the leads to the additional 12 cells or 24 volts.

A fully charged radio "A" or "B" battery will have a specific gravity reading of 1.250 to 1.275 and may be considered discharged when it has a specific gravity reading of 1.175. For best radio results the battery should be recharged when it has a reading of 1.200.

The gravity of a fully charged radio battery is often adjusted by some manufacturers to a lower reading than that of the corresponding automobile batteries. In an automobile the output in current may reach as much as 300 or 400 amperes when starting cold in the winter time, whereas the biggest current ever drawn from a radio battery is never more than a few amperes. The heavy starting duty is best supplied from a battery with high initial specific gravity. On the other hand, it is found that the

It is possible to recharge higher voltages from a 32 volt lighting system; that is, batteries using up to 500 volts on power amplifiers and transmitters, by following the instructions on the attached diagram. Any multiple of this system may be used such as 48, 72, 96 and 120 volts.

Owing to the very low charging current (around one tenth of an ampere) needed for a "B" battery, the efficiency of a charging plant is not lowered to any great extent by charging it from the plant storage batteries, rather than from the generator. However, a high charging current (two to six amperes) is needed for an "A" battery and it should be charged only when the generator is being operated to charge the plant battery. After obtaining the polarity, make sure that the positive of the charging line is attached to the positive of the 6 volt storage battery as indicated on the attached diagram for recharging "A" batteries.

How to Tap for "C" Battery

A number of radio set owners to-day require the use of a "C" battery. Those who possess Willard "B" batteries need not purchase a separate cell or battery for this purpose.

Attached is a diagram showing the manner in which negative "B" taps can be taken off a Willard storage "B" battery and used for "C" battery purposes.

The voltage for "C" batteries varies from 2 to 6 volts on the ordinary receiving set. If 6 volts are required, it is necessary to use three storage cells of the Willard "B" battery; if 4 volts then two cells; 2 volts, one cell.

Figure 4 will answer the purpose for practically all cases. Note that the three cells of the battery have been divided from the balance of the 24 cells. This hookup gives an individual six volt, four volt or two volt battery as a "C" battery. In rare cases it may be that more than 6 volts will be needed for "C" battery. If so then the required amount of voltage may be tapped off in accordance with Figure 4 for "C" battery.

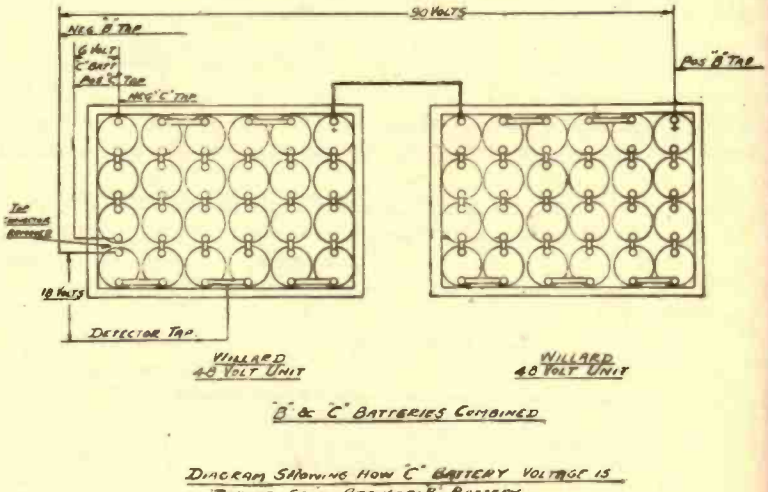


Fig. 4. Making a "C" Out of "B" Battery

American Radio Relay League

PAN AMERICAN RADIO TESTS

The breaking of a world's record coupled with other long distance work, during the Pan American amateur radio tests just concluded by the American Radio Relay League in co-operation with the Revista Telegrafica, demonstrates that the South American amateurs are becoming as efficient in short wave transmission as those in this country.

Carlos Braggio of Bernal, near Buenos Aires, operating amateur station CB8, is the outstanding figure of the Latin American tests through his successful two-way communication with J. H. O'Meara at Gladstone Road, Gisborne, New Zealand. This is the farthest two-way contact ever made on amateur waves.

In addition Mr. Braggio's station is reported to have been heard by Everett H. Gibbs of Framingham, Mass. Mr. Gibbs reported that no code word was received, so a check-up of operating schedule is being made by F. H. Schnell, A. R. R. L. traffic manager. These two events give Mr. Braggio the distinction of being the first South American to be heard outside his own continent.

Argentine Hears U. S.

He has been equally successful in receiving over long distances and was one of the first to hear U. S. broadcasting in the Argentine Republic. Until recently most of his work has been done on phone, but hearing of the success of amateur radio transatlantic work, he installed a continuous wave set.

The transmitting honors for the North American amateurs goes to the Clark University Radio Club at Worcester, Mass. Their amateur station, 1XZ, while participating in the tests, was heard in Sidney, Australia, and the code word identified. This is among the first of the Eastern stations to be heard by amateurs of that continent. The reception of signals from a Massachusetts station in South America has not been positively confirmed.

MUSIC JUMPS OVER STATIC BELT

Radio signals that cannot be heard in point to point communication in a section where there is a great deal of static, pass through the disturbed area with great ease and are picked up by outside stations without any trouble. Radio men, especially ship operators, have known this for many years. However, it has seldom been demonstrated on so large a scale as it was during the Pan-American amateur radio tests of the American Radio Relay League and the Revista Telegrafica. While amateurs in North and South America could hear each other transmitting, operators in the Central American countries had great difficulty in hearing either continent.

Static, Not Distance

The mere question of distance is not as much of a handicap to amateurs operating on short wavelengths as static, the enemy of all kinds of radio communication. Probably Norman R. Weible of Collingswood, N. J., and Carlos Braggio of Bernal, Argentina, the amateurs who first communicated between the two continents, heard one another with greater reliability over thousands of miles than the operators on two nearby ships in the Gulf of Mexico, where each letter often must be repeated many times. Meanwhile, both ship operators might be heard clearly on the Great Lakes.

During these Latin American amateur tests, signals passed through the worst static belt in the world, apparently without losing any of their strength or readability. Braggio's signals were heard equally well in North America, New Zealand and Europe. Nearly a dozen U. S. amateurs heard his call. The operator of Canadian station 1BQ reports reception of Braggio's signals, while the latter cabled that he had copied at least fifty calls of North American amateurs. From now on it is predicted South Americans will be active in international amateur radio.

RADIO RELAY REPORTERS

An experiment to test the value of amateur radio for news gathering is being made by the radio department of the "Milwaukee Journal" in co-operation with Charles S. Polacheck of the Milwaukee Radio Amateurs' Club, Inc., and local representatives of the American Radio Relay League.

The newspaper prints a daily column under the heading "News By Radio." Robert E. Knoff, radio editor, originated the idea of having amateurs act as unofficial correspondents. It is not the intention of the paper to make the plan a permanent feature of its news gathering system, as this would conflict with the regular established agencies for carrying on this work.

The object is merely to demonstrate the reliability of amateur stations should they be needed in an emergency.

DON'T BE A CROOK IN DETROIT

Radio equipped automobiles with loud-speaker attachments have been put into active use by the police department in this city. Three big touring cars, reported to be capable of making more than eighty miles an hour, have been equipped with five-tube neutrodyne sets. These fit in a compartment back of the driver's seat.

Outwardly, there is nothing to show that the cars have radio sets, as the antenna is concealed in the top, and the frame of the car acts as a counterpoise. Each car has a windshield seven-eighths of an inch thick, made of bullet-proof glass. Two gun racks, on the heelboards of the front and rear seats, each carry a sawed-off shot gun.

The cars will be in service twenty-four hours a day and will be in touch constantly with the Headquarters Station KOP, which broadcasts on a wavelength 286 meters.

RADIO REPEATS WHEN CABLES CRACK

Frustrated in his attempt to get a "repeat" on an important European news article by a sudden break in the transatlantic cables, the operator of the Dartmouth, Nova Scotia, radio receiving station, which is maintained by several American newspapers, called on amateur radio men to help him resume his schedule with the British transmitting station. As the station is equipped for receiving purposes only, the operators are seriously handicapped whenever the reception is broken and a "repeat" is desired.

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Providing the Program

By KOLIN HAGER, Chief Announcer of WGY, Schenectady, N. Y.

FEW people realize how earnestly we who are connected with the WGY studio hope they will listen to our nightly request for their comments and suggestions. We know that, if we are to succeed at all, it will be by carefully watching the attitude and following the wishes of the public.

Those who have followed the programs of WGY perhaps have noticed that the average week's broadcasting is carefully proportioned. On Monday evening a brass quartet might be scheduled with half popular and half classical music. Tuesday evening we would endeavor to offer either a drama, a comedy, or a program of music in contrast to the previous evening.

The travelogue programs, embracing stories of trips through different countries of the world; the series of addresses by college instructors; and the many talks on various phases of manufacturing by numerous experts and scientists; all these help to give greater variety to our broadcasting. The predominance of music, which a year or more ago was noticeable, is changing to a greater emphasis on educational material in the form of school or college instruction, and talks by men who are specialists in their particular field. Indeed, if radio is to continue over an indefinite period, it must offer a greater proportion of programs which make people think rather than cause them to sit back and merely be amused or entertained.

There isn't any reason why broadcasting can not be made the school and the college for all kinds of listeners. Its faculty members can be drawn from instructors throughout the country, and its classroom may extend even to the humble farmhouse and far into remote places. This should make for a magnificent organization, but to create and carry on such an undertaking, the government will be obliged to take an active interest, and be a part in the creation and continuance of this work.

My faith in the future of this development is in part due to the sensible letters we receive. The type of our audience is, I believe, superior to that of the average theatre. The better things are preferred, and even strongly urged.

It may surprise many to know that we have five times as many requests for classical music—the compositions of the masters and oldtime American songs—as we have for popular, present day music. The general opinion seems to be that popular dance music is the all desirable thing, but according to the requests we receive, it is the reverse. I believe, too, that this is a representative judgment. WGY's mail will shortly approach a quarter of a million communications of one kind or other, cablegrams, telegrams, letters and post cards. Doesn't it seem logical that if the people want the better music, they also want other features of a high quality? The WGY announcers have all caught this spirit and have confidence in this broadening.

Not so long ago WGY and WJZ joined forces, with the result that many good events from New York have already been broadcast, notable among these, the luncheon of the Associated Press, when President Calvin Coolidge was the principal speaker. Incidentally, the President's father in Vermont heard WGY's broadcasting of the address.

