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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 FREQUENCY AMPLIFICATION with the BALLANTINE VARIOTRANSFORMER

RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 1 Number 6

Contents for

JUNE 1, 1924

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RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

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Changing Radio Into Audio Waves

How the Detector Works to Cause this Change of Frequency

(From an address by HORACE V. S. TAYLOR, broadcast by Station WEAN on May 15)

IN the last issue of RADIO PROGRESS, dated May 15, it was explained what the "carrier" wave meant, and why it was necessary to send out a frequency of a million or so oscillations a second, instead of a few hundred, such as would represent the music itself. This article had to do with the sending end of the broadcasting. The next question is, when this carrier wave reaches your radio set, how is it changed from its high frequency down to the low speed of oscillation which music uses?

The big difference between radio and audio frequency, you will remember, is the speed with which the waves oscillate up and down. It is the same thing with the surface of the ocean. During a storm, if you will examine carefully, you will notice that there are tremendous billows, spaced perhaps forty or fifty feet apart, and on top of these are a series of small ripples, which may measure only two or three inches from crest to crest. In this case, the big billows at the low frequency and wide spacing represent audio frequency, whereas the ripples which pass by very rapidly are representative of radio frequency. There may be several hundred ripples to each billow. When broadcasting the ratio is even more marked as there may be as many as five or ten thousand radio frequency waves to one of audio frequency, but the principle is just the same.

You Can't Shake a Ton

Suppose you pick up a stone weighing about one pound. You can shake this back and forth pretty rapidly, if you want to. But instead of a one-pound stone, let the weight be a sack of grain weighing 100 pounds. This you will find is much harder to shake back and forth, or as we say, to make oscillate, but if

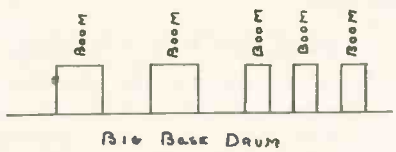


Fig. 1. Bass Drum-Audio Frequency

you apply enought force, you can make it vibrate to some extent, although much slower than before. Now suppose you take a truck loaded with a ton of coal. This is so heavy that when you attempt to shake it you find it impossible. If enough force were used it could be made to oscillate back and forth at a very slow speed, but at nothing like the frequency of oscillation at which you were able to make the small stone vibrate.

Ear Drum Beats Bass Drum

This is the principle of the waves as they pass through a telephone, and also as they strike your ear drum. The telephone diaphram is made of very thin steel, and is quite light. The human ear drum is also quite light and both can easily be shaken back and forth at speeds of several hundred up to seven thousand times a second. This represents the range of tone from a bass note at the bottom of the piano scale up to the high treble notes up at the upper end of the piano. But when an attempt is made to shake the telephone or the ear drum at the tremendous speed of a million cycles a second, the attempt is hopeless. No sound whatever is heard. That is why no one can hear notes which have a speed of oscillation faster than ten or fifteen thousand times a second.

Listen to a Drum Corps

The difference between the two speeds of vibration in a radio wave can be illustrated by the action of a drum corps. As you hear them marching down the street, the sounds are heard as shown in Figure 1. In the diagram distances along the line to the right represent time, while the height of the figures shows loudness. The bass drum sounds like this: Boom—Boom—Boom Boom Boom.

Roll of the Snare

Next we hear the voice of the snare drum, which goes like this: brbrbrbrbr—brbrbrbrbr—brbr, brbr, brbr. Here brbrbr is intended to represent the rolling of the snare drum as the drummer makes

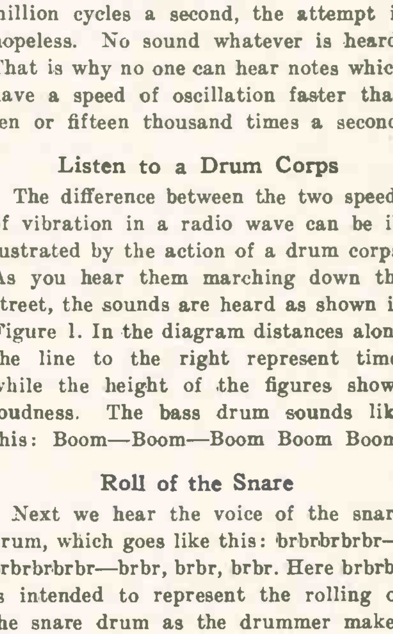


Fig. 2. Snare Drum-Radio Frequency

his sticks go back and forth very fast. If the drummer is new and inexperienced, his sticks move slowly enough back and forth, so that we can distinguish by ear the different individual strokes of the sticks, but as he improves in his technique, he spaces them closer and closer together so that an experienced drummer can make them vibrate so fast we cannot get the separate impulses, but they all run together to form a continuous tone or roll. In such a case what we *do* hear is a sort of block of sounds followed by a space, then another block, another space and then three short blocks, following rapidly one after the other. This spacing, of course, is the same as that caused by the bass drum.

One Million a Second

This block or tone is just like a single audio wave. It is made up of a large number of very short impulses each of which is a radio wave. This shows up more clearly in Figure 2. The radio wave oscillates back and forth with a constant frequency of about a million cycles per second. Of course, the exact speed of vibration depends upon the wave length, which has been assigned to the broadcasting station by the Government. A 300-meter wave has an oscillation speed of exactly one million per second. A 360-meter station sends out 833,000 oscillations, or as it is expressed, 833 kilocycles every second.

This speed depends on the adjustment of the coils and condensers in the sending apparatus, and is never changed, since the radio inspectors require that it be held constant from year to year.

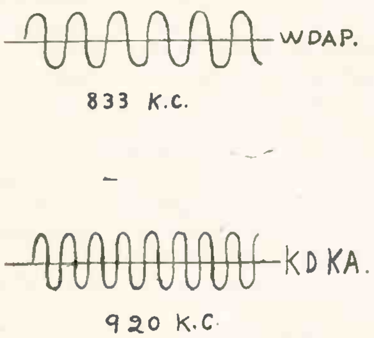


Fig. 3. Carrier Waves Only

But the groups of radio waves, which you see in Figure 2, are varying all the time, depending on the tone which the artist sings. A high note represents a combination of waves in which the groups are repeated at frequent intervals (perhaps a thousand a second), whereas a low note means that the groups are repeated at much longer intervals, (two or three hundred a second.)

From this it will be seen that we can have high or low speed of vibration of the radio wave conbined with either high or low frequency of the audio wave. As an illustration, take two stations like WDAP, Chicago, which operates at 360 meters, and KDKA, East Pittsburg, whose wave length is 326 meters. You will recall that the frequency of oscillation may always be found by dividing the wave length into 300,000,000. By performing this division, you will find that the frequency of these two stations is 833,000 and 920,000, respectively. The carrier waves sent out by these two stations are shown in Figure 3. This is before any one sings into the microphone, so that no audio frequency is seen at all. When a musical tone is played or sung into the microphone at the sending station, it makes the radio or carrier waves gather into groups, and the speed with which the groups are repeated is decided by the pitch of the musical note, so when a high pitched note like high "C" is played, these two stations will group themselves in to waves like Figure 4.

High or Low Radio Frequency

It will be seen that the top curve is of low radio frequency, while the bottom curve shows high radio frequency. This difference is that due to the dissimilarity in tuning between the two stations. As noted above, WDAP is a comparatively low frequency, whereas KDKA works on a higher speed of vibration. But you will notice that the groups of waves are repeated at the same speeds. There are five different groups shown in the cut, and if the note sung is high "C," which has a frequency or speed of vibration of about 1000 oscillations per second, then five of these groups will occur in five one-thousandths or one two-hundredth of a second. Whereas the radio frequency was set by government requirement for each of the stations, the audio frequency has been determined entirely by the pitch of the note the artist was singing.

Now let the same two stations broadcast a note by a bass singer. Of course, the radio frequency, which is what you tune your radio set to, will stay unchanged for the two stations. It is the grouping of the radio waves which will be affected. Figure 5 shows how this occurs. The top curve has the same radio frequency as it had in Figure 4. Of course, the reason is still the same—the vibrations must occur at such a speed that 833,000 of them are crowded into the short space of one second. The lower curve is the same as in Figure 4, and one second will see the passage of 920,000

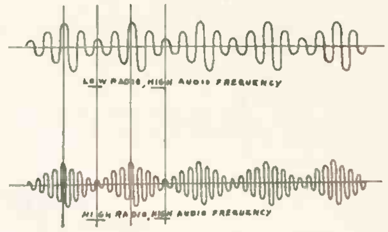


Fig. 4. Soprano Sings High C

waves. But notice the difference in audio frequency between Figures 4 and 5. In the former, the groups occur quite rapidly, showing a high musical tone, but in the latter each group contains a great many more waves and so the reoccurance of the groups is much slower than before. This signifies the low tone by the bass singer.

Hearing the Carrier Wave

It is well to call attention again at this point to the fact that the carrier wave cannot be heard, as it vibrates too fast for the ear to pick up. It is the group of waves which we get over the radio and not the individual pulsation, the same as the snare drum music, as illustrated in Figure 1. The analogy is not quite perfect, because with the snare drum the individual impulses are not quite close enough together to blur completely, and we are able to detect the "carrier wave."

This blurring out of individual impressions is also well illustrated in moving pictures. The lantern which projects

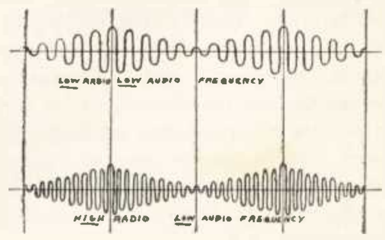


Fig. 5. A Bass Note is Sung

the pictures actually puts a series of stationary photographs on the screen and the reason we see them in motion is because they run too fast for our eyes

Continued on Page 7

New Radio Conference Soon

All Interested Parties To Be Invited by Secretary Hoover

SOON after the adjournment of Congress in Washington, Secretary of Commerce Hoover, will call a general radio conference. He hopes to get co-operation among all the broadcasters, so that a better method of giving out wave lengths will be agreed upon. There are various radio bills before Congress at the present time, but their fate is extremely doubtful. The conference will take place even though the new bills are not enacted into laws.

This will be the third year in succession that such meetings have been called. A great deal of necessary work was finished last year. One of the principal advantages resulting was the changing of wave lengths. Perhaps it will be remembered up to that time almost every large station was working on 360 meters and the result was that it was practically impossible for any ordinary set to separate one from another. But since that time the most powerful or Class B stations, as they are called, have been given wave lengths which differ considerably around any one section of the country. The number of stations at the present time, about 580, is very similar to those in operation a year ago. Many large ones have been added during the year, but these have been offset by those which have fallen by the wayside. However, since it is the smaller stations usually that drop out, it means that the number of powerful stations is all the time increasing, and these are the ones which must be handled very carefully to prevent interference in the radio receiving set. At the present time practically all available wave lengths allowed by law have been allotted, and that is one reason why it is especially necessary to have a conference at that time.

In designating the wave lengths for various stations it must be borne in mind that if the wave length is too short, a conflict will be caused with the various amateurs who are sending code. Even as it is, occasionally there will be some code interference between the amateur and some of the broadcasting stations on the lowest wave length. On the other hand on 600 meters are found a great many ship stations sending commercial code, and it would never do to have them overlap in the same field as the broadcasting. But besides the need of dividing wave lengths into groups is also the necessity of timing the various stations so that they do not step on each others toes. Even though the wave lengths may vary considerably between two high powered stations, still it is impossible for ordinary sets to tune one in and exclude the other, if they are both located within a short distance, say up to five or six miles of the receiving set.

Fourteen Stations in New York.

This point is well illustrated by conditions in New York City. There are fourteen broadcasting stations which serve this territory, which is about ten or twelve more than needed. As a result it is necessary to hold each station pretty carefully to a certain time, or else the listeners, particularly those using crystal sets, will get choruses instead of solos.

At the 1923 conference there were representatives of broadcasters, manufacturers, radio engineers, amateurs, commercial operators, code experimenters, and lastly broadcast listeners. The decisions arrived at were for the most part voluntary, as Congress had not delegated much specific authority to the Secretary of Commerce. It is to be hoped that the present session of Congress will remedy this condition, as about the only control which the Secretary has is over the granting of broadcasting licenses. However, this control has been enough in the past to enable the Department of Commerce to get fairly good results when it is considered there are so many concerns in the United States who wish to avail themselves of the advertising possibilities of operating a broadcasting station.

More Inspectors Needed.

One of the bills before Congress calls for increasing the number of inspectors. The country is now divided into nine districts. These nine may easily be seen on almost any good radio map, as the boundaries are always shown. Each district has a supervisor, an inspector and one assistant inspector. When it is considered that less than thirty people have to handle the radio complaints all over the United States, it is easy to see how it happens that in many parts of the country a great deal of interference exists in illegal ways.

The Bureau of Navigation, under which the radio districts are operated, states that sub-district headquarters are needed at Philadelphia, Omaha, Cincinnati, Los Angeles, Minneapolis, Dallas, Denver, St. Louis, Pittsburg, Savannah and Hawaii.

It may be pointed out here that public opinion has a lot to do with the action of Congress in radio matters. The storm of disapproval in the way of telegrams and letters directed to Washington by an immense throng of broadcast listeners was so effective that the proposed tax of 10 per cent. on radio sets was recently voted down, and as a result the public will not have to pay this additional amount on their radio apparatus.

CHANGING RADIO

Continued from Page 6

to separate each individual impression. It is found that if these pictures recur as often as fifteen times or more per second that we get the feeling of a continuous change, but we all know that actually it is a large number of small changes which bring about this condition to our eyes.

Detector Handles Grouping

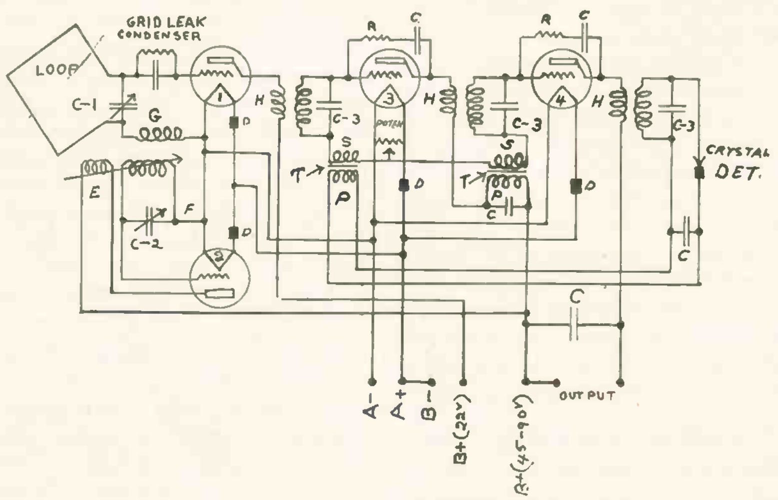
It is the detector, either a crystal or a tube, which handles the grouping of the radio waves, and sends them to our ears at audio frequency. This will be explained at greater length in the next issue of RADIO PROGRESS.

A Reflexed Super-Heterodyne

Only 4 Tubes and a Crystal Needed to Operate This Set

By C. WHITE, Consulting Engineer

THE super-heterodyne is without doubt the most discussed radio receiver at the present time. Its extreme selectivity coupled with the fact that it can be operated without aerial or ground for distant reception makes it an especially appealing outfit for all around use. The advent of the UV199 type of vacuum tube has removed it from the home or laboratory class and has rendered it completely portable. Whether the super-heterodyne will continue to be popular will depend upon two things, the reduction of the cost of operation, and, the maintenance of a high degree of efficiency per tube.



This Super-Heterodyne Uses a Crystal

The main cost of operation is the replacement of "A" and "B" batteries and the tubes that burn out, naturally or through accident; and the maintenance of a high degree of efficiency per tube is dependent upon the ability so to design the receiver that the maximum use is obtained from each tube. The cost of operation can be reduced by the use of the proper type of "A" and "B" batteries, while the risk of accidental burning out can be completely removed by the use of a small safety fuse which slips on the filament prong of the tube base and does not alter the operation of the receiver even in the smallest degree.

Reflex for Efficiency

The reflex idea is the real solution to obtaining maximum tube efficiency from any receiver that permits its use. One of the leading sources of difficulty in applying this idea to the super-heterodyne has been the fact that long wave radio-frequency transformers are generally designed with an iron core since this style of construction has offered possibilities for extreme amplification.

If a receiver with such transformers for radio frequency amplification be used reflex it becomes necessary to bypass audio-frequency through their coils, and, owing to the fact that a coil with an iron core offers varying inductance to varying audio-frequencies, it is quite evident that the introduction of this new variable will cause distortion to a certain degree. The use of air core transformers removes this trouble since such transformers have an inductance which is constant even when the frequency varies within wide limits. The unit E-F-G is a super-heterodyne coupler of standard manufacture and is procurable from any radio dealer. The condenser C-2 should be of the size recommended by the coil manufacturer. The coil E is the rotor of the unit. It is not necessary to mount a control dial for the rotor on the panel since this control will remain fixed after the first preliminary adjustment is made. The main tuning unit consists of a loop and a tuning condenser C-1, which has 11 plates.

Rheostats Are Omitted

For rheostats Amperite automatic current regulators (marked D in figure) are used. These regulators readily afford ample filament control and greatly simplify the wiring and mountings on the panel. The air core transformers H-I are made up of two honeycomb coils tied side by side to form a tight coupling. These coils can be purchased unmounted at a great saving. The coil H is a 75-turn coil and I is a 350 or 400-turn coil. The condensers C-3 should be of uniform capacity and have a rating of .001 mfd. The condensers C have a capacity of .002 mfd. The resistors R are Daven Radio leaks of .05 megohms (50,000 ohms). These resistors make control more certain by stabilizing the RF circuit. The transformers T are Acme audio transformers with the primary and secondary windings marked P and S, respectively.

With any circuit of this nature several types of troubles might arise, and, for that reason, it is not advisable for a man to construct this receiver unless he has had previous experience building

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Head Set and Battery Hook-Ups

The Wrong Connecting May Burn Out Your Tubes

By HARRY A. NICKERSON

FIRST, a brief explanation of series and parallel connections. In the usual "door-bell" dry cell, the center binding post is attached to a carbon rod. This is called the plus or positive terminal. The other (zinc) is the negative or minus terminal. If the positives of two such cells are connected together by a wire, and then the two negatives of the same cells are also connected together, the "output" of the two cells may be taken from either one of the positive and from either one of the negative terminals. This is a parallel connection, as shown in Figure 1. It gives about 1½ volts, no matter how many cells are connected this way.

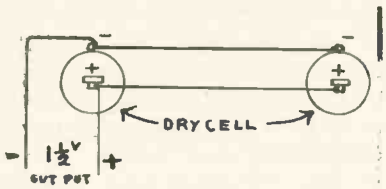

Fig. 1. For WD-11 Tube

The more usual connection is a series connection. Here the plus of one cell is connected to the negative of the other, and the "output" of the two is taken from the unused positive of Cell No. 1 and from the unused negative of cell No. 2, as in Figure 2. This gives about 3 volts for two cells or 4½ volts for three cells.

Holding Hands

Here's a rather novel method of remembering the difference between series and parallel. Place the hands with palms together, in parallel, as it were. Disregard the index, middle and third finger. The two little fingers are one terminal of the output and the thumbs are the other, and the connection is in parallel. Still disregarding the index, middle and third finger, place the left hand palm down and the right hand palm up, with the thumb of left touching little finger of right. Then the connection is a "series" of finger and thumb in a row. Try this with your own hands.

The natural question is next, "What is the effect of the connection series and parallel, in the case of batteries?"

How Many Cells for WD-11?

This may perhaps be answered by an illustration. A WD-11 or WD-12 vacuum tube operates on about 1 volt or so potential of "A" battery. A No. 6 dry cell on closed circuit (i. e., when in use) furnishes a potential of about 1½ volts when new. This falls off to 1¼ and later to 1 volt and less. Many have asked, "Can I use two No. 6 cells on my WD-11 tube?" And the answer is "Yes, and No."

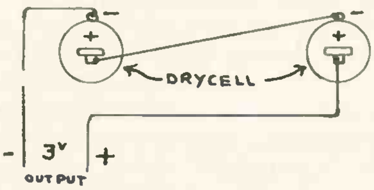

Fig. 2. Usual Cell Connection

Use 6 Ohm Rheostat

Without taking into consideration the possible use of high resistance rheostat (6 ohms is customary) with a WD-11 tube, it will be found on testing with a voltmeter that 2 dry cells in series test about 3 volts; in parallel about 1½. In other words, if the two are used in series with the WD-11 tube, the voltage of 3 volts will probably burn out the filament of the tube as it is supposed to run on 1.1 volts; but if in parallel, the voltage will be such that by use of ordinary rheostat it will be made low enough. Remember this, then, that cells in series produce the sum of the voltages of the individual cells, while in parallel the voltage is that of a single cell. The parallel connection increases the amperage, or quantity of current that will pass per second and if one cell will pass, as on an ammeter, say 28 amperes, then two will produce 56 amperes. Or in other words, if you had a vacuum tube that the manufacturer stated consumed ¼ ampere, one cell would operate it about 80 hours and two in parallel for about double that time (provided the tube was burned intermittently and not continuously.)

Now for Connecting Headsets

Head sets should be so connected that the flow of current through the magnet windings tends to strengthen rather than weaken the permanent magnets of the head sets.

The proper method of connection is outlined below:

Secure a small compass. (A crude form of compass may be made by floating on water a magnetized needle on top of a corkstopper, or by suspending a magnetized needle in the middle by a thread.) Note the North-seeking end of the needle. This is called the North pole. Carefully remove the caps of the receivers and slide off (not pull off) the metal diaphragms. Bring the compass needle near the visible end of the magnets. A magnet end which repels the North pole of the compass needle is the North pole of the receiver. If the winding around this North pole is from right to left (or

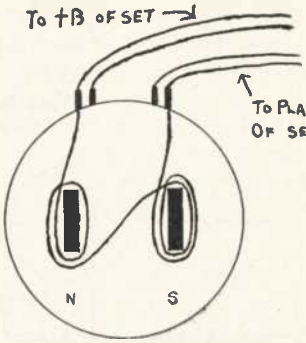

Fig. 3 Polarity of Receiver

more accurately "counter-clockwise" since it is wound opposite to the direction of movement of the hands of a clock), then the end of the coil that is connected directly to the phone cord connected, a series connection is found better than the parallel. In case of the series connection, where the direction of magnet windings is as previously described, a South pole of receiver 1 is con-

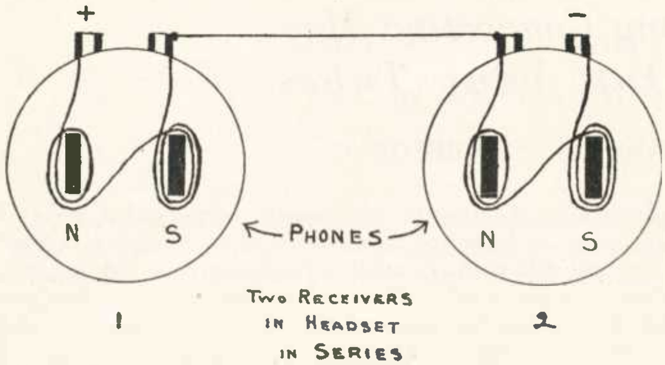

Fig. 4. This Polarity Strengthens Magnets

from the "North pole" magnet winding, should be connected to the Plus, +, of the "B" battery. In the case of a "South pole" magnet, the magnet winding should then be in the opposite direction. The diagram illustrates the connection:

If, on the other hand, both poles are wound just opposite in direction from that outlined above, the phone tip connections should be reversed.

Manufacturers now connect the two receivers in a headset in series, as this connection is generally found to give

nected to a North pole of receiver 2. The illustration in this article of the thumbs and fingers in a series connection, shows the method nicely.

Many so-called "double" phone plugs permit only the parallel connection of two pair of phones. By connecting one tip of each pair of phones in an ordinary one-phone plug, and connecting the other two tips together with a small coil spring, or a double Fahnestock clip or similar device, a first-class series connection may be made. If use of two or more pairs diminishes the volume, an in-

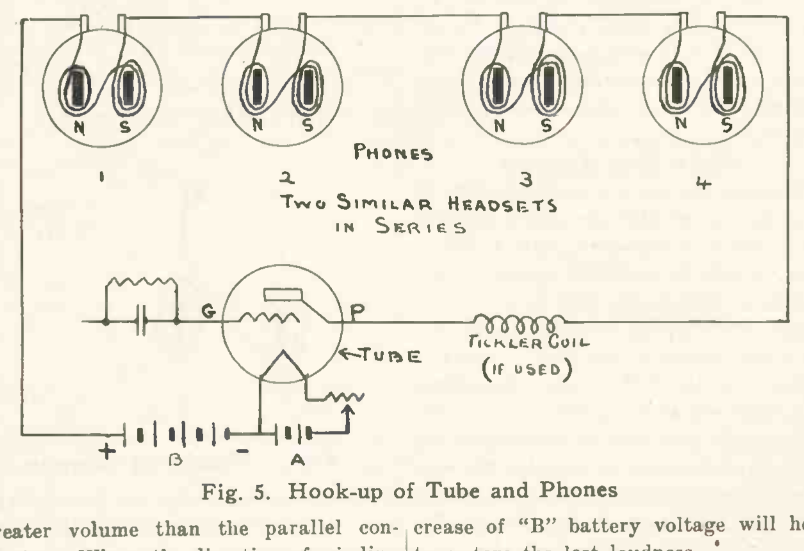

Fig. 5. Hook-up of Tube and Phones

greater volume than the parallel connection. Where the direction of winding on all the magnets is as described previously in this article, the North pole of receiver 2 is then connected to the South pole of receiver 1.

When two double headsets are to be crease of "B" battery voltage will help to restore the lost loudness.

Many manufacturers mark the phone tip which is to go to the phone external binding post, which is connected within the set to the external Plus B post, by a cord with red stripe or similar distinguishing mark, but this practice is by no means universal. Therefore if one wishes to secure the greatest signal volume and at the same time preserve the magnetism of the permanent magnets in the phones, care should be taken to determine the correct connection and when once found, thereafter always follow it.

THREE CONTINENTS TIED TOGETHER.