Several weeks ago WGY took part in a coast-to-coast program, when we relayed the alumni dinner of the Massachusetts Institute of Technology. Six other stations carried this program on; so that it is estimated fifty million people heard it, and England and Cuba received clearly the music and part of the speeches. This is opening up a new phase of broadcasting, which by the several relays from one station to another, can give the listeners a program from the far West, the far North, or perhaps from Cuba. We may some day relay the English concerts to America with the same ease that our own programs are transmitted to-day.

The studio broadcasting at the present time at the major stations is being better and more carefully prepared. The announcing which plays an important part in every program is more dignified and has not the former careless tone which some may remember. As much personality as possible should be in the voice of the announcer, and whatever he says ought to add to the program, and help in its success. There must be an optimism and brightness in all he says, if he is to hold the interest and have the favor of his audience.

AMERICAN RADIO RELAY

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In such cases they make a practice of calling upon the cable companies to forward requests that the transmitting station resume schedule at the place where the break occurred. On this occasion, however, it was impossible to get even this help. The operator of the British transmitting station, unaware of the difficulty, continued to send. In about an hour and a half the schedule would be over and it would be impossible to get the particular portion of the item that had been lost.

The local receiving operator straightway got in touch with Major William C. Borrett, operator of Canadian amateur station, 1DD, and manager of the Maritime division of the American Radio Relay League. Major Borrett asked several Halifax and Dartmouth amateurs to listen on short waves and, if a European amateur was heard, request him to have the British operator repeat.

Half an hour was consumed in listening, but as no European amateurs were heard, the operators of 1BQ and 1DD decided to send out a "general call" in the hope that some listener in England would pick it up. The call was kept up for fifteen minutes, then another fifteen were spent in listening.

They had about decided to send out another call, when they received a telephone message that they had been successful. The superintendent of the transatlantic receiving station was heard saying "Thanks, you have put it over all right. We are getting our repeat." A British amateur had heard the message and informed the operator of the transmitting station.

The Audiometer---It Tests Your Ears

New Device Tells Whether You Are Deaf or Not

By FREDERICK J. RUMFORD, E. E.

IN this article will be described one of the latest uses of the radio or vacuum tube and its associated parts. It has been used with success by the scientists at the laboratory of the Western Electric Company. This instrument is known as the Audiometer and is used for testing the amount of deafness of those who are hard of hearing and to ascertain what normal hearing really is. There are some 300,000 variations of sound which are audible to the normal ear.

The engineers have found that the above figures designate the number of sounds audible to a normal ear by testing the hearing of a large number of

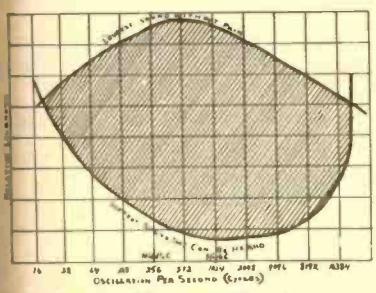

Fig. 1. Normal Hearing

pure tones that were audible to persons with so-called normal hearing. The findings are plotted on different charts, as shown in Figures 1, 2 and 3. The lines to the left and right represent the musical tone or pitch. Each line means double the speed of vibration of the one before it. Since doubling the oscillation speed increases the tone by one octave the result is that each line is an octave higher as we go to the right. The distance up and down denotes the loudness of the tone. The louder the note is the higher is shown in the figure. The lowest line is plotted by finding the lowest intensity at which the tones could just be heard. It will be noted by these figures that the intensity or loudness of the higher and the lower tones must be quite considerably greater to be audible than the tones which are nearer the middle of the range. This will make the line of minimum audibility a curve as is shown. The upper line, which is marked "maximum audibility," shows the greatest intensity which the ordinary person can listen to without discomfort. The shaded area between the upper and lower curved lines shows the area of normal hearing.

Determining Deafness

The measurements are made as illustrated diagrammatically in Figure 4. At "M" is a microphone hooked up with a battery and coil. The tuning fork "T" gives out a pure tone to the microphone. The resulting vibrations are carried through the variocoupler "v. c." to the grid of the vacuum tube. In the plate circuit are the phones and "B" battery as usual. But in series with the phones is a milliammeter to read the current. To operate the equipment a tuning fork giving a tone of say middle C is struck. The variocoupler is adjusted so that the tone is about as low as can be heard in the phones and the milliammeter is read. Then the variocoupler is adjusted to give more energy to the tube with a second reading. This is continued until the volume of sound in the phones has increased to a point where it begins to be painful to the subject. The reading

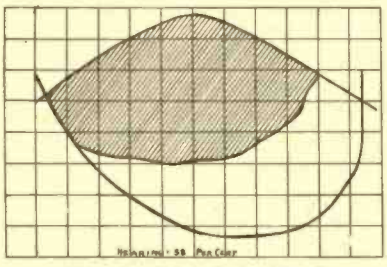

Fig. 2. Mr. A is Deaf

of the meter at this point gives the upper limit of our curves.

As a matter of fact, the actual circuit used differs from the one shown in Figure 4 in this respect. Instead of using a tuning fork to produce the oscillation, it is customary to hook up a regenerative tube, so that it will squeal, just as many of your neighbors' sets are squealing. Then the pitch of the tone is adjusted by changing the value of the tuning condensor, while its loudness

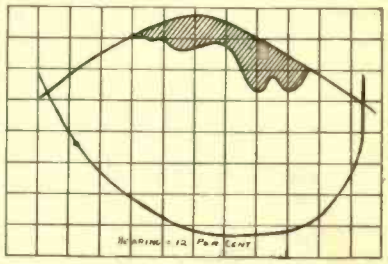

Fig. 3. Mr. B is Very Deaf

is governed by varying the amount of feed-back by the tickler coil. In this way the bother of having so many tuning forks and the trouble in keeping them going is removed. However, the general principle is seen from this diagram.

270 Heard at High C

The number of pure tones audible to the normal ear is such that at high C there are 270 graduations of volume which can be separated one from the other. It will be noted in Figure 1 that at the line of intensity or loudness where the figure is the widest, 1500 different tones can be perceived each having different pitches. If the hearer's ears were equally sensitive to all pitches and intensities within its range, the total number of pure tones audible to the normal ear would be the product of these numbers, 405,000 tones, but the ear is not as sensitive to the higher or lower tones. There are approximately 300,000 tones which are audible to the normal ear.

The number of pure tones having been determined for the normal ear, it is

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Ten Commandments for B. C. L.

Hot Weather Hints for New Comers in Radio

By DR. ALFRED N. GOLDSMITH, Chief Broadcast Engineer Radio Corporation of America

WHILE excellent radio reception is frequently possible during summer months, the best long distance records come in the winter. Signals are not quite so loud in the summer, electrical disturbances such as lightning storms are naturally more common and they interfere occasionally with concerts, particularly those received from distant points. A reasonable attitude will help the Broadcast Listener (B. C. L.) here. He should remember that he cannot expect every act in even the best vaudeville performance to be tremendously amusing and just what he wants, nor can he expect the weather every day to be clear and pleasant.

Similarly he must not expect every day to be just right for long distance radio reception. Now and then a summer storm may interfere with both radio and picnics. The listener should become acquainted with his local stations and enjoy them during the summer, and be satified with the long distance records he has made, or will make, in the winter. In other words, he should get the best there is in radio during all seasons, and above all he should be reasonable.

The Distant Listener

If the listener lives rather far away from all the radio broadcasting stations which he wants to hear, there are several things he can do. He can lengthen his aerial wires and increase their height from the ground. Both of these measures make the signals louder as a general rule. He can add an audio frequency amplifier unless, of course, he already has this instrument. He can also increase the voltage of his "B" battery or plate battery up to 90 or even 112 volts (that is, to four or five of the usual 22½-volt units or blocks). He can use a more sensitive loud speaker, or content himself with headset operation. He should also tune more carefully, so as to get the very loudest signal which his set is capable of giving. If there is a tickler adjustment on his set, he should learn how to use it so as to get full volume of signals. And he should remember that the good results he will then get are going to be even bettered in the winter.

The Nearby Listener

If the listener is very near a powerful broadcasting station, he may get excessively loud signals from that station and have difficulty in picking up other stations when the nearby station is in operation. In extreme cases it is not possible to get the distant station at all under such circumstances any more than it is possible to hear a whisper from a distance when someone else is shouting nearby. Still a good deal can be accomplished by some of the following measures which should be tried.

The listener can cut down the size of his antenna or use a small indoor aerial having a length of say thirty feet. A few trials may be necessary to find the best length of indoor antenna in such cases. When an aerial less than 30 feet in length is used a small fixed condenser of five ten-thousandths of a microfarad, (.0005 mfd.) should be connected between the aerial and ground binding posts or terminals of his set. This will permit the reception of waves of the same length possible with an outdoor antenna. The listener should experiment until he gets the best signals and the greatest ease of choice of one station or another. A little patience is required to get the desired results in some cases. It should be remembered that no one ever learned to run an automobile skillfully through heavy traffic in five minutes. Sometimes the "traffic" in the ether is heavy, and it may not be easy at first to pilot the desired signals through the receiver. Paderewski took quite a little time to learn to play the piano, but it was worth while. So is time spent in mastering the capabilities of the receiving set.

Catching Waves Above 450 Meters

Since the longer waves have been opened to broadcasting by the government, it is desirable to be able to receive them. It may be that the receiver on its present aerial is not capable of tuning in these longer wavelengths from about 450 meters to 545 meters which have been in use since May 15th, 1923. Generally the same condenser placed between the aerial and ground binding posts or terminals, which has already been mentioned, will serve also to enable picking up the longer waves. The larger the value of the condenser the higher the wave length which can be picked up.

Advice to Broadcast Listeners

There are ten good rules for broadcast listeners:

1. Don't try to hear Australia in midsummer. Be satisfied to enjoy the nearer stations most of the time.

2. Don't be disappointed if an occasional storm interferes with your summer radio evening. There are many fine concerts coming. You can't expect to find a pearl in every oyster nor to receive a record-breaking concert every night.

3. If you want louder signals, use a longer aerial, more tubes, higher plate voltage, more sensitive loud speakers and more careful tickler and receiver adjustment.

4. A pleasant signal filling a moderate size room should be enough to give satisfaction. It is not worth while producing signals which deafen the neighbors. It is wasteful to insist on tremendous signals which are generally less pleasant than moderate signals.

5. If your local station comes in too loudly and drowns others out, a smaller aerial will help in tuning him out, with a smaller condenser connected between aerial and ground. And if all measures to get rid of the local station fail, why not enjoy his concerts? He is working

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Why Must a Grid Leak?

Every Tube Set Needs a Few Megohms

By ERNEST WALKER SAWYER, Chief Engineer, Electrad, Inc.

ONE of the mysteries of a radio set is the Grid Leak. One often wonders why the grid needs to leak, and if it must, how is it made to do so? Here is a description of this part of the radio set and an account of how it is made, by one of the companies who have specialized in the manufacture of this unit.

The Grid Leak is as important an item in a Radio as the safety valve is in a steam engine. It might be called "The Heart of the Radio" as it helps control the flow of electrons in the circuit.

Electrons Make the Music

Electrons are the little fellows who carry the music from the aerial to your ears. Your antenna may be perfect and your tubes may be operating at remarkable efficiency; but if the electrons do not move along the path to your ear in a smooth and orderly manner, the music is distorted.

Your favorite broadcasting station may have cost $50,000. A further $100,000 will be spent each year in operating it. Your receiver costs $25.00 to $200.00 and if you realized the tremendous importance these little fifty cent Grid Leaks have in getting the proper results from this outlay, you would certainly have several sizes available for experimenting.

The volume of the music depends very much on both the grid and on the plate circuit. An important factor which determines the grid voltage is the number of negative electrons which are attracted to the grid from the filament.

These negative electrons, it must be understood are little particles or pieces of electricity, and they fly across the space from the filament to the grid at such a tremendous speed that they might literally be said to be in both places at the same time. They are given off by any piece of metal when hot enough, and that is the reason why we heat up the filament: namely, to send off these small particles.

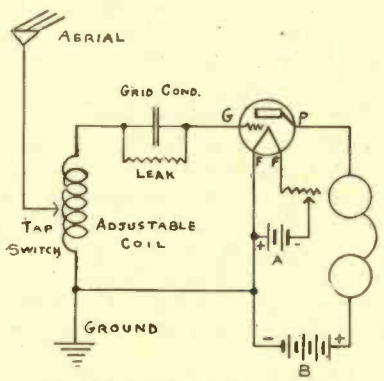

Fig. 1. Grid Leak Hook-up

The negative charges on the grid sometimes reach a point where they practically stop the flow of plate current. The grid current piles them up. Unless a Grid Leak is in use, the tube will become choked up and will not operate. If the Grid Leak is the incorrect size, the tube will only partially operate.

This may be seen better by observing the connections in Figure 1. This shows a simple, non-regenerative set, but the principle of operation applies to all tube sets no matter how complicated. The primary circuit is from the aerial to the tap switch and the adjustable coil to the ground. The secondary circuit oscillates between the grid to the grid condenser and adjustable coil to the filament. The output circuit is from the plate, through the telephone and "B" battery to the filament. Suppose the Grid Leak were omitted. In that case, the only connection to the grid would be one plate of the grid condenser. Now, it must be remembered that a condenser has no metallic contact at all between the two terminals. That is why direct current can not flow through a condenser. Alternating current, especially at high radio frequency, passes through it easily. So the signal coming in from the aerial is impressed on the grid, but these electrons, which we have been discussing flow in large numbers out of the filament and across to the plate, and a small proportion of them fall by the wayside and are attracted to the grid. Of course, the greater majority of them go across to the plate and flowing through the phones give us the music which we desire.

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TEN COMMANDMENTS

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hard for you and it is nobody's fault that you are so close to him that you are bound to hear him. Broadcast stations have to be closer to some people than to others.

6. For the new longer waves above 450 meters, use a condenser connected between the aerial and ground terminals of your set.

7. A little patience in learning to handle your receiver yields rich returns in satisfaction from fine signals. Remember that "Rome wasn't built in a day," and keep on getting more and more familiar with your set and how it works.

8. It is a good idea to read the radio column of a newspaper or a good radio magazine. (Editors Note—We know which one he means). It helps you to know how your set works and keeps you up-to-date in radio. Information of this sort is an aid in getting the concerts loud and clear.

9. Ask your radio dealer for advice; he can probably tell you what you want to know and will be glad to do so. The manufacturer of your set is also willing to help you get the desired results from its use.

10. Do not throw away the direction sheets or booklet that came with your set and with the tubes. Read all such material carefully now and then. If you have lost the direction sheets write to the dealer or manufacturer for another. The direction sheets answer most of the questions which have been puzzling you and preventing you from getting the best out of your set.

WHY MUST A GRID LEAK?

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If the Grid Leak has been removed, these stray negative charges, which strike the grid, will pile up on it, since they have no escape, and in a short time the grid will have a strong negative charge. Like repels like in electricity, and the negative charges on the grid repel the swarm of negative electrons coming up from the filament, with the result that they no longer reach the plate and the telephone, so the telephone current drops to zero. Such action is called "blocking" the tube. But when we connect the Grid Leak we give a path which these wandering negative charges can take to get back to the filament. When the proper value of leak is installed there is no backing up at all of the charges, but they pass through the Grid Leak as fast as they strike the grid.

Two Megohms Usual

If you have never changed your Grid Leak you will be surprised at the different results you get from different sizes. Some tubes will work best with one megohm, while others will require two or even as high as five or six to get the best results. By best, I mean there may be from 100 to 500 percent difference in your volume. Manufacturers often supply two Megohm Leaks with their sets. The only reason I can find for this is because two is an easy number to say and to remember. The public has been sold on two Megohm Leaks.

That is only part of the story. Each type of tube creates new conditions. The UV-199 provides a high emission at low filament temperatures. The UV-201-A averages five times the emission of the ordinary amplifying tubes. The emission or flow of electrons varies with the current and voltage being used.

Here you are then; each type tube, perhaps each individual tube of the same type, requires a variation in grid resistance for maximum efficiency and that variation is covered by engineers of the Radio Corporation as follows:

WD-11 and WD-12	2 to 3 Megohms
UV-200	½ to 2 "
UV-201-A	2 to 9 "
UV-199	2 to 9 "

R C A Gives Advice

The Radio Corporation of America says further, "A Grid Leak resistance between two and five Megohms is satisfactory for average work. A resistance between five and nine Megohms is sometimes better for weak signals."

At first thought, you would naturally advise use of a variable Grid Leak for every set, but the public as a whole do not want so many variables; so the next best thing is to adopt for each type of set, that fixed leak which gives the best results with that set.

Must Not Rub Pencil Line

In case a variable leak is to be used, it is quite necessary to get one that has two characteristics—one of these is that it must be durable enough so that shifting it from one valve to another does not wear it out easily. Many of the older leaks consisted of an arm rubbing on a pencil line. Of course, this does not last very long, as the friction wore the line away almost like an eraser. After that the leak stopped working. The other quality which the adjustable unit should have is, it should not be what is called "microphonic." This word refers to the same action which you get in the sending station microphone; that is, when any vibration in the air goes on around, it makes a change in the resistance and so in the amount of current passing. Of course, this would be fatal in a receiving Grid Leak as it would tend to make a transmitting station out of the set. A very satisfactory type of adjustable leak is shown in Figure 2.

Don't Mount Leak on Panel

If such a piece of apparatus is used, it is often desirable not to mount it on the panel where it can be easily handled, as in case of trouble the operator is almost sure to start turning the handle. Of course, this is the wrong thing to do, as such a leak does not get out of order, and if it is once right it stays right. For this reason, many builders install it on the floor of the cabinet, where it can be adjusted only by raising the lid. This removes the temptation to keep monkeying with it all the time.

From the foregoing, it is easy to see that when you have once found the correct Grid Leak for the particular set, tubes, antenna and ground, you should be assured that the resistance should remain exact. You see, therefore, that you must use the utmost caution in purchasing only those Leaks that are properly made by responsible people. Insist that your Grid Leaks be certified, correct and guaranteed.

The Grid Leaks of four or five years ago were usually of the lead pencil type. A few marks on a piece of fibre or bakelite would suffice to satisfy the experimenter. If the tube worked badly they added more or erased some.

Here is the heart of the radio,—one of the sources of success or failure of the set, and yet a careless pencil mark has, until recently been permitted, even in expensive sets of well-known manufacers.

In the Grid Leak, you are dealing with minute electrons of electricity passing over a path of extreme high resistance, 500,000 to 9,000,000 ohms (½ to 9 megohms). Here is the subject for a great deal of research work. The problem of handling such minute portions of electricity at such extraordinarily high resistance resembles somewhat the problems of dealing with lightning. Two storm clouds are filled with energy. The electricity generated is enormous; the path between the clouds or from the cloud to the earth is possibly a mile of thin air. Its resistance is beyond comprehension. Finally, the pressure becomes so great that the electricity jumps. If there were a copper wire or other easy conducting path, there would be no zigzag flash and no thunder. It is exactly the same in the receiving set. The accumulated charges flow along the Grid Leak. If the path is a perfect conductor, there is no noise. If the Grid Leak element is uneven or only partially a conductor, then the Grid Leak may create noises in your set. You will realize from this the importance of a proper element in the Grid Leak. Just as a copper conductor carries currents in a smooth manner, because it is uniform and regular and has no bad spots or holes in it, so the Grid Leak should be made of materials that have been thoroughly stirred up and pressed together to make sure that the rod is a regular piece without any lumps in it.

Lamp Black is the Secret

The elements of Electrad Grid Leaks are made of a paper in which carbon in the form of lamp black has been thoroughly mixed through the pulp during the process of the paper manufacturing. This is one method of obtaining the desired result. After the paper, mixed with graphite, is cut to the desired size for the special Grid Leak required, copper or brass tongues or clamps are fastened to each end to make contact between the element and the ferrules of the Grid Leak. These contacts likewise are extremely important, as a loose con-

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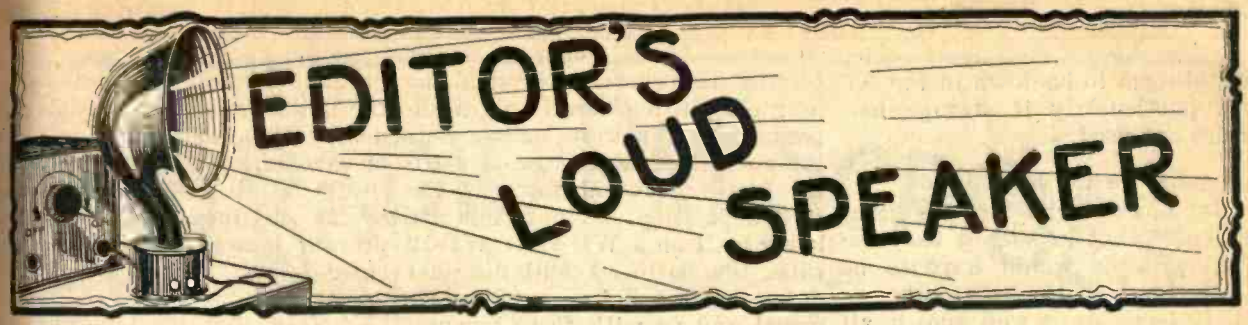

SUPERSTITIOUS STATIC

WITH the coming of summer we have again a large crop of stories about static. These are told so often that it almost seems to be a superstition that static will wreck radio receiving in the summertime. To be sure, it does cause interference at times—once in a while even putting reception out of the question—but these effects are not nearly as bad as they used to be. Undoubtedly there are various improvements which can be made on present-day sets which will still further reduce this bugaboo.