According to the Star, a daily newspaper of Johannesburg, Transvaal, Africa, under the date of March 14, N. Grant Dalton, a radio amateur of that place, picked up radio broadcasting from Europe and America on the same evening. This linking of three continents was secured when Mr. Dalton, using a three tube set picked up 2LO of London and WGY of Schenectady, N. Y. The Schenectady reception was recorded at 4 a. m., so it is evident that Mr. Dalton is a fan of the first water.

REFLEXED SUPER-HETERODYNE

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and operating radio sets. One of the possible troubles that might be experienced is extremely critical tuning. This can be cured by placing a few turns of short-circuited wire around each unit H. This will broaden the wave band and the amount of broadening will depend upon the number of turns short-circuited. Another very common trouble is the failure of the tube No. 2 to oscillate. This can be generally cured by reversing the terminal connections to the coil E of the coupler. All super-heterodyne couplers of standard manufacture are so designed that this will not happen, since the spacings of the coil winding has been worked out previously. The efficiency of a crystal detector is very high for long wave rectification, and there are several good fixed crystals that will work fine in this set. In actual layout great care should be taken to space the air core transformers H-I as far apart as possible to prevent serious inter-stage inductive coupling. Very often a .002 condenser across the secondaries of the audio frequency transformers T will greatly improve the results.

Every Home a Broadcasting Station

But Your Friends Will Not Send You Many Applause Cards

By L. O. MARSTELLEN, Radio Engineer, Westinghouse E. & M. Co.

EVERY one is interested in learning the trouble that has been and may be caused by operating a miniature broadcasting station, and even more interested in how to prevent this interference.

Nearly all the sensitive receiving sets in use are capable of broadcasting speech and music. This can readily be done by the use of a microphone properly connected to a receiving set. Before proceeding further, let me explain that a microphone is a simple little device, one form of which we use every day; namely, the part of the telephone into which we talk. Talking into a very sensitive microphone causes the voice to affect the powerful radio waves sent out by the transmitter, which is really a large sensitive receiving set having a microphone connected to it. The tickler on the transmitter is adjusted so as to make the circuit oscillate, and consequently transmit radio waves, just as your receiving set will do with a similar tickler adjustment.

If I thought that you would use the microphone only to reprimand your neighbor, who is causing his receiving set to transmit whistles and squeals, then I certainly would explain how to connect the device to your set. However, there is always the possibility of the ladies broadcasting tea party gossip or the uncanny East or West wind from a Mah Jong party, so I shall leave the "home broadcasting" idea for you to think about.

The purpose of mentioning the possibility of using your receiving set as a broadcasting station is to call your attention to the power you control with the knobs and dials on your set.

If you do not have a microphone connected to your receiving set, you can still transmit, but it will be whistles and squeals which are a source of interference to your neighbors.

Many times during the reception of an interesting program, one will hear a whistle or squeal caused by a neighbor who improperly manipulates the controls of his set. The fact that he can very easily prevent such interference is an excellent reason for paying him a visit and explaining the situation. Before paying your neighbor this instructive visit, however, it would be well to learn the cause, effect and remedy for such interference.

Tuning the Single Circuit

There are several types of receiving sets which can be made to act as a transmitter. The first of these is the favorite set, a single circuit regenerative receiver. One of these controls is known as a tuner handle or knob. This control makes it possible to tune-in one station and eliminate another. The other control is a tickler or intensifier. Its purpose is to increase the signal strength. Both tuner and tickler should be operated simultaneously. Now, let us consider the proper operation of this set.

With the tickler set near zero, bring the tuner control to approximately the setting where you would expect to find the desired signal, and, with the other hand, bring the tickler control up to the point where a slight hiss or rustle is heard, and keep the tickler so adjusted as you more accurately tune in the signal. Never increase the tickler beyond the point where the hissing sound is heard or you will hear a whistle or squeal, indicating that you are sending an interfering wave which will interfere with your neighbor's reception.

If a slight change of the tuner adjustment causes a squeal or whistle to be heard, you should immediately remedy matters by decreasing the tickler until the whistle disappears. If you do not decrease the tickler setting, your set will continue to act as a transmitter and radiate an interfering wave. This will cause your neighbors to receive a whistle like noise mixed in with the concert music from the broadcasting station. Many times music of excellent quality is condemned because of the interference caused by the wave sent out from a neighbor's receiving set.

Practice Kills Interference

With a very little practice the single circuit receiving set can be operated, night after night, without causing any interference.

Another type of receiver, which often finds a place in the amateur's home and sometimes is used for broadcast reception, has one more control than the single circuit set, making a total of three controls.

One control tunes the primary or antenna circuit and the other tunes the secondary or tube circuit. The third control is marked tickler or intensifier. This receiver is very selective, but requires considerable skill and patience in order to tune in weak signals. As this type of receiver has three controls, and, as the average person has but two hands, it is rather difficult to keep the tickler properly adjusted as the primary and secondary controls are operated. The general tendency is to set the tickler to maximum and then tune the primary and secondary until the whistle-like note of a broadcasting station is heard. That means that the operation has probably interfered with your neighbor's reception of the concert.

Send Half a Mile

How far will any one or all of these three types of receivers transmit? Any one will cause interference over a distance of four city blocks and can, under most favorable conditions, be heard six blocks away.

Possibly the evil has been recognized in the cities where so many receiving sets must be used within a small area, and that greater co-operation between neighbors has necessarily been obtained.

Frequency is Changed by Modulation

Two Side Bands of Different Wave Length are Radiated

By R. H. LANGLEY, Radio Engineer General Electric Company

THE wave in space which brings us the broadcast music or voice is known as a modulated high frequency electro-magnetic wave. Let us examine this rather imposing expression and see what it actually means.

The voice or music which we wish to transmit varies in frequency from about 30 cycles per second to about 4000 cycles per second. An electro-magnetic wave could be created at these frequencies. But it is found that it would travel only slightly further than the sound waves themselves. There would therefore be very little to be gained by changing the sound wave into an electro-magnetic wave of the same frequencies.

But a *high frequency* electro-magnetic wave will travel to enormous distances. The term "high frequency" in this case means oscillation speeds from about 30,000 cycles per second to about 3,000-000 cycles per second. It will be seen at once that these vibrations are of an entirely different order from the voice and music frequencies. Roughly, they are 1,000 times as great, or stating the fact in another way, one thousand cycles of the high or radio frequencies will occur during one cycle of the voice or audio frequency.

Audio and Radio Together

The modulated wave is a combination of the audio and the radio frequency. The radio frequency part of the wave is spoken of as the "carrier" because it is used to carry the audio frequency. The radio frequency is modulated by the audio frequency, and we ordinarily think of the audio frequencies as existing in the complete wave as a change in amplitude or intensity of the radio frequency. The successive cycles of the carrier frequency vary in intensity or strength in accordance with the audio frequency.

When we say that the wave is electromagnetic, we mean that it consists of two parts. One part is a magnetic field, exactly like that given by the familiar horse-shoe magnet. The other part is an electric field, exactly like the one that can be obtained by rubbing a piece of glass with a cork, by which the glass will then pick up small bits of paper. In the wave, these two fields, electric and magnetic, move through space together, at the velocity of light, or 186,000 miles per second.

The process by which the radio frequency is modulated at audio frequency is relatively simple. A vacuum tube oscillator is used. As long as the plate voltage on this oscillating tube is held constant, the resulting wave has constant amplitude or intensity and is not modulated. In order to modulate the wave, the plate voltage is varied up and down in accordance with the audio frequency, and the amplitude of the resulting wave in space varies in the same way.

Three Speeds at Once

Now, it is found that this wave of changing intensity is exactly equal to the sum of three frequencies, that is, three frequencies whose amplitude or intensity does not change. One of these is, of course, the carrier frequency at which the transmitting tube is oscillating. The second frequency is the sum of the carrier and the voice frequency, and the third is the difference between them These sum and difference frequencies are known as the side bands. With a receiver that is sufficiently selective, we can tune to any one of these three frequencies and detect it. Remember that each of these frequencies is constant, and that it is only their sum which varies in amplitude. It is easy to see why the sum does change in intensity, because, since the three frequencies are slightly different, they cannot stay in step with each other, or, as we say, in phase with each other, and will consequently tend to help each other at certain times, and at other times will act against each other, and reduce the amplitude or intensity of the combination.

No two successive cycles of the modulated wave are alike in amplitude. But are they alike in frequency? Before we can answer this question, we must say what we mean by frequency. When this word is applied to something that repeats itself exactly time after time, it has a very definite meaning. The frequency is the number of these exactly similar cycles that occur in one second. But when the cycles are constantly changing, we can only say that the frequency at any instant is the number of cycles which would occur in one second if all the succeeding cycles were exactly like the one occurring at that instant. In a modulated wave therefore, we must think of the frequency as constantly changing in its instantaneous value.

The limits between which the frequency of a modulated wave changes are the sum and difference frequencies which we have called the side bands. Let us take a numerical example now, and see how this all works out.

Let us say that the carrier or radio frequency which we wish to use is 800,-000 cycles per second. This corresponds roughly to a wavelength of 380 meters, such as is sent out by WGY. That is, the peaks of the wave as it travels through space, will be 380 meters, or about a quarter of a mile apart.

When She Reaches High C

Let us say that the voice frequency at the instant we are considering is 1000 cycles per second. This corresponds roughly to high C on the piano.

The modulated wave, then, has a nominal frequency of 800,000 and its amplitude varies up and down 1000 times per second in accordance with the voice frequency.

The side bands would be the sum and the difference of these two frequencies, that is, 801,000 cycles per second and 799,000 cycles per second, and the instantaneous value of the frequency of the modulated wave will vary between

Continued on Page 14

Peculiar Pranks Performed by 107 Meters

General Electric Company Experiments with Short Wave Sending

THE development of short wave (less than 200 meters) radio transmission, which has resulted in the rebroadcasting of signals from WGY by eight English stations, has produced some interesting results. As high as ten kilowatts have been impressed on the antenna at Schenectady in sending the 107 meter pulsations on their long journey. This is a tremendous quantity of power. There are only a few regular broadcasting stations in the United States which use as much as one kilowatt (1000 watts) and that is the biggest power allowed by law for regular broadcasting.

Because of this great power, special precautions must be taken by those who handle it.

WGY Same as 2XI

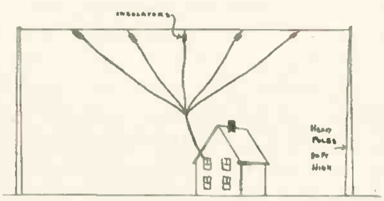
For months experiments have been carried on by a group of General Electric radio engineers in a small isolated building, a mile from the transmitter of WGY. In this building has been assembled, in the apparent disorder of most laboratories, the equipment necessary for a high-powered radio transmitter. The station, because of the power and variety of wave lengths used, operates on the experimental license of the General Electric Company, 2XI. You will sometimes hear this station going quite late at night. You may not realize that it is the same company that usually transmits with the call letters WGY.

Lights Lamp Through Body

Because of the intense field or electrification about the transmitter, it is possible to light an ordinary fifty watt 110 volt lamp to full brilliancy by holding the lamp in the hand. Two men, standing on insulated stools, and each holding a metal rod in his hand, can draw a six inch arc between the rods. No shock is felt because current of this nature travels through the skin rather than through the body.

This is because of the tremendous speed of reversing its direction. A wave of 107 meters corresponds to a frequency of oscillation of about one million times a second. It is just as if the electricity changed its mind as to what direction it wanted to run so often that it did not have time to penetrate into the interior of the body. This phenomenon is usually known as the "skin effect." However, if bare hands were used instead of the metal rods, a severe burn would be the result at the spot where the arc struck the hand. The building is heated by a small coal stove and the engineers have learned that care must be taken in transferring coal from the coal bucket to the stove. If the body comes in contact with any metalic object, then arcs will jump from stove to shovel.

Metal pencils, watches or similar articles containing metal cannot be carried on the person on account of the small sparks which jump to them. Shoes with nails cannot be worn because of the sting experienced when the wearer steps on nails in the floor.



Type of Fan Aerial

By the use of its short wave transmitter, WGY has reached distant places with a fair degree of reliability which were only occasionally reached on ordinary wave lengths. Furthermore, the signals are transmitted so clearly and with such volume that it is possible to rebroadcast them 3000 miles away. On several occasions all eight stations of the British Broadcasting Company relayed WGY's entertainment programs. The most successful experiment was on April 5, when an entire program of organ, tenor and trumpet solos, and an address, was carried by wire from the Wanamaker auditorium in New York to the transmitter of WGY in Schenectady. This whole program was sent out on 107 meters and also on 380 meters, and the signals on the former wavelength were picked up and relayed by the British stations.

Regular Radios on 380 Meters

The 380 meter waves were for use with the ordinary radios so they could tune to General Electric Company as they had been in the habit of doing. This is necessary because it will be remembered the regular radios are not able to receive any lower than 225 or 250 meters.

According to a radiogram received from London during the progress of the program, the transmission was "all as clear as if played in London." The short wave signals from WGY have also been heard consistently in Los Angeles with loud speaker strength on only two tubes and this at times when daylight covered the western half of the country. Tests have shown that the signals are remarkably free from the fading which is experienced on the longer wavelengths.