During the past winter the favorite indoor sport has been to get stations a little farther away than those heard by our neighbors. Most fans seem to belong to the army that does nothing but juggle their jacks and swirl their switches in the effort to stretch their 1500-mile set into a 2000-mile receiver. Recently some one asked us the question, Why does a man listen to radio? Thinking it was a conundrum, we bit and gave it up. He answered that he did not know what they *did* want to hear, but he knew one thing they didn't want to get, and that was music. All his friends, he continued, would wait until the music was coming in fine and that was the signal to cut it off and try for some other place they just couldn't hear.

Switch Swirlers New Problem

At this time of the year we think it would be a good idea if the switch swirlers would turn from their attempts to get cross-country reception and devote their energies to improving their sets in the line of reducing static. Enough has already been done in this direction to show that the search is promising, and think of the fortune that awaits anyone who invents a real solution for this problem. By all means get out your collection of odd condensers, coils, dials, and miscellaneous junk and go to it.

HOW MANY KNOBS?

In the gradual improvement of radios there seems to be quite a tendency toward reducing the number of controls. Whereas a year ago most sets had six or eight knobs to be turned and pushed, the most recent ones struggle along with half that number. But even now there is one popular set, which has by actual count sixteen handles on it, which must be manipulated correctly in order to get the station you want.

Here we disagree with some experimenters. One chap recently said that he liked to be able to vary this and that, and that he did not want it cut and dried, so we asked him if he had ever complained to the phonograph manufacturers, because all you had to do to play a record was to turn on the machine and drop the needle. Just imagine a victrola with a dozen or so knobs to be punched and twisted correctly before we could get any music.

What is the Ideal Set?

In our opinion, the most desirable set of all would be one that had a single handle to control it. A hand would point to the various station call letters, and all that would be necessary to hear WXYZ would be to point the hand at those letters. But we have the great disadvantage in radio that a nearby station has an amount of energy perhaps a thousand times or more as great as that which comes in from a distant point, so it seems doubtful whether we shall ever be able to get perfectly satisfactory results from a radio with only a single control. It seems quite likely that a second one will have to be retained to adjust the loudness, or volume. With such a set it would be only necessary to adjust the first handle for the station you want to hear and then turn the second until the loudness was satisfactory.

Such a set is not in the remote future. As a matter of fact, some manufacturers are already building it. And the success which is being obtained not only from the engineering point of view, but also from the popularity of this form, leads us to believe that they are really on the right track.

LOCATING YOUR BATTERIES

When you proudly bring home a radio set for the first time, one of the serious questions is, Where shall it be put? After this momentous decision has been made, the rest seems easy, but somewhat later on the thought occurs, Where shall the batteries be placed? If the set uses dry cells, it is sometimes possible to install them inside the cabinet. Indeed, some radios are designed so that both "A" and "B" batteries are placed in this location and for such sets there is no argument about where to put them.

The majority of instruments, however, will not accommodate the batteries inside. For those using storage batteries there is, of course, never a chance of such an interior location. Most people will then install them on the floor underneath the set. This position is quite satisfactory, provided there is plenty of room under the table. But this does not seem to be a very neat solution of the problem. The ideal location

would seem to be down in the cellar, particularly if storage batteries are used.

Beware the Long Leads

But now we run into the great difficulty that in such a case the battery leads would have to be quite long, perhaps twenty or thirty feet. As is well known, all radio leads should be kept as short as possible. How can we get around this difficulty? Well, in the first place, it must be remembered it is the radio frequency leads which are particularly vulnerable to difficulties from length. The grid leads to your tubes *must* be kept down to a few inches if you are going to get good reception. They carry a frequency of about one million cycles per second. Next in importance are the wires running to the plate. But direct current has no leakage capacity at all, and so the length of the wire does not cause any serious trouble. However, the "A" storage battery leads usually carry some high frequency current as well as direct current for lighting the filament. If we could get rid of this high frequency, then we could make the leads as long as we like.

Straining Off the Radio Frequency

In order to skim off this high frequency and leave only the direct current, it is merely necessary to connect in a condenser. This should have a value at least as big as .002 mfd. Any value larger than this will be just as good. The two terminals of the condenser should be connected to the "A" minus and the "A" plus binding posts of the set. Then wire thirty or forty feet long may be run to the "A" battery without fear of hurting the tone. The direct current from the battery will not run through the condenser and so is not short circuited by it, while the high frequency radio waves pass readily through the condenser, and thus do not waste themselves in the long leads.

With such an installation it is true that some voltage from the "A" battery will be used up in forcing the current through the long circuit, but this is no disadvantage. It merely means that the rheostat will be turned a little farther around towards the full-on position. If dry cells are being used on a WD-11 or WD-12 tube, the batteries will not last quite as long before needing renewal and so with these vacuum tubes is that slight objection. Aside from that, however, this plan is admirable, and we suggest that you try it out. Ordinary twisted green lamp cord serves very well for making these leads and costs around 3c per foot.

DANGER FROM LIGHTNING

Last year a great deal was said about the danger which was incurred by having an aerial connected to a house whenever a thunder storm was in progress. To be sure, most of the articles in the press mentioned the fact that an aerial caused no danger at all, provided it was connected to an approved lightning arrestor, but so many articles appeared on this subject that it seemed to affect the radio fans in just the opposite manner from what it was intended. The thought seemed to be that where there was so much smoke there must be some fire, and that if everybody was talking about there being no danger, perhaps there was some, after all. So it is at the risk of creating the same feeling that we bring up the subject now.

All Authorities Agreed

It often happens in radio matters that there is a difference of opinion in regard to the way some things work. But in this case all those eminent in the profession are unanimous in declaring that an aerial is not a menace to a building, but, on the other hand, is a protection. If you take a trip out through the country, you will find that the more prosperous farms are all equipped with lightning rods; and what is an aerial but a glorified lightning rod? The principle of such a rod is not to conduct the lightning to ground when it wants to strike the building, as most people suppose. By no means. It is a case of vaccination. We do not inject serum into a patient to cure him of the smallpox. The idea is to prevent him ever having the disease.

Vaccinating the Lightning

In the same way the idea of a lightning rod is not to cure the thunderbolt, but to prevent its ever happening. There was once an old building which threatened to fall and do a lot of damage. But instead of trying to arrange a lot of mattresses for the building to fall on and so deaden the shock, the workmen got busy and took the building down piece by piece. This was quite effective in preventing its falling. In the same way by erecting an aerial we prevent the stroke from occurring. In other ways, we vaccinate the thunder cloud. Little by little the aerial discharges the electricity, though it tries to accumulate, with the result that it never gets up spunk enough to strike out with its death-dealing blow.

Approved Arrestor Necessary

Naturally, we are assuming that an approved lightning arrestor is used to ground the aerial during a thunder shower. Some people use a switch for this purpose, and it works all right if they remember to throw it; but to guard against forgetfulness it is better, and indeed the fire underwriters demand that a lightning arrestor be connected between the aerial and ground all the time. This does not affect the operation of the set at all except to save its life in case lightning should strike it. But be sure that your lightning arrestor has the approval of the underwriters' laboratory printed either on the cover of the box or the device itself, as there are various cheap unapproved arrestors on the market which are positively dangerous.

Rx DR RADIO PRESCRIBES.

NOTE: In this section the Technical Editor will answer questions of general interest on any radio matters. 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 or development work, higher rates will be charged, which may be obtained upon application.

Question. In building the five-tube neutrodyne, which was illustrated in the April 15 issue I find difficulty in neutralizing the second stage. What is the trouble?

Answer. When it seems impossible to neutralize a neutrodyne set the trouble may be caused either by magnetic or electrostatic action. The magnetic action is caused when the coils are spaced incorrectly or when they are tipped at the wrong angle, whereas electrostatic trouble results from the capacity action between the various wires and parts and is due to the fact that these wires act like small condensers and so pass a certain amount of high frequency from one to the other.

It is rather difficult to predict which cause is responsible for trouble in any particular case. It is generally best to go about finding a remedy by assuming that the capacity is at fault. Naturally the small neutralizing condenser is shifted so as to try out its extreme range. If this does not help, then the wiring should be gone over to make all the leakage capacity as small as possible. Along these lines care must be given to making the leads short and straight. Particular attention must be given to the grid leads and after that to the plate wires. The filament circuit carrying mostly direct current is not so important, provided it is kept away from the high frequency wires. If it is the capacity action that is at fault, then the results will be considerably better after slight changes along the above lines are made.

If this does not effect a remedy, then the most likely troubles is that the coils are not properly spaced or correctly tipped. To test this out is merely a method of cut and try. Since the holes are already drilled for the variable shaft to go through, it is difficult to change the spacing of the coils. But the experiment can be tried turning the coils slightly either to the right or to the left, and if either adjustment shows a better neutralization then you will know you are on the right track.

Question. What is meant by a by-pass condenser?

Answer. A by-pass condenser is connected in some circuit in parallel with a large inductance like a telephone or transformer, and is intended to allow high frequency to get through the circuit without having to run through the high inductance at radio frequency. The low frequency audio waves will not go through these small condensers, and so operate the phone or transformer just as though the by-pass condenser were not there. This piece of apparatus is needed most as a shunt across the primary of the first audio frequency transformer. The output from the plate of the detector contains both radio and audio frequency, and the former should be by-passed since it has difficulty traversing the inductance of the primary, whereas the audio frequency must go through the transformer in order to operate the first amplifier.

Question. Why is an ammeter not used for testing storage batteries the same way as for dry cells?

Answer. The dry cell has an output when new around 25 or 30 amperes. This is not enough to injure the battery itself. It is quite satisfactory to use this test since the condition of the cell is shown pretty well by the reading. When the current drops to ten or fifteen amperes on short circuit through the meter, then it is known that its useful life is about ended. On the other hand, if a storage cell is tested by short circuiting through an ammeter the current will amount to several hundred amperes. This will be enough to wreck an ordinary ammeter, but if a special high reading meter is used, then that trouble is removed, but it is very apt to injure a storage cell to short circuit it in this manner. Such treatment will sometimes cause the plates inside the cell to buckle or bend at the edges, and then they are likely to cut through the wooden separators, which ruins the cell. The best way of testing storage batteries is with a hydrometer. A reading of 1.275 shows a full battery, if it is the automobile type. The radio batteries usually have a somewhat lower gravity when full, nearer 1.250.