Hemp Conductors for Aerial

While the design of a short wave transmitter is similar to that of any broadcasting set, the enormously high frequency involved—2803 kilocycles—requires the use of some unusual and novel apparatus. The aerial is of the fan type, as shown here, but it differs in some respects from the conventional antenna. In order to decrease resistance losses its conductors are made of three-eighth inch hemp, over which is braided many fine strands of bare copper wire. Owing to the "skin effect" which has just been mentioned, such conductors have just as low resistance, as if they were made of solid copper. The electrical oscillations travel over the surface only, and do not penetrate to the inside. The advantage of the hemp interior is that the conductor is made very much lighter and stronger than if a solid copper rod were used, and of course such a construction is also somewhat cheaper. The two wooden poles supporting the antenna are much larger around and stiffer than necessary to support a structure of this size, but they are essential to prevent the aerial from swinging.

If the aerial should swing it would change the height above ground slightly and this would affect its capacity. Such a capacity change would cause a shift of a few meters in wave length, and while it would not be so important while sending at 380 meters, it can easily be seen that proportionately it is much larger when compared with 107 meters.

Counterpoise—No Ground

The building sheltering the transmitter is located a short distance to one side allowing the counterpoise to come directly underneath the center of the antenna, greatly increasing the radiating efficiency of the system. The counterpoise is composed of a large number of conductors running underneath the aerial, but well insulated from the ground. This network of conductors is all connected together and is used instead of a ground on the transmitting set.

The aerial is eighty feet high and sixty feet in width at the top part of the fan.

To secure maximum radiation and minimize shielding, the transmitter is located on level ground, a mile from the nearest building.

The oscillating system of the transmitter is of the conventional coupled-type in which the frequency is controlled by a tuned circuit rather than by the aerial circuit. This greatly reduces the possibility of frequency change due to the swinging of the antenna in the wind.

Fading is Reduced

Of course, if the frequency shifted, it would mean that the receiving stations would no longer be exactly in tune, and this would cut down the loudness and produce fading. This is a point worth thinking about on an ordinary receiving set. If your own aerial is allowed to swing in the wind very much, it will detune your set and cause apparent fading of any distant station you may be receiving. The remedy is to tighten up your wires and guy the poles so that the aerial will not swing much, even in a high wind.

The primary coil consists of one and one-half turns of copper ribbon two inches wide, and this is tuned by an air condenser made of aluminum plates three feet square. An air condenser is used instead of the conventional mica or plate glass. In solving the problem of a spacer for these plates that would not break down, the use of very thin hard rubber strips was decided upon. Power tubes are of the water-cooled type, and are connected through a pump to a large cooling radiator, which insures an uninterrupted water supply. The entire unit is suspended on springs.

Air as an Insulator

Air is used as the insulator instead of the usual mica or glass, for the following reasons: Any solid insulator, or di-electric as it is called, has a small loss each time the current reverses, and it can be readily seen that even if the loss per reversal or cycle is very small, yet when it is multiplied by nearly 3,000,000 cycles per second, the result will be fairly large. Air, on the other hand, has no losses whatever, and so the air condenser is much more efficient for this very high frequency.

The modulator tube is water-cooled, and it is connected to the same cooling system as the oscillator. The speech power amplifier is a 250 watt radiotron, and, because of the intense field from the oscillator and its associated apparatus, it is shielded by a copper box to prevent regeneration and the resulting loss in quality. All wires connected to the amplifier are shielded, and the lines to the studio and control room are covered with lead and buried to prevent the radio signal from getting back into the input circuit.

No "A" or "B" Batteries

The power supply to the plates is not furnished by "B" batteries as more than 10,000 separate cells would have been required to furnish the 15,000 volts needed. Instead is used a rectifier something like the ordinary Tungar, which you will see used to charge storage batteries. The difference is mainly one of size. Instead of charging a battery at six volts, it furnishes 30 kilowatts of power at 15,000 volts. Instead of "A" batteries special direct current generators are connected to the filaments. By this means the ripple coming from an alternating current source is suppressed.

TEACHING ENGLISH

It is highly important that a broadcasting station announcer choose his words carefully. Letters are occasionally received from foreign-born people who explain that they are listening to radio announcements for the purpose of perfecting themselves in English. A French Canadian recently wrote to the General Electric Company, "What I admire most about WGY is your announcer. His pronounciation is most perfect; I get every word distinctly and receive, in this manner, good lessons in English, a language which I learned only from books."

FREQUENCY IS CHANGED

Continued from Page 12

these two frequencies as limits. It is seen at once that if a receiver is to respond to this modulated wave, it must not tune so sharply as to give a different intensity to the different frequencies in this band. If it amplifies the 800,000 cycle part of the wave 100 times, when in tune with it, it must give practically the same amplification up to 801,000 cycles and down to 799,000 cycles.

Musical notes contain frequencies as high as 4,000 or 4,500 cycles per second. The receiver must therefore have a band of uniform response 8,000 or 9,000 cycles wide. It need not, however, have a band any wider than this. This is the limit to which the selectivity of a broadcast receiver can be carried, and to which it should be carried, if we are to be able to choose between broadcasting stations at will. Each station uses a different nominal frequency, and these nominal frequencies may be 10,000 cycles apart, so that as the waves vary up and down 4,000 or 4,500 cycles each side of the nominal frequency, they will not overlap each other.

Until the advent of the super-hetrodyne receiver, nothing even approaching the degree of selectivity just described could be obtained. Thus it was that we often heard two and three stations at the same time, and were unable to eliminate a powerful nearby station and listen to more distant ones. In the super-hetrodyne receiver, however, we can attain this remarkable degree of sharpness of tuning. We can separate stations that differ by less than one per cent in frequency and yet not distort the music by cutting off the side bands.

Tuning in with a Neutrodyne

Don't Start Changing the Neutralizing Condenser

By E. J. CRAINE

It is nearly as simple to operate the Neutrodyne Receiver as it is the average set, even those employing only one or two main controls. To get the *distant* stations it is necessary to know only a little more than to get the stations that are near at hand.

In operating the Freed-Eisemann type of Neutrodyne Receiver, the following points must be observed for the highest efficiency.

1—The Aerial

The dimensions of the aerial are directly responsible for distance, selectivity, and volume. As a rule, the higher the aerial the greater the distance obtainable with it, the longer the aerial the greater will be the volume from it. However, it should not exceed 100 to 120 feet.

When the aerial is the proper height and length, the problem is selectivity, or the ability to cut out all but some one distant station. If there are no broadcasting stations within thirty-five or more miles, the high aerial is the best, but when the set is installed near a broadcasting station, it is often necessary to cut the aerial down to increase selectivity. For all round results in congested districts 75 feet is a good length. This measurement is from set to the furthest end of the aerial.

Lamp Cord for Aerial

On account of its neater appearance and flexibility, on an inside aerial, single conductor lamp cord is preferable to antenna wire. It is important that at no time (whether the aerial is inside or outside) should the aerial loop back on itself. It should keep going away from the set in one direction.

For electrical reasons, when installing an aerial it is best to keep the lead-in, or wire leaving the aerial, away from the building. This is of great importance when the building is of steel construction.

Do not forget to scrape the insulation from the wire at the point of contact and preferably solder joints.

2—The Kind of Wire

An aerial that has but a single wire has a slight directional effect. Stations in the direction of which a single wire aerial is pointing (open end of aerial) will not come in as strong as will stations from the other end.

Strength as well as electrical resistance must be taken into consideration when one is chosing a wire to use for an outside aerial. Stranded hard drawn No. 14 copper wire, untinned, is most satisfactory. It is preferable to use the same wire to the point where it enters the building, after which a porcelain tube or approved window lead-in strip should be used. Leading from the inside to the set, lamp cord is appropriate. Wherever the aerial might come in contact with parts of the building, glazed porcelain insulators should be installed.

3—The Ground Wire

Flexible lamp cord can also be used for the ground wire. Usually, the water pipe is the best ground. If the ground lead is too long, over 30 feet, it will not act as a good ground but rather as a counterpoise, and will not affect the operation of the set to such a great extent. It is not a good practice to run the aerial and ground leads in close proximity and parallel to each other. Better results will be obtained if they are separated at least six inches or more.

When an outside aerial is used, it is necessary to use an approved lightning arrester.

4—Do Not Use a Loop

As the Neutrodyne set has not been designed for a loop, a loop is not recommended, unless it be separated at least six or more feet from the set. This prevents the tendency of the tubes to fall into oscillation, due to an electromagnetic effect of the loop in its relation to the coils of the set.

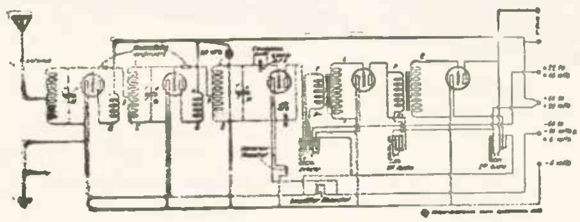


Fig. 1. Hook-up Showing Neutralizing Condensers

5—"Balancing"

Quite often a man is called in to examine or give advice on a set that is not operating properly. Usually, the advice is to change the electrical value of a certain part inside the cabinet. This device is called a neutralizing condenser and should *never, under any consideration whatever, be tampered with.* See Figure 1. Before leaving the factory each neutralizing condenser is adjusted permanently with type 201A tubes and once properly adjusted, it need never be readjusted, no matter what type of tube is used.

When it is taken into consideration that the primary and secondary coils also belong to the grid and plate circuit of a tube, and that the capacity existing between these two coils is much greater than the capacity of the tube alone, it is apparent that the little capacity differences existing in different tubes are not sufficient to warrant changing an adjustment made by experts under real operating conditions. It is extremely difficult to adjust these condensers in this make of set unless the seal is broken, and breaking the seal breaks the guarantee.

The owner of a Freed-Eisemann Receiver need not be alarmed at the paragraphs on neutralization, as trouble from this source is very remote.

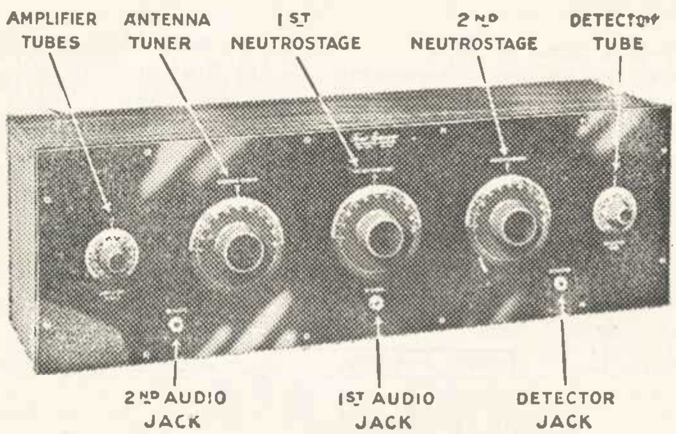


Fig. 2. Names of Neutrodyne Controls

6—Vacuum Tubes

It is sometimes recommended that the owner of the set use the same type tube throughout. This applies also to the detector tube, the one in the extreme right as one faces the set. Some owners of Neutrodyne sets are using a soft tube, UV-200, as detector, but experience indicates that a hard tube often gives as good and more uniform results.

In testing out the relative efficiency of tubes, tune in a fairly weak station and have the phone plug in the first jack, using the last two tubes as spares. When the station is tuned in, change each tube around. After changing each tube, readjust the tuning dials as well as the rheostats until the greatest volume is obtained on the weak station. Then put the phones in the second jack, keeping out the last tube as a spare to test out the second last tube. In this way defective as well as noisy tubes can be eliminated and new ones substituted for them.

The life of a tube is from 1,000 to 2,000 hours constant use, although there are exceptions to this rule. In time, a tube wears out and requires renewing, even though the filament lights.

7—Rheostats and Jacks

Rheostats play a part in distant reception and they should also be varied, until the pressure on the filaments is just 5 volts. This is their most sensitive point. The amplifier rheostat is used to regulate the flow of current to the filaments of the two radio and two audio amplifiers, and the detector rheostat for regulating the detector tube only. These controls are seen in Figure 2.

The Jacks are receptacles into which the phone or loud speaker plug is to be inserted. For head phone reception the first or second jack is preferable. This also applies to extreme distant reception. Stations within 1,000 miles can be tuned in directly on the loud speaker by using the third jack. A little experience is required in using this method.

8—Dials

There are three main dials on the Freed-Eisemann Neutrodyne set. These are: Antenna tuning dial, first neutrostage and second neutrostage.

For the first and second neutrostage the following dial settings correspond closely to wave lengths as follows:

1st and 2nd Neutrostage

Dial	Wave Length	Dial	Wave Length
14	275	53	429
15	278	58	448
17	286	59	455
20	309	64	469
28	337	74	484
35	360	75	492
38	380	82	509
43	405	88	526
48	411	94	546
49	417		

Note that the antenna tuning dial setting is not shown. The characteristics of the aerial govern the setting of this dial to a certain extent, and it will be necessary to arrange a table from the settings of a few nearby stations in order to choose other wave lengths with this dial. This dial bears a definite relation to the wave length of stations to be received, and the wave length is a guide to the proper setting of the dial. High wave lengths will be represented by high dial readings and low wave lengths by low dial readings.

For the average broadcast listener a description of the meaning of the term "wave length" is not necessary, and should not be confused with the distance a set is capable of receiving. To be specific, if 492 meters be the wave length of a station in New York and also that of a station in California, both will be found on the same dial number. If the readings on the dials do not compare to within a very few degrees with the tables listed above, it is not an indication that the set is at fault, as no two sets will be exactly alike, due to constructional details, etc.