Question. What value of gridleak is best for a UV-199 tube?

Answer. For general purposes a 4 or 5 megohm leak will be found most satisfactory, although in some cases a higher value—6 to 8 megohms—will give slightly better reception of the weak stations.

Question. Some wiring diagrams show a grid leak across an audio transformer. What is the reason for it?

Answer. The practice of connecting a grid leak of half a megohm or less across the secondary of an audio transformer is ordinarily not recommended. It should never be necessary if only one or two stages of audio frequency are used. The idea is that if the set howls continuously such a leak will absorb enough energy to kill the oscillation. This is quite true, but the serious objection is that the leak not only absorbs energy from the undesirable oscillation but also from the music you wish to hear and there is no differential action; that is, if it cuts down the noise, it is apt to cut down the music in nearly the same proportion. If such an oscillation or howl is caused in a one or two stage audio amplifier, the best remedy is to find the trouble and correct it rather than try to kill the symptoms of the disease. When we use the three step audio amplifier, the cause is somewhat different. It is rather difficult to construct a set with so many amplifiers without causing a howl. Instead of a grid leak it is best to start experimenting with a condenser, usually .001 mfd. This should be tried out in various places at the transformers, and if you have good luck it will kill the howl, but if it can not be stopped by a condenser and the wiring has been gone over as carefully as possible to make the leads short, and furthermore if the transformers have been shielded and the iron cores grounded, then about the only thing left to do is to connect the ends of the grid-leak across from one terminal to the other as described. The resistance should be kept as high as possible so as not to reduce the music any more than necessary.

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WHY MUST GRID LEAK

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tact means a noisy Grid Leak or one of very high resistance.

An electric current is now passed through the element to season it. An analogy which might be mentioned is the passing of a current around a piece of iron to form a permanent magnet. The

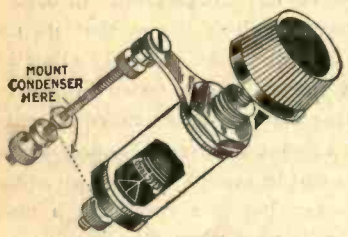


Fig. 2. Variable Leak

atoms of lamp black apparently align themselves in perfectly regular order, end for end, so as to offer the smoothest possible path to the passage of the small current for which it is intended. Next, the elements are treated with special water-proofing compounds, as the water-proofing matter must not affect the element. The leaks are now seasoned a few days, just as you bake steel to anneal it. Next, the element is carefully inserted in the glass tube or other insulating case, and the ferrules are soldered on each end to protect the element further from contact with fingers and atmosphere. Glass cases are most common, but there are other insulating materials now in use, in which the dielectric losses and insulating qualities are considered perhaps better. Then the Grid Leak is again tested and labeled or stamped and certified correct. It is now ready for use.

The various values of leaks are packed in cabinets where they can be kept in good order. The Electrad Company make up the various values in several different colors to harmonize with the rest of the set. Such a cabinet is shown in Figure 3.

Condenser Won't Correct Leak

There has, in the past, been considerable propaganda on Grid Leaks to the effect that if your Grid Leak is the incorrect resistance, you can compensate by adjustment of your variable condenser. This is an absolutely incorrect method of procedure. As you can readily see, one cannot adjust resistance by altering capacity. If your Grid Leak is

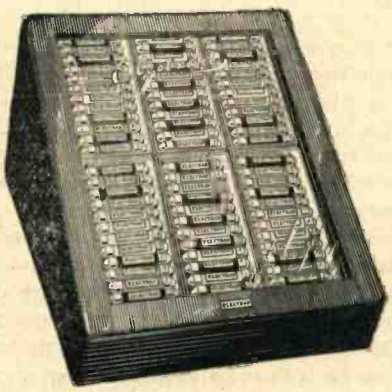


Fig. 3. Grid Leak Cabinet

the wrong size, you must get another. If they are certified correct, then you know what you are getting and can try out several sizes until you find the one best suited for your particular requirement.

THE AUDIOMETER

Continued from Page 21

easy to decide the percentage of deafness of a person with abnormal hearing, by the same method. Figures 2 and 3 show the percentage of the normal hearing of two persons, namely, Mr. A and Mr. B, which proves that Mr. A hears 58 per cent. of all that a person with normal hearing would perceive, but Mr. B only hears 12 per cent. of all the sounds that are audible to a normal person under the same conditions

The advantage of this method of measuring the hearing is that it will be possible to find out just what tones can not be heard. No doubt this will give the

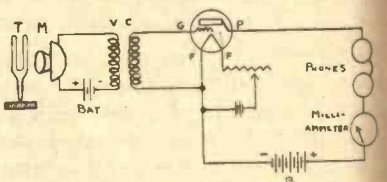


Fig. 4. Simplified Hook Up

doctors a very good clue to find out what is the main cause of a patient's deafness. It will probably then be possible to remove the cause and likely in many cases restore normal hearing to the sufferer.

The audiometer measures deafness with all possible accuracy and therefore it will eliminate any chance of dispute between brother physicians, who have a large variation in their standards of deafness and normal hearing. The "audiometer" ought to prove of value in a court of law where considerable confusion results when it is necessary to prove the accuracy of a person's hearing or deafness.

DR. RADIO PRESCRIBES

Continued from Page 28

Question. Can dry cell tubes be restored after they have been run on too high voltage?

Answer. The UV-199 tube contains a filament made of platinum with a small percentage of the element thorium added to it. If this tube is run at too high a voltage it will burn off the layer of thorium, with the result that it will no longer work. If the voltage has not been *too* high or too long continued, the tube may be restored to practically its former efficiency by running it at normal filament voltage, but with "B" battery entirely disconnected for a period of about one-half an hour. This allows some of the thorium in the filament to come to the surface and after that it will work as before.

The WD-11 and WD-12 tubes have a filament made of tungsten, but coated with oxides of rare earth. If these are run too hot, by allowing the rheostat to be turned on too far or by using two or more dry cells in series instead of in parallel, then the oxide coating is burned off with no chance of replacing it. The tube has to be scrapped. The moral is, be sure that the filaments do not run any brighter than a dull red.

Question. Which is the best transformer ratio 3 to 1 or 10 to 1?

Answer. Audio transformers are made in a large number of ratios. The 3 to 1 is the most popular, although the 5 to 1 is frequently used. It is inadvisable to use a 10 to 1 transformer except in the first stage, as two such instruments hooked up together will almost invariably cause howling.

Question. What is meant by a buffer tube?

Answer. This is the name given to a single stage of radio frequency when connected between the detector and the aerial. While it has the advantage of increasing the loudness of the signal, it is usually specified for another purpose. It is about the only way that an ordinary regenerative set can be made non-radiating (non-squealing). Even with such a tube, the set will sometimes oscillate or squeal if the radio is improperly operated, but in such a case, the amount of squealing will be very small.

"RADICAST"

Recently several articles have appeared in current magazines in regard to some word to take the place of "broadcast," as this latter already had a definite meaning before the coming of radio. One good suggestion has been to coin the word "radiocast." This appeals to us as being rather awkward to pronounce, and we suggest that the most logical word would be "radicast." Try this on your friends and see how they like it.

PRIZES FOR SUBSCRIPTIONS

Head Phones
or
Transformers

FREE if you secure two subscriptions for RADIO PROGRESS for one year— your own and that of a friend.

UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

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

		W.L.	K.C.	W.P.
KDKA	Westinghouse Elec. & Mfg. Co., East Pittsburgh	326-	920-	1000
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, O.	270-	1110-	250
KDPT	Southern Electrical Co., San Diego, Cal.	244-	1230-	100
KDYL	Salt Lake Telegram, Salt Lake City, Utah	360-	833-	100
KDYM	Savoy Theatre, San Diego, Cal.	280-	1070-	100
KDYQ	Oregon Institute of Technology, Portland, Ore.	360-	833-	100
KDYX	Star Bulletin, Honolulu, Hawaii	360-	833-	100
KDZB	Frank E. Siefert, Bakersfield, Cal.	240-	1250-	100
KDZE	The Rhodes Co., Seattle, Wash.	270-	1110-	100
KDZF	Auto. Club of So. Cal., Los Angeles, Cal.	278-	1080-	500
KFAD	McArthur Bros. Mercantile Co., Phoenix, Ariz.	360-	833-	100
KFAE	State College of Washington, Pullman, Wash.	330-	910-	500
KFAF	Western Radio Corp., Denver, Col.	360-	833-	500
KFAJ	University of Colorado, Boulder, Col.	360-	833-	100
KFAQ	City of San Jose, San Jose, Cal.	360-	833-	250
KFAR	Studio Lighting Service Co., Hollywood, Cal.	280-	1070-	150
KFAU	In. Sch'l Dist. of Boise City, B'ise H. S., Boise, Id.	270-	1110-	150
KFBB	F. A. Buttrey & Co., Havre, Mont.	360-	833-	100
KFBK	Kimball-Upson Co., Sacramento, Cal.	283-	1060-	100
KFCF	Frank A. Moore, Walla Walla, Wash.	360-	833-	100
KFCM	Richmond Radio Shop, Richmond, Cal.	360-	833-	100
KFCZ	Omaha Central High School, Omaha, Neb.	259-	1160-	100
KFDH	University of Arizona, Tucson, Ariz.	360-	833-	150
KFDV	Gilbreth & Stinson, Fayetteville, Ark.	360-	833-	200
KFDX	First Baptist Church, Shreveport, La.	360-	833-	100
KFDY	So. Dakota State College, Brookings, So. Dakota.	360-	833-	100
KFEL	Winner Radio Corp., Denver, Col.	360-	833-	100
KFEQ	J. L. Scroggin, Oak, Neb.	360-	833-	150
KFEV	Felix Thompson Radio Shop, Casper, Wyo.	263-	1140-	250
KFEX	Augsburg Seminary, Minneapolis, Minn.	261-	1150-	100
KFEZ	Amer. Society of Mech. Engineers, St. Louis, Mo.	360-	833-	250
KFFQ	Markehoffel Motor Co., Colorado Springs, Col.	360-	833-	100
KFFV	Graceland College, Lamoni, Iowa.	360-	833-	100
KFFX	McCray Co., Omaha, Neb.	278-	1080-	100
KFFY	Pincus & Murphy, Alexandria, La.	275-	1090-	100
KFGC	Louisiana State University, Baton Rouge, La.	254-	1180-	100
KFGD	Chickasha Rad. & Elec. Co., Chickasha, Okla.	248-	1210-	200
KFGH	Leland Stanford University, Stanford Univ., Cal.	360-	833-	500
KFGJ	Mo. Natl. Guard, 138th Infantry, St. Louis, Mo.	265-	1130-	100
KFGX	First Presbyterian Church, Orange, Tex.	250-	1200-	500
KFGZ	Emmanuel Missionary Col., Berrien Sprs., Mich.	268-	1120-	250
KFHD	Utz Electric Shop, St. Joseph, Mo.	225-	1330-	100
KFHF	Central Christian Church, Shreveport, La.	265-	1130-	150
KFHJ	Fallon & Co., Santa Barbara, Cal.	360-	833-	100
KFHX	Robert W. Nelson, Hutchinson, Ks.	229-	1310-	150
KFI	Earle C. Anthony, Inc., Los Angeles, Cal.	469-	640-	500
KFIF	Benson Polytechnic Institute, Portland, Ore.	360-	833-	100
KFIX	R. C. of Jesus Christ of L.D. Sts., Ind'p'nd'n'e, Mo.	240-	1250-	250
KFIZ	Daily C'm'nw'lth & O.A.Heulsm'n, Fond d'L'c,Wis.	273-	1100-	100
KFJC	Seattle Post Intelligencer, Seattle, Wash.	270-	1110-	100
KFJK	Delano Radio and Electric Co., Bristow, Okla.	234-	1280-	100
KFJM	University of N. Dakota, Grand Forks, N. Dak.	280-	1070-	100
KFKB	Brinkley-Jones Hospital Association, Milford, Ks.	286-	1050-	500
KFKQ	Conway Radio Laboratories, Conway, Ark.	250-	1340-	100
KFKX	Westinghouse Elec. & Mfg. Co., Hastings, Neb.	341-	880-	1000
KFLR	University of N. Mexico, Albuquerque, N. M.	254-	1180-	100
KFLV	Rev. A. T. Frykman, Rockford, Ill.	229-	1310-	100
KFMQ	University of Arkansas, Fayetteville, Ark.	263-	1140-	100
KFMS	Freimuth Dept. Store, Duluth, Minn.	275-	1090-	100
KFMX	Carleton College, Northfield, Minn.	283-	1060-	500
KFMZ	Roswell Broadcasting Club, Roswell, N. M.	250-	1200-	100
KFNF	Henry Field Seed Co., Shenandoah, Iowa.	266-	1130-	500
KFOA	The Rhodes Co., Seattle, Wash.	454-	660-	500
KFSG	Echo Park Evangelistic Ass'n, Los Angeles, Cal.	234-	1280-	500
KGN	Northwestern Radio Mfg. Co., Portland, Ore	360-	833-	100
KGO	General Electric Co., Oakland, Cal.	312-	960-	1000
KGU	Marion A. Mulreny, Honolulu, Hawaii	360-	833-	250
KGW	Portland Morning Oregonian, Portland, Ore.	492-	610-	500
KHJ	Times-Mirror Co., Los Angeles, Cal.	395-	760-	500
KHO	Louis Wasmer, Seattle, Wash.	360-	833-	100
KJR	Northwest Radio Service Co., Seattle, Wash.	270-	1110-	100
KJS	Bible Institute of Los Angeles, Los Angeles, Cal.	360-	833-	750
KLS	Warner Brothers, Oakland, Cal.	360-	833-	250
KLX	Tribune Publishing Co., Oakland, Cal.	508-	590-	500
KLZ	Reyno'ds Radio Co., Denver, Col.	360-	833-	500
KNT	Grays Harbor Radio Co., Aberdeen, Wash.	263-	1140-	250
KNV	Radio Supply Co., Los Angeles, Cal.	254-	1180-	100
KNX	Electric Lighting Supply Co., Los Angeles, Cal.	360-	833-	100
KOB	N. M. C. of Agri. & Mech. Arts, State Col., N. M.	360-	833-	500
KOP	Detroit Police Dept., Detroit, Mich.	286-	1050-	500
KPO	Hale Bros., San Francisco, Cal.	422-	710-	500
KQV	Doubledav-Hill Electric Co., Pittsburgh, Pa.	280-	1070-	500
KSD	Post Dispatch, St. Louis, Mo.	545-	550-	500
KTW	First Presbyterian Church, Seattle, Wash.	360-	833-	750
KUO	Examiner Printing Co., San Francisco, Cal.	360-	833-	150
KUS	City Dye Works & Laundry Co., L. Angeles, Cal.	360-	833-	100
KWG	Portable Wireless Tel. Co., Stockton, Cal.	360-	833-	100
KWH	Los Angeles Examiner, Los Angeles, Cal.	360-	833-	500
KYO	Electric Shop, Honolulu, Hawaii	288-	1040-	100
KYW	Westinghouse Elec. & Mfg. Co., Chicago, Ill.	535-	560-	1000
KZM	Preston D. Allen, Oakland, Cal.	360-	833-	100
KZN	The Deseret News, Salt Lake City, Utah	360-	833-	500
WAAB	Waldemar Jensen, New Orleans, La.	268-	1120-	100
WAAC	Tulane University, New Orleans, La.	360-	833-	100
WAAF	Chicago Daily, Drovers Journal, Chicago, Ill.	286-	1050-	200
WAAM	I. R. Nelson Co., Newark, N. J.	263-	1140-	250
WAAW	Omaha Grain Exchange, Omaha, Neb.	360-	833-	500
WAAZ	Hollister-Miller Motor Co., Emporia, Ks.	360-	833-	100
WABA	Lake Forest College, Lake Forest, Ill.	265-	1130-	100
WABE	Young Men's Christian Assn., Washington, D. C.	283-	1060-	100
WABI	Bangor Ry. & Elec. Co., Bangor, Me.	240-	1250-	100
WABL	Conn. Agri. College, Storrs, Conn.	283-	1060-	100
WABM	F. E. Doherty Auto. & R'dio E. Co., Saginaw, M.	254-	1180-	100
WABN	Ott Radio, Inc., La Crosse, Wis.	244-	1230-	250
WABP	Robert F. Weinig, Dover, Ohio	265-	1130-	100
WABT	Holliday-Hall, Washington, Pa.	252-	1190-	100
WABU	Victor Talking Machine Co., Camden, N. J.	225-	1330-	100
WABX	Henry B. Joy, Mount Clemens, Mich.	270-	1110-	150
WBAA	Purdue University, West Lafayette, Ind.	360-	833-	250
WBAD	Sterling Electric Co., Minneapolis, Minn.	360-	833-	100
WBAH	The Dayton Co., Minneapolis, Minn.	416-	720-	500
WBAK	Penn. State Dept. of Police, Harrisburg, Pa.	400-	750-	500
WBAN	Wireless Phone Corp., Paterson, N. J.	244-	1230-	100
WBAP	Wortham-Carter Pub. Co., Fort Worth, Tex.	476-	630-	750
WBAV	Erner & Hopkins Co., Columbus, Ohio.	389-	770-	500
WBAW	Marietta College, Marietta, Ohio	246-	1220-	250
WBAY	American Tel. & Tel. Co., New York, N. Y.	492-	610-	500
WBBF	Georgia School of Technology, Atlanta, Ga.	270-	1110-	500
WBBG	Irving Vermilya, Mattapoisett, Mass.	240-	1250-	100
WBBM	Frank Atlass Produce Co., Lincoln, Ill.	255-	1330-	200
WBBO	Michigan Limestone & Chem. Co., Rodgers, Mich.	250-	1200-	500
WBBQ	Frank Crook, Pawtucket, R. I.	252-	1190-	100
WBBR	Peoples' Pulpit Ass'n, Rossville, N. Y.	244-	1230-	500
WBL	T. & H. Radio Co., Anthony, Ks.	261-	1150-	100
WBR	Penn State Police, Butler, Pa.	286-	1050-	250
WBT	Southern Radio Corp., Charlotte, N. C.	360-	833-	500
WBU	City of Chicago, Chicago, Ill.	286-	1050-	500
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337-	890-	1000
WCAD	St. Lawrence University, Canton, N. Y.	280-	1070-	250
WCAE	Kaufmann & Baer Co., Pittsburgh, Pa.	461-	650-	500
WCAH	Entrekin Electric Co., Columbus, O.	286-	1050-	100
WCAJ	Nebraska Wesleyan Univ., Univ. Place, Neb.	360-	833-	500
WCAL	St. Olaf College, Northfield, Minn.	360-	833-	500
WCAM	Villanova College, Villanova, Pa.	360-	833-	150
WCAP	Chesapeake & Potomac Tel. Co., Wash'gt'n, D. C.	469-	640-	500
WCAR	Alamo Radio Elec. Co., San Antonio, Texas	360-	833-	100
WCAS	W. E. Dunwoody Ind. Inst., Minneapolis, Minn.	246-	1220-	100
WCAT	S. Dakota State Sch. of Mines, Rapid City, S. D.	240-	1250-	100
WCAU	Durham & Co., Philadelphia, Pa.	286-	1050-	250
WCAY	Kesselman-O'Driscoll Co., Milwaukee, Wis.	261-	1150-	250
WCBC	Univ. of Michigan, Ann Arbor, Mich.	280-	1070-	200
WCBD	Wilbur G. Voliva, Zion, Ill.	345-	870-	500
WCK	Stix, Baer & Fuller Dry Goods Co. St. Louis, Mo.	360-	833-	100
WCM	University of Texas, Austin, Tex.	360-	833-	500
WCX	Detroit Free Press, Detroit, Mich.	517-	580-	500
WDAE	Tampa Daily Times, Tampa, Fla.	360-	833-	250
WDAF	Kansas City Star, Kansas City, Mo.	411-	730-	500
WDAG	J. Laurance Martin, Amarillo, Tex.	263-	1140-	100
WDAH	Trinity Methodist Church, El Paso, Texas.	268-	1120-	100
WDAK	The Courant, Hartford, Conn.	261-	1150-	100
WDAP	Board of Trade, Chicago, Ill.	360-	833-	1000
WDAR	Lit Brothers, Philadelphia, Pa.	395-	760-	500
WDAU	Slocum & Kilburn, New Bedford, Mass.	360-	833-	100
WDAX	First National Bank, Centerville, Iowa.	360-	833-	100
WEAF	American Tel. & Tel. Co., New York, N. Y.	492-	610-	500
WEAH	Wichita Board of Trade, Wichita, Kas.	280-	1070-	100
WEAI	Cornell University, Ithaca, N. Y.	286-	1050-	500
WEAJ	University of S. Dakota, Vermillion, S. Dak.	283-	1060-	200
WEAM	Borough of N. Plainfield, N. Plainfield, N. J.	252-	1190-	100
WEAN	Shepard Co., Providence, R. I.	273-	1100-	100
WEAO	Ohio State University, Columbus, Ohio.	360-	833-	500
WEAP	Mobile Radio Co., Mobile, Ala.	360-	833-	100
WEAS	Hecht Co., Washington, D. C.	360-	833-	100
WEAU	Davidson Bros. Co., Sioux City, Iowa.	360-	833-	100
WEAY	Iris Theatre, Houston, Texas.	360-	833-	500
WEB	Benwood Co., St. Louis, Mo.	273-	1100-	250
WEV	Hurlburt-Still Electric Co., Houston, Texas.	360-	833-	100
WEW	St. Louis University, St. Louis, Mo.	261-	1150-	100
WFAA	Dallas News & Dallas Journal, Dallas, Tex.	476-	630-	500
WFAB	Carl F. Woese, Syracuse, N. Y.	234-	1280-	100
WFAH	Electric Supply Co., Port Arthur, Tex.	236-	1270-	150
WFAN	Hutchinson Elec. Service Co., Hutchinson, Minn.	360-	833-	100
WFAV	Univ. of Nebraska, Dept. of E. Eng., Lincoln, Neb.	275-	1090-	500
WFI	Strawbridge & Clothier, Philadelphia, Pa.	395-	760-	500
WGAO	Glenwood Radio Corp., Shreveport, La.	360-	833-	100
WGAW	Ernest C. Albright, Altoona, Pa.	261-	1150-	100
WGAY	Northwestern Radio Co., Madison, Wis.	360-	833-	100
WGAZ	South Bend Tribune, South Bend, Ind.	360-	833-	250
WGI	Am. R'dio & Res'ch Corp., Medf'd Hillside, Mass.	360-	833-	100
WGL	Thomas F. J. Rowlett, Philadelphia, Pa.	360-	833-	250
WGR	Federal Tel. & Tele. Co., Buffalo, N. Y.	319-	940-	750
WGV	Interstate Electric Co., New Orleans, La.	242-	1240-	100
WGY	General Electric Co., Schenectady, N. Y.	380-	790-	1000
WHA	University of Wisconsin, Madison, Wis.	360-	833-	500
WHAA	State University of Iowa, Iowa City, Iowa.	484-	620-	500
WHAB	Clark W. Thompson, Galveston, Tex.	360-	833-	200
WHAD	Marquette University, Milwaukee, Wis.	280-	1070-	100