9—Operation

When you want to pick out a distant station, and it operates on a wave length of say 546 meters, the first step is to consult the radio program of the newspaper to find out whether or not that station is due to be on the air at the time.

Plug your phones in second audio jack, bring up the rheostat to the proper operating point and set first and second neutrostage dials on 94. Now slowly turn antenna tuning dial over its entire range. If nothing is heard, try various combinations of the neutrostage dials, but all combinations to be within one or two degrees. If unsuccessful, try other stations.

Troubles in Soldering Radio Wires

How to Make a Good Joint---What Flux to Use

By W. S. STANDIFORD

LARGE numbers of persons throughout the United States and Canada are making and installing their own sending and receiving sets; the vast majority being "new to the game," have trouble in getting firmly soldered joints that will remain united. It is of great importance to the working of receiving and broadcasting outfits, that a clear path for electrical energy (which at its best is very weak, owing to distances traveled) should be provided so that no buzzing sounds due to loose connections are heard along with the signals, there being enough trouble occasionally encountered in the radio field without adding any from this source.

A Knack to Soldering

Soldering wires on variometers and other parts is easy, once the knack of handling a soldering iron is learned. It is much better from a practical standpoint for those who have never done work of this kind, to try it on some spare pieces of copper wire, twisted together and not connected to any radio apparatus. This will enable them finally to do a neat and lasting job on their new radiophone set. Soldering coppers or irons as they are termed, range in weight from a few ounces to several pounds; they can be either made or bought, as preferred. Both light and heavy irons have their advantages and disadvantages. Light irons are easier to handle, but lose their temperature very quickly when compared to the heavier variety. The ability to retain heat as long as possible, expedites the work as it allows of a number of joints to be fastened together, before the iron gets too cold and has to be reheated. Thus very rapid work can be done with a reasonably heavy iron. One weighing about three-quarters or one pound (shank and handle not being included in the weight) will be about right for radio work.

A very good tool, weighing close to one pound, was made by the writer from a one-inch round copper bar, its shank being from a poker and the wooden handle obtained from an old broom. In order to do good work in soldering, five things are essential. The point of a soldering iron has to be coated with solder or "tinned," as it is termed by men who make a living doing this work. All portions to be united together must be made very clean, either by scraping with a piece of a sharp knife blade kept for this purpose, or filed or rubbed with emery cloth—whichever method proves the handier to the novice.

In ordinary classes of small work, such as soldering one wire to another, or sheets of metal to other sheets; the heat of the soldering iron itself must be sufficient not only to melt the solder, but also to raise the temperature of the metals to be joined together, so that firm and lasting junctions are made.

Don't Get It Red Hot

Do not let your iron get too hot, that is, red-hot; as in cases of the latter kind, it will not take any solder at all. Lastly, it is always essential to keep the iron well "tinned" at all times, so that when a person wants to use it, the device will be ready and you will thus save time by not having to re-tin it. As new irons sold in the hardware stores are in the rough state, with no tinning upon their points, most of them also having no handle, which has to be bought separately, it is necessary after a handle is put on, to smooth its four-sided working face and point with a medium coarse file so as to make the tin stick to it.

To tin these sides and point proceed as follows: Put the iron in a clear red coal fire which is not giving off any smoke. Heat it until it is nearly red-hot. When it has the right degree of heat, the solder will melt instantly when it is applied to the surface of the iron. At this stage if it is held about three inches away from the palm of the hand, the heat given off from the hot metal may be felt. This will serve as a guide for future heatings instead of touching solder to the tool.

How to Tin the Iron

Have some powdered rosin together with solder on a board or an aluminum pie pan (ordinary solder does not stick to aluminum), then quickly brighten one face of the soldering iron with an old file or a piece of sandpaper tacked on a block of wood, and then rub it rapidly into the rosin and solder mixture. The surface of the hot copper bit will be found to have taken a shiny coating of solder. Repeat this process with the other sides until they are tinned. If it should happen that a soldering iron refuses to take a tin coat, heat the copper bit a little hotter, but not red-hot; file its face and rapidly rub it on a lump of salammoniac to remove any grease, then plunge into the rosin and solder flux. A few trials will enable any one to do good tinning work on the iron.

Once the nose of an iron is "tinned" it will remain so, provided it has not been overheated so as to burn off the solder or cause it to become alloyed with the copper. This can easily be seen by its surface turning very rough and black. In cases of this kind, file and re-tin.

Flux is Important

Having coated the tool with tin, the next thing is to use it on the wires of radio outfits, it being presumed that the novices at soldering have practiced this kind of work on other pieces of wire, before trying it on their instrument wires. A description of fluxes and their action will be gone into, as fluxes play a most important part in soldering work. The main reason for using fluxes in order to make firm joints that will not become loose, exists in the fact that a thin film of oxide always forms upon all brightened surfaces of metals; this oxide is caused by the action of the air. Fluxes dissolve and prevent any further oxide forming, and by thus preventing the additional formation of oxides, allow the solder to stick directly to a metallic body, instead of to an oxide film which, sooner or later, allows all joints to come apart.

Twisting the Pig Tail

To solder twisted or "pig-tail" wires on vario-couplers, untwist them and scrape any insulation off of the ends and brighten with emery or sandpaper, also coating them with rosin flux, taking care not to get any of the latter on the insulation or other parts where it is not needed. Heat the iron in a gas or coal fire until it has acquired the right temperature, when the solder on its tinned surface will be observed to melt; this shows it to be hot enough to do good work. Remove it from the fire, give it a quick rub on a piece of old carpet kept especially for the purpose, and touch it to a bar of solder. A drop of the latter will adhere to the iron and can be conveyed to the wires that need uniting. Hold the hot copper on the wires' junction, and as soon as they are hot enough, the solder will leave the iron and flow over the wires' surface. Remove your iron but do not disturb the joint until the solder has set, which will be shown by a sudden dulling of its surface. It may be necessary to add more solder to the joint; in this case, add more flux and put on another drop of metal.

Aluminum Aerials

Some radio fans use aluminum wires for their aerials and try to solder the joints with ordinary "half-and-half" tinners' solder and then wonder why it does not stick to the wires. Aluminum is one of the most difficult of all metals to solder, for the reason that an insoluble oxide forms just as quick as it is removed. For this reason a special type of solder is necessary and as a matter of fact, any aluminum soldering job is much harder to do than the usual kind which is used for copper, etc.

If possible, a radio fan who desires to use an aluminum wire aerial should have a wire of such length that it will reach the binding posts of his set without any soldered connections in it. Should this be impracticable, then resort will have to be made to a soldered "lead-in" wire. If this work is done with a solder and flux of the formula given in this article, aluminum wires may be soldered with the least amount of trouble. The formula for this aluminum solder is 79 per cent. tin, 20 per cent. zinc and 1 per cent. aluminum. This metal can be melted in an iron ladle over a hard coal fire. Use a dry grooved board having a slot cut in it the thickness of a lead pencil. Stop up both ends with dry wooden plugs and pour the hot metal from the iron ladle into the grooves.

The flux is composed of equal parts of stearic acid and rosin, melted together and well stirred. A bar of common yellow laundry soap melted up with a sufficient amount of rosin so as to make a mixture that can be spread on with a stick, will also make a good flux for aluminum.

Heat the place on the wire with an automatic blow torch which can be bought cheaply at any hardware store. These devices use denatured alcohol and give a very hot flame, so they are just the thing for aluminum work. When the solder is observed to melt (which differs from the ordinary variety in that it flows more sluggishly), then quickly rub the hot surface with flux and tin well with the solder, taking care to have plenty on so as to exclude the air. Keep pushing the solder backward and forward. This removes the oxide and prevents any more from forming. When both wires are thoroughly tinned, wind one over the other in the usual manner. Then heat the joint again and apply more flux and solder so as to cover both parts well. In aluminum soldering work it is better to have each wire well covered with a plentiful supply of solder so as to exclude moisture. This solder will impart a strength to a joint nearly equal to the metal itself. An aluminum soldering bit will be found to work much better for soldering aluminum than a copper one, although, the latter can be used successfully for aluminum work. Joints on outside aerials should be painted with several coats of asphaltum varnish, so as to keep out the moisture.

REGULAR SIZES FOR "B" BATTERIES.

A special committee will be appointed in the near future by the Bureau of Standards at Washington under the direction of Mr. G. W. Vinal. This committee will consider making recommendations as to the size and performance of "B" batteries. Nine different dry battery manufacturers, two telephone companies, the American Railway Association and nine government bureaus are all co-operating with the Bureau of Standards to attain this end.

It is desired to develop a standard method of testing, so that batteries will be rated in the same way. As is well known, the capacity of a battery depends considerably on the speed with which the charge is used up. If the battery is allowed to stand on the shelf for a year before it is used, it naturally has lost a considerable part of its charge. But, aside from this, even with fresh batteries, the amount of electricity which can be used out of it depends on the size of the current. If a heavy current is drawn from the cell, the total capacity will be considerably less in proportion than if the discharge is at a lower rate.

The average "B" battery is usually rated in milliampere hours. This is like the ampere hour rating of a storage battery, except that milliamperes are used instead of amperes. Of course, a milliampere merely means that it is 1/1000 of an ampere. The reason for rating it in this way is that the current drawn from the "B" battery in operating a radio set is about one or two milliamperes. For this reason it seems logical to use this unit in specifying a capacity.

The ordinary small "B" battery contains about 700 milliampere hours, while the large one will run as high as 2500 to 3000 milliampere hours.

It has been decided not to demand a "noise" test on batteries, as practically all the reliable makes are now so free from the undesirable feature of making noise in a set that the test seems superfluous. The committee has been requested to adopt a standard set of names for the various styles and sizes of "B" batteries so that it will be easy to substitute one make for another if desired.

Radio Amplifier Without Transformer

Regeneration Not Sacrificed in This Two Tube Hook-up

By OLIVER D. ARNOLD

THE Superdyne hook-up is proving rather popular and many people are inquiring just how it works as no radio transformer is used, and yet radio frequency amplification increases the signal strength and range considerably. We are showing a simplified hook-up of a two tube set, which has a considerable range when adjusted correctly. Although only two tubes are shown, namely, a radio amplifier and detector, either one or two states of audio could be added to increase the loudness of the signal and then distant stations could be brought in on the loud speaker.

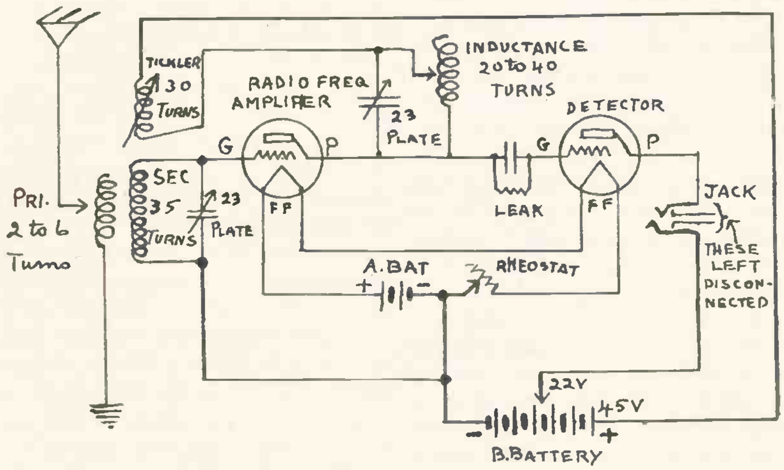
Secret of Superdyne

The essential part of this particular set, and one that is made use of by various manufacturers, is the tuned impedance. By "impedance" is meant the combination of the inductance coil and the condenser, and it is called "tuned" because the condenser and preferably the inductance, are adjustable for wave length. This impedance unit is connected between the plate of the first tube and the "B" battery. As will be seen from the diagram the plate is also connected to the grid of the detector tube, so that the amplified oscillations coming from the first or audio frequency tube, are impressed directly on the grid of the detector.

The reason this idea is better than connecting the aerial directly to the detector, is that the radio amplifier increases the strength of the signal some three or four times before it gets to the detector and it is this feature that increases the range which this radio is able to cover. It might be asked why it is necessary to use the impedance at all. In the first place the "B" battery must be connected to the plate of the first tube, or else there will be nothing to force the current to flow through it. But if a straight connection were made direct from the "B" battery to the plate, then that wire would act like a short circuit for the high frequency, because the radio waves could go out from the plate through this wire direct to the "B" battery and in such a case no voltage would be impressed upon the grid of the detector; but by putting in the combination of inductance coil and condenser, this condition is remedied.

When a parallel connection is made of a coil and a condenser and the values are adjusted correctly, then the combination will oscillate at a certain frequency, which is decided by the values of the capacity and inductance. When oscillating at this special frequency the condenser and coil are said to be in resonance. One of the peculiarities of a parallel resonant circuit is that waves of that particular frequency will not pass through the combination. The two units being partners, as it were, absorb all that particular vibration that comes along for themselves, and do not let any of it through. So in this set, if we wish to tune to 360 meters say, if we adjust the 23-plate condenser so that it, together with the inductance will tune to 360 meters, which is the equivalent of 833 KC. (833,000 cycles) then this frequency coming out from the plate of the first tube will have nowhere to go except over to the detector tube. Since it is five times as strong as it was before it went through the first amplifier, it will give large volume at the detector.