		W.L.	K.C.	W.P.
WHAG	University of Cincinnati, Ohio	222-	1350-	200
WHAH	Rafer Supply Co., Joplin, Mo.	283-	1060-	250
WHAM	University of Rochester, Rochester, N. Y.	283-	1060-	100
WHAS	Courier-Journal & Louisville Times, Louisville, Ky.	400-	750-	500
WHAZ	Rensselaer Polytechnic Institute, Troy, N. Y.	380-	790-	500
WHB	Sweeney School Co., Kansas City, Mo.	411-	730-	500
WHK	Radiovox Co., Cleveland, Ohio	283-	1060-	100
WHN	George Schubel, New York, N. Y.	360-	833-	100
WIAC	Galveston Tribune, Galveston, Tex.	360-	833-	100
WIAD	Howard R. Miller, Philadelphia, Pa.	254-	1180-	100
WIAJ	Fox River Valley Radio Supply Co., Neenah, Wis.	224-	1340-	100
WIAK	Journal-Stockman Co., Omaha, Neb.	278-	1080-	200
WIAO	School of Eng. of Milwaukee, Milwaukee, Wis.	360-	833-	100
WIAR	Paducah Evening Sun, Paducah, Ky.	360-	833-	100
WIAS	Home Electric Co., Burlington, Iowa	360-	833-	100
WIK	K. & L. Electric Co., McKeesport, Pa.	234-	1280-	100
WIP	Gimbel Brothers, Philadelphia, Pa.	508-	590-	500
WJAB	American Electric Co., Lincoln, Neb.	360-	833-	500
WJAD	Jackson's Radio Eng. Laboratories, Waco, Tex.	360-	833-	150
WJAG	Norfolk Daily News, Norfolk, Neb.	283-	1060-	250
WJAN	Peoria Star, Peoria, Ill.	280-	1070-	100
WJAQ	Capper Publications, Topeka, Ks.	360-	833-	100
WJAR	The Outlet Co., Providence, R. I.	360-	833-	500
WJAS	Pittsburgh Radio Supply House, Pittsburgh, Pa.	250-	1200-	500
WJAX	Union Trust Co., Cleveland, Ohio.	390-	770-	500
WJAZ	Chicago Radio Laboratory, Chicago, Ill.	448-	670-	1000
WJH	Wm. P. Boyer Co., Washington, D. C.	273-	1100-	100
WJX	Deforest Radio Tel. & Tel. Co., N. Y., N. Y.	360-	833-	500
WJY	R. C. A., New York, N. Y.	405-	740-	500
WJZ	Broadcast Central, New York, N. Y.	454-	660-	500
WKAA	H. F. Paar, Cedar Rapids, Iowa.	268-	1120-	100
WKAF	W. S. Radio Supply Co., Wichita Falls, Tex.	360-	833-	100
WKAP	Dutee W. Flint, Cranston, R. I.	360-	833-	250
WKAQ	Radio Corp. of Porto Rico. San Juan, P. R.	360-	833-	500
WKAR	Michigan Agr. College, E. Lansing, Mich.	280-	1070-	500
WKY	WKY Radio Shop, Oklahoma, Okla.	360-	833-	150

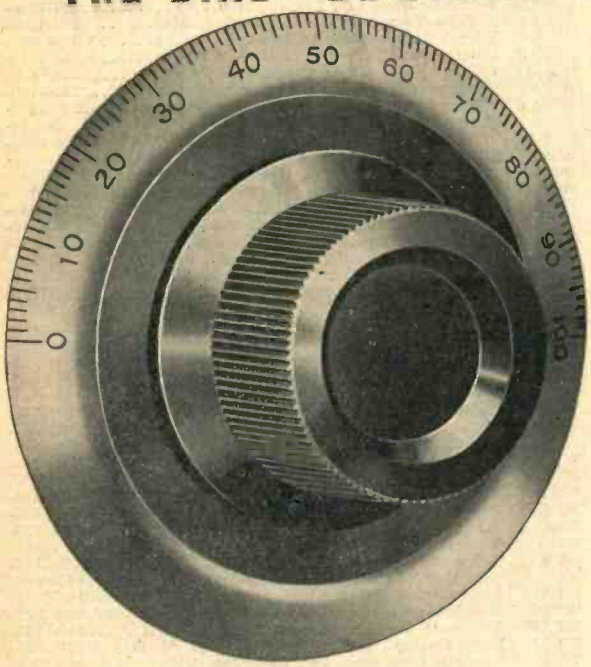
		W.L.	K.C.	W.P.
WLAG	Cutting & Wash. Radio Corp., Minneapolis, Minn.	416-	720-	500
WLAH	Samuel Woodworth, Syracuse, N. Y.	234-	1280-	100
WLAJ	Waco Electrical Supply Co., Waco, Tex.	360-	833-	150
WLAK	Vermont Farm Machine Corp., Bellows Falls, Vt.	360-	833-	500
WLAL	Naylor Electrical Co., Tulsa, Okla.	360-	833-	100
WLAN	Putnam Hardware Co., Houlton, Me.	283-	1060-	250
WLAW	Police Dept. City of N. Y., New York, N. Y.	360-	833-	500
WLW	Crosley Mfg. Co., Cincinnati, O.	309-	970-	500
WMAB	Radio Supply Co., Oklahoma, Okla.	360-	833-	100
WMAC	Clive B. Meredith, Cazenovia, N. Y.	261-	1150-	200
WMAF	Round Hills Radio Corp., Dartmouth, Mass.	360-	833-	500
WMAH	General Supply Co., Lincoln, Neb.	254-	1180-	100
WMAJ	Drovers Telegram Co., Kansas City, Mo.	275-	1090-	250
WMAK	Norton Laboratories, Lockport, N. Y.	360-	833-	500
WMAP	Utility Battery Service, Easton, Pa.	246-	1220-	150
WMAQ	Chicago Daily News, Chicago, Ill.	448-	670-	500
WMAT	Paramount Radio Corp., Duluth, Minn.	266-	1130-	250
WMAV	Alabama Polytechnic Institute, Auburn, Ala.	250-	1200-	750
WMAY	Kingshighway Presbyterian Church, St. Louis, Mo.	280-	1070-	100
WMC	"Commercial Appeal," Memphis, Tenn.	500-	600-	500
WMU	Doubleday-Hill Elec. Co., Washington, D. C.	261-	1150-	100
WNAC	Shepard Stores, Boston, Mass.	278-	1080-	100
WNAD	University of Oklahoma, Norman, Okla.	360-	833-	100
WNAN	Syracuse Radio Telephone Co., Syracuse, N. Y.	286-	1050-	200
WNAP	Wittenberg College, Springfield, Ohio.	231-	1300-	100
WNAS	Tex. Radio Corp. & Austin Statesman, Austin, Tex.	360-	833-	100
WNAT	Lenning Brothers Co., Philadelphia, Pa.	360-	833-	250
WNAV	People's Tel. & Tel. Co., Knoxville, Tenn.	236-	1270-	500
WNAX	Dakota Radio Apparatus Co., Yankton, S. D.	244-	1230-	100
WOAC	Pagan Organ Co., Lima, Ohio.	265-	1130-	150
WOAG	Apollo Theatre, Belvidere, Ill.	273-	1100-	100
WOAH	Palmetto Radio Corp. Charleston, S. C.	360-	833-	100
WOAI	Southern Equipment Co., San Antonio, Tex.	384-	780-	500
WOAL	William E. Woods, Webster Groves, Mo.	229-	1310-	100
WOAN	Vaughn C'nserv't'ry of Music, Lawrenceb'rg, Tenn.	360-	833-	200
WOAP	Kalamazoo College, Kalamazoo, Mich.	283-	1160-	100
WOAV	Penn. Nat'l Guard. 2d Bat, 112th Inf., Erie, Pa.	242-	1240-	100
WOAW	Woodmen of the World, Omaha, Neb.	526-	570-	500
WOAX	Franklyn J. Wolff, Trenton, N. J.	240-	1250-	500
WOC	Palmer Sch. of Chiropractic, Davenport, Iowa	484-	620-	500
WOI	Iowa State College, Ames, Iowa.	360-	833-	500
WOK	Pine Bluff Co., Pine Bluff, Ark.	265-	1130-	250
WOO	John Wanamaker, Philadelphia, Pa.	508-	590-	500
WOQ	Western Radio Co., Kansas City, Mo.	360-	833-	500
WOR	L. Bamberger & Co., Newark, N. J.	405-	740-	500
WOS	Mo. State Marketing Bureau, Jefferson City, Mo.	441-	680-	500
WPAB	Pennsylvania State College, State College, Pa.	283-	1060-	500
WPAC	Donaldson Radio Co., Okmulgee, Okla.	360-	333-	200
WPAH	Wisconsin Dept. of Markets, Waupaca, Wis.	360-	833-	500
WPAK	North Dakota Agri. Col., Agri. College, N. D.	360-	833-	250
WPAL	Avery & Loeb Elec. Co., Columbus, Ohio.	286-	1050-	100
WPAM	Auerbach & Geutell, Topeka, Kas.	360-	833-	100
WPAZ	John R. Koch (Dr.), Charleston, W. Va.	273-	1100-	100
WQAA	Horace A. Beale, Jr., Parkesburg, Pa.	360-	833-	500
WQAC	E. B. Gish, Amarillo, Tex.	234-	1280-	100
WQAM	Electrical Equipment Co., Miami, Fla.	283-	1060-	100
WQAN	Scranton Times, Scranton, Pa.	280-	1070-	100
WQAO	Calvary Baptist Church, New York, N. Y.	360-	833-	100
WQAQ	Abilene Daily Reporter, Abilene, Tex.	360-	833-	100
WQAS	Prince-Walter Co., Lowell, Mass.	265-	1130-	100
WQAX	Radio Equipment Co., Peoria, Ill.	360-	833-	100
WRAA	Rice Institute, Houston, Tex.	360-	833-	200
WRAL	No. States Power Co., St. Croix Falls, Wis.	248-	1210-	100
WRAM	Lombard College, Galesburg, Ill.	244-	1230-	250
WRAV	Antioch College, Yellow Springs, Ohio.	242-	1240-	100
WRAX	Flexon's Garage, Gloucester City, N. J.	268-	1120-	100
WRAY	Radio Sales Corp., Scranton, Pa.	280-	1070-	100
WRC	Radio Corp. of America, Washington, D. C.	469-	640-	500
WRK	Doren Bros. Electric Co., Hamilton, Ohio.	360-	833-	200
WRL	Union College, Schenectady, N. Y.	360-	833-	500
WRM	University of Illinois, Urbana, Ill.	360-	833-	500
WRW	Tarrytown Radio Research Lab., Tarrytown, N. Y.	273-	1100-	150
WSAB	S. E. Mo. State T'chers' Col., Cape Girardeau, Mo.	360-	833-	100
WSAC	Clemson Agr'l. Col., Clemson College, S. C.	360-	833-	500
WSAD	J. A. Foster Co., Providence, R. I.	261-	1150-	150
WSAH	A. G. Leonard, Jr., Chicago, Ill.	248-	1210-	500
WSAI	U. S. Playing Card Co., Cincinnati, Ohio.	309-	970-	500
WSAJ	Grove City College, Grove City, Pa.	360-	833-	250
WSAP	Seventh Day Adventist Church, New York, N. Y.	263-	1140-	250
WSAW	Curtis & McElwee, Canandaigua, N. Y.	275-	1190-	100
WSAY	Irving Austin, Port Chester, N. Y.	232-	1290-	100
WSB	Atlanta Journal, Atlanta, Ga.	428-	700-	500
WSL	J. & M. Electric Co., Utica, N. Y.	273-	1100-	100
WSY	Alabama Power Co., Birmingham, Ala.	360-	833-	500
WTAM	The Willard Storage Battery Co., Cleveland, O.	389-	770-	1000
WTAN	Orndorff Radio Shop, Mattoon, Ill.	240-	1250-	100
WTAQ	S. H. Van Gorden & Son, Osseo, Wis.	225-	1330-	100
WTAR	Reliance Electric Co., Norfolk, Va.	280-	1070-	100
WTAS	Charles E. Erbstein, Elgin, Ill., near.	286-	1050-	500
WTAT	Edison Electric Illum. Co., Boston, Mass.	246-	1220-	100
WTAY	Pioneer Publishing Co., Oak Park, Ill.	283-	1330-	500
WTG	Kansas State Agri. Col., Manhattan Ks.	360-	833-	500
WWAD	Wright & Wright, Inc., Philadelphia, Pa.	360-	833-	500
WWAE	Alamo Dance Hall, Joliet, Ill.	227-	1320-	500
WWAF	Galvin Radio Supply Co., Camden, N. J.	236-	1270-	100
WWAO	Michigan College of Mines, Houghton, Mich.	244-	1230-	250
WWJ	Detroit News, Detroit, Mich.	517-	580-	500
WWL	Loyola University, New Orleans, La.	268-	1120-	100