Of course, it is necessary for the "B" battery to pass current to the plate, but this current being direct and not alternating has no trouble at all in going through the inductance. In other words, the impedance or combination of condenser and coil acts like a strainer, and holds back the 360 meter wave, so that it has to run to the detector grid.



Radio Frequency Hook-up—No Transformer

Notice that the primary circuit from the aerial to ground is not tuned. It is adjustable from two to six turns as wound on a tube about 3½ inches diameter. Using the larger number of turns it gives louder signals, but makes the set less selective. In case there is no local station going to cause interference, it is set to about six turns and left there. But if a local station starts up and starts to blanket the station you want, then by cutting down the primaries to two or three turns, the set becomes more selective, although it reduces the volume of all the stations.

The secondary is wound on the same tube as the primary, and if desired, may be a continuation of the same wire.

American Radio Relay League

Attending the Club at Home
New Directors Announced by League

AN experiment to determine whether it is possible to hold a club meeting by radio, with all members seated comfortably in their homes, has been tried out successfully by amateur radio fans at Dallas, Texas. The meeting was called to order by the president, motions carried and all business transacted with as much ease as though the members were gathered in one room.

The idea was conceived by members of the West Gulf Amateur Fone Club which organization was started recently by local representatives of the American Radio Relay League, the national association of radio telegraph amateurs. Practically all members have installed radiophone transmitters in their homes. Due to bad weather, the suggestion was made that the members hold their meeting "in the air". Notices were sent to all club members, suggesting a wave length of 190 meters.

At the appointed time all members were at their sets, when the president started up his radiophone and called the meeting to order. The roll was called by the secretary, and, as their names were spoken, the members picked up their microphones and answered "Present."

As each set had been carefully tuned in advance, all members of the club could hear everything that took place. Amateurs in nearby towns had been invited "to attend," and it was interesting to hear the voices of these out-of-town members, since they seldom had the time and facilities to attend the regular meetings.

The session lasted more than two hours, and met with such general approval that it was voted to hold subsequent "ether meetings" every Sunday afternoon thereafter. The broadcast listeners in Dallas have been invited to listen in on these occasions.

This scheme seems to have a large appeal to the wives in the Neighborhood. As they can get their husbands to stay at home and attend the club at the same time, they feel that it is a great improvement. What the husbands think of the innovation has not yet been reported. So far the poker clubs have not been found adaptable to this scheme.

NEW DIRECTORS ANNOUNCED BY LEAGUE

The names of the new directors of the American Radio Relay League were announced to-day by the executive committee at the A. R. R. L. headquarters at Hartford, Conn., following official count of the ballots from all divisions throughout North America. Because of its position as a non-commercial association and the democratic nature of its constitution, peculiar to an organization of the kind, it is required that the directors be selected by the membership.

Between 15,000 and 16,000 ballots were distributed and in several divisions rather strenuous campaigns were waged by the supporters of the candidates. After a complete survey of the votes cast by the league's membership in the United States and Canada the following men were declared officially elected:

Atlantic Division—George L. Bidwell, Washington, D. C.; Central Division—Clyde E. Darr, Detroit, Mich.; Dakota Division—Cyril M. Jansky, Jr., Minneapolis, Minn.; Delta Division—Benjamin F. Painter, Chattanooga, Tenn.; East Gulf Division—Harry F. Dobbs, Atlanta, Ga.; Midwest Division—L. Boyd Laizure, Kansas City, Mo.; New England Division—George H. Pinney, South Manchester, Conn.; Northwestern Division—Karl W. Weingarten, Tacoma, Wash.; Pacific Division—Allen H. Babcock, San Francisco, Cal.; Rocky Mountain Division—Paul M. Segal, Denver, Colo.; Roanoke Division—W. Treadway Gravely, Danville, Va.; West Gulf Division—Frank M. Corlett.

A. H. Keith Russell becomes a director through his election as Canadian General Manager of the A. R. R. L. Although Canada is divided into several operating divisions, it is represented on the board by this office created in the league's new constitution. The election of the foregoing candidates becomes effective July 1, 1924.

The annual meeting will be convened by the President, Hiram Percy Maxim, of Hartford, Conn., the latter part of July.

SHORT WAVES FROM FRANCE.

Radio amateurs of the United States and Canada are listening for test signals from the Eiffel Tower in Paris, through special request to the American Radio Relay League from General Forrio, director of telegraphs for the French Government.

A special short wave radio transmitter has been installed at the tower for this purpose and reports of reception by amateurs of North America under varying weather conditions are to be sent to the A. R. R. L. and forwarded to the French Government.

During his recent visit to Paris, where the International Amateur Radio Union was formed, Hiram Percy Maxim, President of the A. R. R. L., learned from General Forrio that his Government was desirous of obtaining the the co-operation of American amateurs.

The object of these tests is somewhat similar to that of the Bureau of Standards when it undertook to collect data on fading with the assistance of amateur stations. The department of telegraphs of the French Government, however, is particularly desirous of securing information on the strength and range of short wave radio transmitting equipment.

For further particulars address the American Radio Relay League, at Hartford, Conn.

READING A HOOK-UP

ANYONE who gets very far with radio, sooner or later has to try to understand what the lines of a hook-up mean. It may be a simple set, starting with a crystal and a single coil, and if this is as far as the reader gets, he will probably understand the connections the first time he sees them; or at the other end of the scale he may find a nine tube set which perhaps has reflex and regeneration up its sleeve, and if he is able to understand this diagram after an hour's study, he will be doing well.

Some hook-ups are much easier to read than others, even when they refer to the same circuit. In the first place the symbols should all be standard. For instance, a telephone is represented by a couple of circles, joined by a curved line. A battery is a long light line side of a short heavy one. These signs are easily recognized after a few minutes study and should cause the diagram reader no trouble.

Cross Overs Are Bad

Most diagrams show the wiring in such a way that there are a good many lines crossing each other. This makes the diagram hard to read, and there is also the danger that a mistake may be made as to whether the two wires crossing are supposed to be connected or insulated from each other. It will be noticed that the diagrams published in RADIO PROGRESS are singularly free from cross-overs. For instance, take the hook-up of the ultradyne on Page 19. The same scheme of connections has been published many times before, as it is not particularly new, but it usually is wired in such a way that the diagram shows a great many crossings. In our hook-up these have been reduced to a very small number.

Some cross-overs are unavoidable in a complicated drawing. It is much easier for the eye to follow a straight line than one that has a lot of curves in it. That is why we have adopted the latest and best convention of drawing wires straight, even though they cross each other. The older scheme was to put a half-circle in one of the lines where it crossed the other. In order to show that two crossing lines are to be connected together a dot is placed on the junction, but even this is not considered the best form, as it is quite possible that a draftsman might make a mistake of omitting the dot, which would mean that the lines crossed without connecting. To avoid this trouble the best practice is never to draw four wires connected so that they all come together at a single point. Instead, two points are shown near each other and one wire joins the main line at each of these points. When this convention is followed out it is much easier to read the diagram, since a straight line with a "T" connection at the side always means the wires are joined, whereas two straight lines crossing each other mean a real cross-over without any connections.

We invite our readers' comments on this form of diagram. We shall adhere to it in all cases except where a contributor's sketch, using the old scheme, reaches us so late that it can not be corrected.

PAYING FOR PROGRAMS

One of the big questions of the hour, which is being much discussed in the press, is where to get the money for the music or who shall pay for the programs. At the present time about all the artists who sing and play in the studios of the big broadcasting stations are receiving no compensation for their work except the thought of the pleasure they are giving to their thousands of listeners, and also for the advertising they get from having their names broadcast to the public by studio announcers. Of course, speeches by eminent men also go unrewarded in the monetary sense, and it is doubtful whether such speakers seek any pay.

There seems to be a general indication, however, that these conditions will not continue indefinitely. Many of the more famous artists, who do not need the extra advertising they get from radio, are refusing to appear before the microphone unless they get some sort of tangible returns. Of course, there is always a host of those who are not so well known and who possess considerable talent who are glad to have the chance to show what they can do to the listening public. They know if they can please their radio audience that they will have opportunity to advance faster in their chosen profession.

But there is also evidence that the broadcast listeners are demanding a higher and higher quality of concert. A year ago almost anything in the way of music would do. But let some of the performances of last summer be repeated at the present time and a quantity of hisses in the form of objecting post cards will greet the broadcast director the next morning.

If the tendency of the public is to want better and better music, and, on the other hand, those able to give the best music show an inclination to withhold their services, unless they are paid, it certainly looks as if the time were coming soon when the programs would become an expense to the broadcasting stations.

Even now the cost of running a sending station is by no means light. One of the operators of a medium-sized station in the East recently testified, that he was spending $12,000 per month on his station, and this did not include any salaries to professional talent. How long will the present stations be willing to spend such sums when they are getting no direct returns from their efforts?

Four Classes of Stations

At present those sending out radio may be divided into four classes. The first contains the government stations, city stations and educational institutions, who would have no idea of trying to collect any money from listeners from the very nature of the thing. The second class would embrace all those who have various services to perform to the public which are in no way connected with the art itself, such as newspapers, electric generating stations and the like. This class would probably have no interest in trying to charge their listeners, as their idea is merely that of advertising their services so that they will build up a favorable popular opinion. If they attempted to collect for such broadcasting it would in a large measure defeat the object for which they are working.

The third class would comprise the manufacturers of radio sets and parts. Their principle concern, of course, is to sell their product and if they are able to impress it on their listeners that they are the first in the field along their own lines they will benefit greatly in expanding their trade, but it is a question whether they should be expected to furnish free entertainment to any one who has bought one of their sets or parts. They would certainly be justified in collecting pay from their listeners if it could be done conveniently.

The fourth class is made up of radio dealers, stores and repair shops. They do not manufacture parts, but they are interested in selling them and it is rather natural for people in the immediate vicinity of such stations to think of them as being the logical place to purchase their supplies, but, of course, their sphere of interest is somewhat limited, as in general it would not be expected that a customer would travel more than a few miles to any one store doing broadcasting, if other equally good but silent stores were considerably nearer. Such senders, too, would seem to be entitled to compensation for their services.

Try and Get It

Almost everyone seems to agree that these two latter classes are reasonable in their wish to collect something which might be called rental for their service to the public. But, as the popular expression has it, "Try and get it."

There have been several suggestions made. One is that the government tax all sets and return a proportion to the broadcasters. This seems a rather poor scheme, as it would be very hard to work and quite unpopular. Another suggestion has been to use special sending apparatus, which will mix the music up in such a way that the ordinary radio set would reproduce it so that it sounded like a Chinese orchestra playing bag pipes. Special radios would be rented at, say $2.00 per month, which would naturalize this music and make it come out real American Jazz. Already such a system has been worked out in the laboratories of one of the big companies, and it seems to be practical from the operating point of view, but again this method is beset with difficulties. Any one realizing how much trouble is given by radios in general when working with plain every-day broadcasting will realize what a terrible state of affairs would be created when a lot of special apparatus must be added to get the concerts. Besides, there will undoubtedly be a lot of enterprising experimenters who will turn their talents to constructing a radio pass key which will unlock the music of these new special broadcasting stations. No, such a scheme does not seem likely to be the right one.

Begging for Funds

Perhaps the most promising suggestion has been that radio operators be asked to contribute to a national fund to pay the expenses of broadcasting. In order to get the various listeners to send in their subscriptions every so often a lecture will be broadcast explaining the need of collecting funds and asking for contributions. It would seem that such a proposal might have some chance of success, at least at the start, but it is our own opinion that it would not work indefinitely. When it is realized that the average human being is somewhat lazy (we know we are), so that it is too much of an effort to write a postal card telling our favorite soprano how much we liked her singing, then it stands to reason that we are not going to fish out a 50-cent piece once a month, wrap it up in a mailing card and send it to the broadcasting station. Undoubtedly the large number of listeners would have plenty of good intentions, but they would probably be only used for paving stones.

Our Own Suggestion

We will now offer our own suggestion as a solution of this difficulty. It is well known that when any organization has a tag day, almost every man, woman, and child seen on the street that afternoon is the proud wearer of a tag. It is not so much that each person feels that the cause is good, but he thinks everybody else believes it is a good one and is a little bit ashamed to be seen without the evidence that he has come across with his own contribution.

Continued on Page 23

Explaining the Second Harmonic

A Further Improvement on Major Armstrong's Super-Heterodyne

By VANCE

THE Super-Heterodyne, or "Super-Het," as most people now call it, is undoubtedly one of the best sets ever put out; that is to say, when it works. As built by the commercial radio factories the adjustments are made directly before placing it on the market, and so it becomes a very easy radio to operate. But as built by the ordinary amateur the preliminary adjustments are somewhat numerous, and the result is that the inexperienced amateur does not usually make a success of this design.

Hearing a Clock Stop

Have you ever been in a room with a fairly large clock, and suddenly heard it stop? Up to that time it was ticking regularly and its very regularity made it unheard. When you entered the room doubtless, you did not even realize that the clock was there, but if it happens to run down when you are nearby the sudden stop in its regularity is much more marked than the noise of the ticking itself. This might be said to resemble the basic principle of the super-heterodyne. If we have a regular radio wave striking our set, it will operate an ordinary detector, if it is loud enough, but if it comes too far a distance, it may be too faint to be reproduced by the set. If we can introduce a certain form of irregularity into the wave, it will then come through the radio and be heard.

Making It Irregular

The easiest method of making the wave irregular is to combine it with another wave oscillating at almost the same speed. Since the two are now nearly together, but not quite, they will fall into step and then out of step, and then into step again. It is like a fellow and a girl walking along a sidewalk together. The girl takes rather short, quick steps, and the man beside her, with his longer legs, makes his steps slower, although they both travel along side by side. As you watch them going down the sidewalk, you will notice they are in step, but a short distance further on, they have fallen out of step. This action of their feet in being first the same and then opposite and then same again is called in electricity, "getting in and out of phase." Instead of saying that the two waves are in step we say they are "in phase," but it means the same thing. When two oscillations are in phase, they help each other and add up their effect, but when they are just opposite, or out of phase, they hinder or subtract one from the other, and the result is not the sum but the difference of the two.

Getting back to our broadcasting, we have two oscillations through the same coil, first, the outside wave, which we want to hear, and second, the local wave, which we have intentionally tuned to be a small amount out of tune with the first. As just explained, this will cause the result that the two will be first in phase and then out of phase.

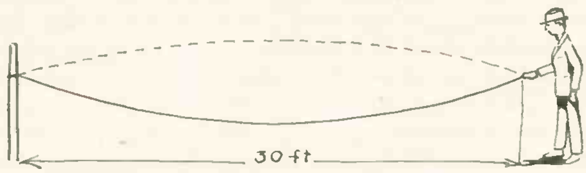


Fig. 1. Rope Vibrates as Fundamental

The number of times that this in and out takes place may be found by subtracting the number of steps or oscillations that one takes from the number taken by the other. Thus, if our fellow and girl, in going a certain distance, have taken 50 steps for the one and 56 for the other, they will have been in and out of step 56 minus 50, or six times in going that distance. Or if the man should speed up his feet and walk 62 steps in the same time, again the number of times they got in and out of phase would be 62-56, which again equals

PAYING FOR PROGRAMS

Continued from Page 22

Now it is well known that the average fan is proud of his set and likes to invite his friends in to hear how much better his radio operates than those of any of his neighbors. Suppose an association were formed of national broadcasters, and this association issued monthly tags or labels which might be affixed to a radio set? These tags could be sold by radio stores and the like for 50 cents or more, according to the inclination of the purchaser. Each one would bear the name of the month prominently. By doing a little propaganda work in the way of speeches over the radio the condition could easily be brought about that no radio listener would dare invite his friends to listen to his set unless it carried the monthly tag, showing that he had done his part to pay for the talent.

No one likes to be called a "cheap skate," and rather than risk being thought the meanest man in the world almost every-one would overcome his laziness to the extent of paying his monthly 50 cents and getting his tag.

There are at present nearly 3,000,000 sets in the United States. If most of them contributed 50 cents a month or $6.00 a year it would place a fund of from $10,000,000 to $15,000,000 annually in the hands of the program directors to get the very best talent. This would put a stop to the rather mediocre music which is oftentimes put on the air at present.

6. That is, it makes no difference which is going faster; it is always the larger number minus the smaller which represents the number of times this action takes place. The regular name for this falling in and out of step is "beats." Thus we say that in the above illustration there were six beats.

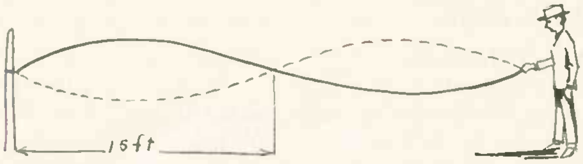


Fig. 2. Rope Oscillates as Second Harmonic

In the same way the number of beats in a receiving set is equal numerically to the difference in the speed of oscillation of the two waves. If one comes in with a frequency of 1,000,000 cycles per second, and the other oscillates at a speed of 1,030,000 cycles, then the beat note will be, 1,030,000 minus 1,000,000 equals 30,000 vibrations per second. This smaller number of waves per second is much easier to use in a receiving set than the high frequency. This particular point will not be explained here, but will be treated in a later article, as the second harmonic, which we are describing, does not enter into the above theory.

Harmonics Are Higher Notes

When a violin string vibrates it always divides in such a way that there is a whole number of parts to the string. The main tone, or fundamental is caused by the string vibrating as a whole. The center of the string goes back and forth and the two ends are fixed. But, besides this, other notes are produced at the same time, and it is the combination of these other notes that gives the violin its particular tone or timbre which enables the ear to recognize that it is a violin and not a piano. The fundamental may also be called the first harmonic, although the latter name is not usually applied. The second harmonic is caused by the string vibrating in two equal parts. Here the center and two ends are stationary, and the first and third quarters of the string are in motion.

This can be seen easier by trying it out with a clothesline. Suppose you take a line 30 feet long and swing it around so that it vibrates as a whole, as shown in Fig. 1. This is like the fundamental of a violin and gives out the basic note. By speeding up the line twice as fast the vibrations break into two parts, each 15 long, as seen in Fig. 2. This is the second harmonic and gives a note on the violin exactly an octave higher. In the same way the third harmonic goes three times as fast and is caused by the string vibrating in three equal parts, and so forth, up the line. The highest harmonics usually heard in ordinary band instruments are the ninth and the eleventh.

In the matter of these vibrations electricity and music are alike. If we have a radio wave oscillating at 500,000 times a second, then the second harmonic will go twice as fast; i. e., 1,000,000. Having found out what the second harmonic means, we will now show how it is used in the new radio sets.

Beats in a "Super-het"

As we have described, the whole essence of this form of radio lies in the fact that "beats" are produced between the incoming signal and the local wave generated by the oscillating set. This local wave is produced by the oscillating tube in the radio set and must go at such a speed as to cause something like 50,000 beats per second. Some manufacturers use a higher speed, and some a lower, the limit usually being from 20,000 to 100,000.

The older forms of super used a special separate tube to cause these local oscillations and then ran the combined waves through the detector to pick out the beats. But the latest model uses the same tube for detector and oscillator. The most obvious way of connecting up such a combination tube is shown in Fig. 3. The coil and condenser "C" are used to tune to the incoming wave. This will have a frequency of 1,000,000 cycles, if it happens to be a 300 meter station that we want to hear. In the grid lead is a radio frequency transformer, with an adjustable condenser "C2" connected across the secondary. The primary of this transformer is in series with the plate. This is one of the conventional ways of producing regeneration or feedback in an oscillating tube, and the frequency at which it will oscillate is determined by the adjustable capacity "C2." This transformer is usually in the form of a variocoupler, and by turning the rotor the amount of feedback, and so the violence of the oscillation may be easily controlled. By adjusting "C2" to give an oscillating speed of 1,050,000 a beat note will be produced at a speed of 1,050,000, minus 1,000,000 equals 50,000, which is what is desired. The same tube acts as a detector, and the output here shown as going to a telephone may be further amplified by running through intermediate frequency amplifiers in the usual manner.

This Hook-up Hard to Tune

The trouble with this connection is that it is very difficult to operate. The two frequencies are so close together that it is almost impossible to make them operate in a stable and consistent way. It will be seen that it is always easier to make a big change rather than a small change in such apparatus. For instance, it is easy to cut a foot off a board that is too long, but when you try to cut off one-sixteenth of an inch,

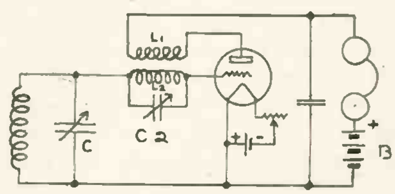


Fig. 3. Old Scheme of Coupling

right away you get into trouble. Or if you want to pass an automobile which is traveling at 20 miles an hour, you can shoot by at 25 without giving it a thought, but to try to pass it at 21 miles an hour requires much more careful adjustment of your accelerator.

Second Harmonic the Solution

This is where the second harmonic comes in. It has long been known that an ordinary vacuum oscillator not only produces a strong fundamental note at the frequency to which it is adjusted, but also gives out a very pronounced second harmonic going as described at twice the speed. So the ingenious idea was tried out of adjusting the oscillating circuit not at 1,050,000 cycles, but at just one-half this, 525,000, and then using the second harmonic to produce the beats. It is found by experiment that this idea works out beautifully. There is no trouble at all in tuning two circuits as far apart as 1,000,000 and 525,000. Since one is going nearly twice as fast as the other, it is like the above automobile passing the other at 40 miles an hour instead of 21 miles an hour. Such an adjustment can be made easily and is perfectly stable. The further advantage is that while the older scheme, turning either the "C" or "C2" dial caused a slight change in the other circuit, by the new scheme they are entirely independent.

Double Speed Easy to Get

It may be asked what precautions are necessary in using the second harmonic? Fortunately, there are no points at all which have to be looked out for. By making "C2" or the variocoupler coils large enough, the speed of oscillation is cut in two. It must be noticed, though, that the frequency varies at the square root and not as the first power of the capacity, and so the condenser or the coil must be made to have four times the value that it had before in order to get twice the wave length. Once this change has been made, no one could possibly tell from the operation of the set whether it was the fundamental or the second harmonic that was being used to cause the beats, nor is there any trouble in getting the oscillating tube to give out a second harmonic. All ordinary oscillating tubes seem to give out this double frequency just as easily as they do a single one. This is fortunate because it means no additional apparatus of any kind is required.

Hooking Up the Set

We are now ready to show the hook-up of the six tube super heterodyne. Looking at Fig. 4, the loop is tuned by the adjustable condenser, "C1," to the incoming wave, which we assume to be a 300 meter station, and so oscillating at a speed of 1,000,000. This wave is impressed on the grid or input of the first tube, which is reflexed as a radio amplifier and also a first intermediate amplifier. The radio frequency comes out of the plate circuit amplified and goes to the primary of transformer "T1," and from there through by passing condenser "C4" to the "B" battery. The secondary of transformer "T1" puts the amplified radio wave on the grid of the second tube, which acts as an oscillator and also first detector. It will be seen that the plate of the second tube runs through the primary of oscillation transformer "T2" through the by-pass condenser "C3" and the "B" battery. The secondary of "T2" is connected through "T1" to the grid. This makes a very powerful feedback and sets the second tube into powerful oscillation. The frequency of these oscillations is governed entirely by adjustable condenser "C2." mediate amplifier. This further amplified wave comes out of the plate through the primary of "T2," which it does not affect, since it is now at such a long wave length; then to the primary of "T4," which is tuned to this frequency, and so to the "B" battery. The secondary of "T4" is connected to the grid of the third tube, which forms the second intermediate stage. From there on the hook-up is not shown, as it is the standard super-hetrodyne connection. That is, the fourth tube is the detector, and the fifth and sixth tubes comprise two ordinary stages of audio amplification.

These Adjustments Made at Factory

All the adjustments just mentioned are made at the factory with two excep-

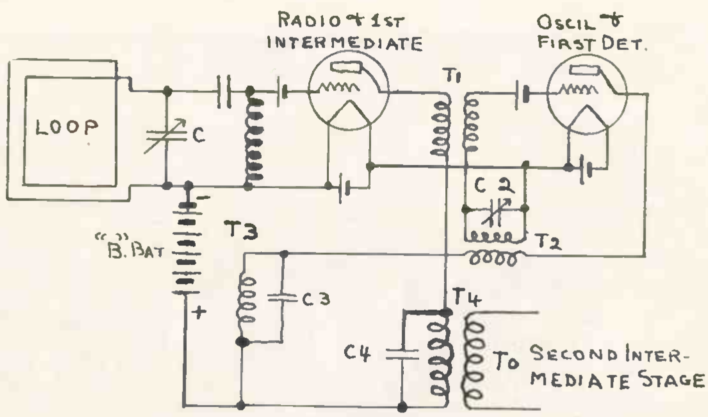


Fig. 4. Modern Super Hook-up

Adjusting Second Harmonic

This condenser is adjusted until it has an oscillating speed (in the illustration on receiving a 300 meter wave) of 525,000. The second harmonic, of course, is going at double this rate, or 1,050,000 cycles. Since the second tube is getting this frequency and at the same time the 1,000,000 cycle wave from "T1," a beat note of 1,050,000 minus 1,000,000 or 50,000 will be produced in the detector and sent out the plate to transformer "T3." This intermediate frequency will pass through the primary of transformer "T2" without any effect, since it is tuned by condenser "C2" to the much higher vibration. This intermediate frequency going through the primary of "T3" causes a more powerful wave of the same speed in the secondary coil (shown in the diagram just above the letter "T"), and so is impressed on the grid of the first tube as the first inter-

tions. These are condensers "C" and "C2." After the set is in the hands of the user, these two dials are the only controls which are turned to pick out one or another station. The user of this radio may be quite ignorant of what is going on in the set and still he will have no trouble in making the adjustment. He merely rotates dials "C" and "C2" until he hears some station.