42 MAVERICK SQUARE

TRU-FIX RADIO PRODUCTS

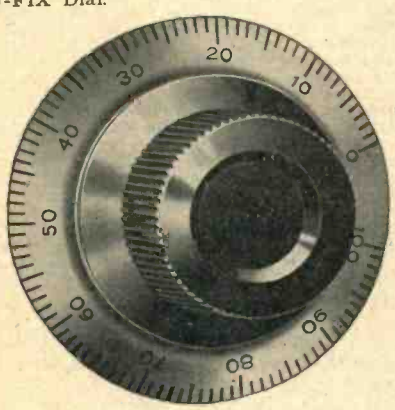
EAST BOSTON, MASS.

THE DIAL "DE LUXE"



4 Inch Dial

In designing the TRU-FIX the manufacturer has gone into every detail relative to requirements of Dials used on Radio Instruments, and after many experiments with springs, etc., adopted the last word in Dials—the springless TRU-FIX Dial.



2½ Inch Dial

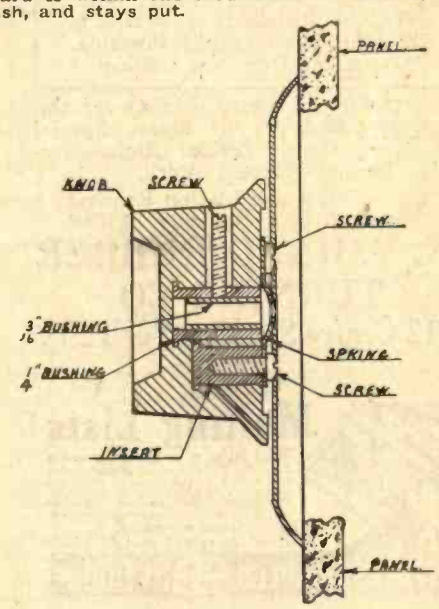
TRU-FIX Dials are made of selected sheet brass .023 of an inch thick. The edge is very thin with a gradual contour to meet the panel and is finished in bright nickel with 100 division scale running from left to right, etched in the surface, inlaid with black enamel, thereby making TRU-FIX DIAL easily read at all times.

The Knob, highly finished, is made of Bakelite 1½ inches high with bevel edge at base and is attached to dial with a flat spring device made into the dial itself.

DISTINCTIVE AND SELECTIVE

The patented spring feature under the knob is one of the superior points of this dial. You are always sure of a true running dial, as it keeps the dial in perfect alignment—always flush with panel, ensures perfect settings as the dial is not disturbed by jars or other causes. This gives you a dial that is different and one that always insures a more selective tuning. Perfect control on portable sets. Other dials cannot accomplish this feature.

Replaces the Vernier, as it can be moved forward or backward to within one thousandth of an inch, without backlash, and stays put.



Cross Section Tru-Fix Dials

WHY TRU-FIX IS A SUPERIOR DIAL

1. Corrects out-of-alignment of shaft with panel by spring feature made into the dial.

2. Corrects looseness of end play in any units used, such as Variocouplers, Condensers, Rheostats, etc., by slight friction on panel to take up this end play.

3. Corrects overbalanced units where there is a loss of friction caused by poor assembly in their manufacture and incorrect balancing of weights and metals.

4. Corrects loss of tuning adjustments, such as fading, etc., due to slight jars or vibrations, which allows the condenser or variocoupler to rotate out of position, thereby losing the station being tuned.

5. Corrects body capacity, as the metal of the dial acts as a shield when grounded. This can be done by setting a plug flush with panel and allowing the dial to touch it lightly, having the plug grounded.

These Dials, on account of the above listed features, are the only Dials to use on portable sets.

LIST PRICES

	Silver	Gold
100—3 inch Dial	$1.00	$2.00
102—4 inch Dial	1.25	2.50
104—2½ inch Dial	1.00	2.00

SOLD ONLY THROUGH THE JOBBERS—JOBBERS, WRITE

RADIO FREQUENCY AMPLIFICATION with the BALLANTINE VARIOTRANSFORMER

Get distance that everyone can enjoy

Let the whole family hear the announcer's "This is Station ZYX, The Voice from 'Way off Yonder!" They can—by adding BALLANTINE Radio Frequency to your present outfit. Providing, of course, you have a loud speaker.

The voice or music will be clear and strong. And you'll find it easier to separate the various stations. BALLANTINE Units may be hooked in between any standard receiver and its audio amplifier.

Transformer only for panel or base..... $9.60

At dealers or postpaid

Complete radio frequency amplifier unit with socket and rheostat.. $15.00

All wavelengths sharply tuned

Pure tones at maximum volume for the number of tubes employed are assured by the continuously variable feature of the BALLANTINE transformer. For, this instrument tunes sharply throughout the range of 200 to 600 meters. Pigtail connections and full shieldings prevent stray noises. Notable results have been obtained in the One-, Two-, and Three-Tube Reflexes as described in Radio Broadcast.

Keep your set "on its toes" all summer with BALLANTINE Variotransformers.

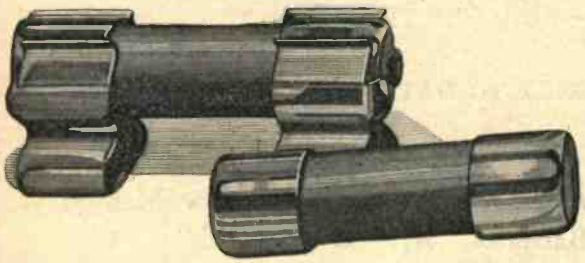
BOONTON RUBBER MFG. CO.
Pioneers in Bakelite Moulding
824 Fanny Road, Boonton, N. J.

RADIO FREQUENCY AMPLIFICATION with the BALLANTINE VARIOTRANSFORMER

BEST FOR REFLEX
PRICE $1.25

CELERUNDUM
The Crystal With a Soul

BEST FOR CRYSTAL SETS
PRICE $1.25



" DE-TEX-IT "

A Real Wonderful Fixed Detector That WORKS !

Why Continue Spending Money for a Crystal or a Detector That Won't Stand Up

Will Stand Any Plate Voltage
Positively Will Not Burn Out

YOUR MONEY REFUNDED IF NOT SATISFIED

If Your Dealer Cannot Supply You, Send $1.25 to

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