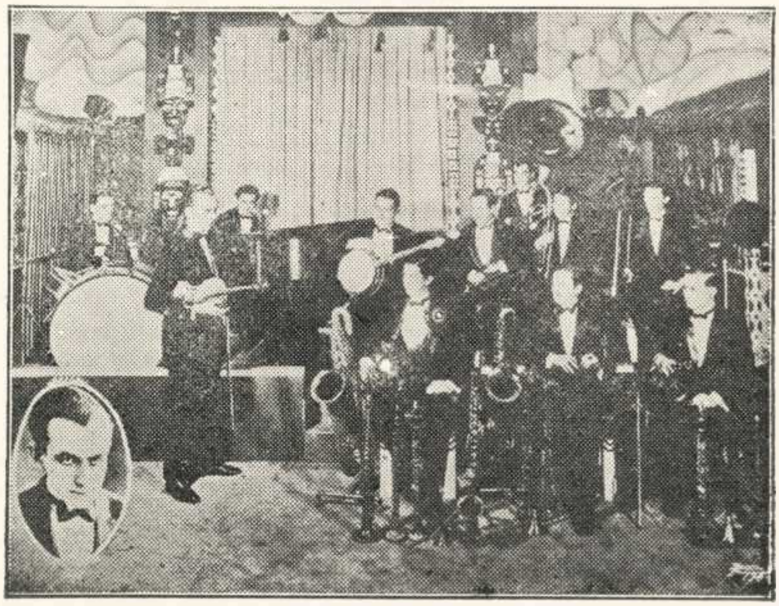
A fine adjustment is obtained by shifting one or the other dial a small amount back and forth. Once a station has been received with a certain pair of dial settings it will always come in again at the same place.

The "super-het" has a great many advantages which are well known and will not be described here, but all the good things which may be said about the ordinary set using a separate oscillator also apply to this second harmonic modification, which has been described above.

Some Sending Station Stories

WHERE WJZ MUSIC COMES FROM

IN the various voting contests which have been held from time to time, one of the most popular kinds of entertainment has proven to be dance music. This seems to appeal alike to the high brows, who prefer a large proportion of operatic selections, and also to the man in the street, who does not know the difference between an overture and the sounds heard when the orchestra is tuning up. A feature of the program from WJZ, New York, which is heard every Tuesday and Friday, is the Alamac Orchestra. This collection of artists plays dinner and dance music under the leadership of Paul Specht. Our picture shows the ensemble of the orchestra as a whole, also Mr. Specht himself.



Contests and puzzles are running Mah Jong a close race this season, but few of them have inspired the radio audience to the effort which that inaugurated by Irving Selzer and his Cafe Boulevard Orchestra, in their weekly Wednesday broadcasts from WJZ, has aroused. The contest is simple in the extreme. but gives excellent opportunity for the exercise of subtlety and wit by the listener. Each Wednesday during the regular broadcast program one player gives a solo of a few bars of some popular song, the title of which is in the form of a question; the listeners must guess the name of the song, the kind of instrument upon which it was played, and figure out a clever answer to the question in the title. Much to the surprise of both the orchestra and WJZ, the radio fans have caught on to the game, each Thursday bringing more than 400 guesses in the first mail and the totals swelling to more than three times that number each week.

FRENCH FROM THE AIR

As part of the children's hour program, beginning at 6:30 every Friday evening, WGY, the Schenectady, N. Y., broadcasting station, is offering children's stories in French by Aime Le Blanc. Mr. Le Blanc is a direct descendant of Daniel Le Blanc, who settled in Arcadia (Nova Scotia) in 1650 and whose family story is immortalized by Longfellow in the poem, "Evangeline."

The introduction of Mr. Le Blanc on the children's program a few weeks ago brought congratulatory telegrams, telephone calls and a great many letters to WGY. Many of them were from French people, and others from those who are studying French and who found the stories excellent instruction. French-Canadians were particularly enthusiastic with the new children's feature.

Mr. Le Blanc was born and educated in Paris. He was graduated from College Chaptal and Ecole Normale Superieure, and in 1912 was sent to Persia by the French government as professor of science. During the war he served in the engineers corps and was discharged in 1919 as a lieutenant.

In 1923 he came to Schenectady as resident representative of Cie Francaise Thomson Houston at the General Electric Company. Telling to his own children the wonderful tales and stories familiar to French children suggested the idea of broadcasting the stories. Mr. Le Blanc will welcome suggestions from his listeners for other stories.

NEW YORK TALKS TO SAMOA.

American Vice-Consul Quincy F. Roberts at Apia, Samoa, 7300 miles from New York, reports the reception of WEAF's program from 7:18 p. m. to 7:50 p. m. on Friday, March 14, which was from 1:48 to 2:20 a. m., New York time. The special program of Paul Whiteman was being broadcast on this occasion. This is the first time that an uninterrupted program has been received from such distance over land and water. The equipment used by Vice-Consul in Charge Roberts consisted of a single circuit regenerative receiver with two stages of audio frequency amplification. His antenna is a single inverted L, 80 feet high and 150 feet long.

There is six and one-half hours time difference between the metropolitan broadcasting station and the receiving point in the far Pacific. The previous long distance report at this point was the reception of a Chicago station 745 miles nearer.

The details of the program sent to WEAF by Mr. Roberts indicate that not only was the orchestra heard, but solo numbers recognized, as well as the closing announcement, including a summary of the program for the day following.

Station WEAF does not attempt long distance records, but it has received reports consisting of complete logs of its programs for more than 20 minutes, including identification of announcements and musical numbers from such points as Cape Town, South Africa; Buenos Aires, Argentina, as well as Samoa. All these records were sufficiently complete to admit of substantiation without doubt that WEAF was the station which was received.

℞ DR RADIO PRESCRIBES.

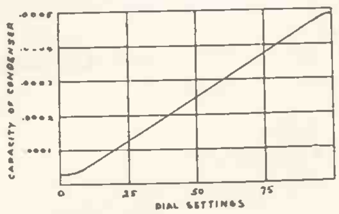
NOTE: In this section the Technical Editor will answer questions of general interest on any radio matters. Any of our readers may ask not more than two questions, and if the subjects are of importance to most radio fans they will be answered free of charge in the magazine. If they are of special interest 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. Please give hook-up for single tube set, using variometer, condenser, and coil?

Answer. If this set is to be made non-regenerative, the variometer may be omitted, but since it will work considerably better if regeneration is used, we are showing the connections, as such. The hook-up appears on this page. The 23-plate condenser is placed in series in the aerial to give fine tuning. Coarse tuning may be accomplished by adjusting the number of turns in the coil. This may be a spiderweb coil with taps, or it may be a single slide tuner. The plate circuit runs through the variometer to the phones and "B" battery, and the amount of feedback is adjusted by turning the rotor of the variometer. While this set will work quite well, it is somewhat more difficult to adjust than the kind which uses a variocoupler, since the amount of feedback depends on the setting of the variometer in a rather irregular fashion; also it is quite a squealer, and care must be used in adjusting, or it will destroy the pleasure of neighboring listeners.

Question. What is meant by a straight line condenser?

Answer. As the rotor of a variable condenser is turned from zero to one hundred the capacity increases. In many condensers this increase is somewhat irregular, since turning say five degrees will add more capacity at some parts of the scale than it will at others. In the straight line condenser, the amount of capacity increases regularly, as the handle is turned. If a plot is made on regular square ruled paper or co-ordinate paper, as it is often called, then the horizontal distances are laid off to represent divisions on the dial and the vertical height stands for the amount of capacity in the condenser. If the condenser is a good one the line connecting the capacity and the dial setting will be straight. If, however, the plates are not well spaced, or are not semi-



Straight Line Condenser

circles, then the line will be wavy. It will be noticed that at both ends of the line there is a slight curvature. This is caused by the fact that it takes a couple of degrees at each end of the dial before the rotating plates start to mesh into the stationary ones.

Question. How much water should be put in the storage battery?

Answer. A storage battery should be inspected about once a month in winter and twice a month in summer to see that it has sufficient water. The water leaves the cells partly through evaporation and partly through the electrolytic action on the charge. This action is caused by the electricity breaking up the water into its two parts, oxygen and hydrogen. These two gases bubble up through the liquid and out of the vent caps. The reason that the battery should be inspected oftener in summer is because the higher temperature causes the water to evaporate quicker. When necessary it is well to add enough water to each cell to bring the level about a quarter inch or so above the top of the plates.

Continued on Page 28

DR. RADIO PRESCRIBES

Continued from Page 27

Question. Can a Tungar be used on direct current?

Answer. No, a Tungar will not work except on alternating current. It is used to change alternating into direct current and if the service you have is already direct, there is no need to try to change it. In such a case you can charge your "A" or "B" batteries directly from the electric light wires by connecting a resistance in series with the batteries.

Question. How is a volt meter connected on a set so that it will read the "B" battery voltage continuously?

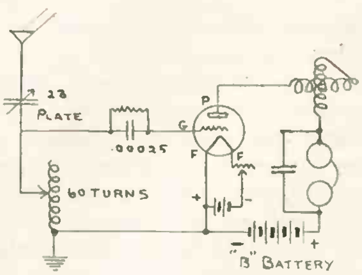
Answer. All that is necessary is to run two wires, one from the plus of the volt meter to the "B" battery plus and the other from minus to minus. However, we do not recommend leaving the meter in circuit all the time as it takes as much current to operate the meter as is used by several vacuum tubes. It is much better to insert a switch or preferably a push button in series with either wire. When a reading is desired your button may be pressed and then released again.

Question. What is the capacity of an ordinary dry cell?

Answer. Most dry cells contain 20 ampere hours. This is enough to operate a WD-11 or WD-12 tube for about 75 or 80 hours. Three tubes will light for a little less than one-third this time. Three dry cells in series will work a UV-199 tube for about 300 hours, or three tubes for 90 hours. It is not recommended to use dry cells with the UV-200 or the UV-201A, since they use so much energy in lighting the filaments.

Question. Please publish a single tube hook-up using one variometer and no variocoupler?

Answer. Such a diagram is shown here. Aside from the tube, phones, batteries and fittings the only requirements are one 23-plate condenser, one variometer and a coil, which may be wound on a spider web form, or may be a honeycomb coil already made up. If a spider web coil is to be wound, about 60 turns would be used, and taps brought out at turns No. 30, 40, 50 and 60. These taps will give the coarse adjustment for wave lengths. The 23-plate condenser is connected in the aerial and gives fine adjustment for tuning. If the rotor is connected to the aerial and the stator to the grid, then the body capacity effect will be minimized. Any kind of tube can be used but the WD-11 working on a single dry cell, is recommended for this hook-up. An ordinary 6 ohm rheostat will control the filament current. A single block of 22½ volt is right for the "B" battery. Regeneration or feed back is controlled by the variometer in the plate circuit.



This set can be made up very cheaply and has only two controls to accomplish tuning. It will have a range of 1,000 miles, if used with a good aerial and ground. If desired, one or two audio amplifiers could be added instead of the telephone and good loud speaker action will be had.

The Cheapest One-Bulb Receiver

This Costs $9.30, Including Set, Tube, Batteries and Phones

By CLARENCE H. WEST

I AM an advocate of simplicity in radio. I believe in accomplishing satisfactory results with a minimum number of parts, and also believe that in time radio apparatus will perhaps become as cheap as my steadfast friend—the Dollar Watch. If wrapping paper were satisfactory, I would paper all my rooms with it for the sake of cheapness. But this is not radio.

If the construction information herein is followed carefully one can make a good radio receiver at the low cost of $9.30, which represents the prices I paid for a vacuum tube, 1 dry cell, 1 "B" battery, and a pair of cheap phones. All of the parts with the exception of the above mentioned can be constructed from odds and ends lying around the house.

Dutch Cleanser Box

Procure a cardboard tube or salt box, even a "Dutch Cleanser" box will do; and if it be the latter, cut the tin ends off evenly. Most every family has an old, discarded electric door bell or buzzer which has been previously removed for reasons of raising a family of roaches instead of announcing callers.

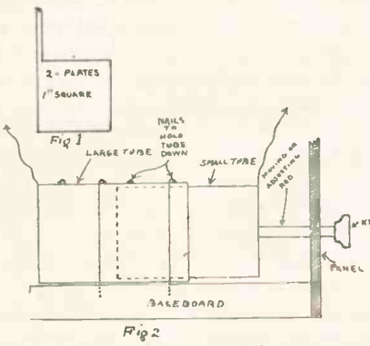
If your household does not contain one, the corner hardware or electrical man has lots of old ones that have been removed from apartments. He will give you one or charge a nickel, as my dealer did.

Now get your thinking cap on and hunt for the following:

1. Battery cap nuts from old dry cells.
2. Washers with hole for ordinary size screws.
3. Spring magazine clips, the kind used on newsstands.
4. A tin cocoa box, or any tin box.
5. Baseboard, 5x7 in., and ½ to ¾ in. thick.
6. Wood panel, 7x7 in., about ¼ in. thick, and straight.
7. Wood screws, ½ to ¾ in. long.

You are now ready to assemble.

Screw the wood panel to the baseboard and bore two holes on the upper right-hand corner for the aerial and ground binding posts. The size of the holes must fit the screws. On the right side of panel bore three holes; these are the "B" battery post and "A" battery posts. In the lower right portion of the panel bore two holes about one and one-half inches apart. These are for the phones. The following construction data is for the apparatus to be mounted on panel and baseboard.



Figs. 1 and 2. Detail Views

Bulb Socket

Take the four spring clip magazine holders and bore a hole in each end, then bend up at right angles. Place your bulb on the baseboard with prongs resting on the plane and mark with a pencil the exact point where each prong touches the board. Now screw the clips directly over the markings. Do not screw tightly, as a wire will have to be led from each prong later on in the construction.

This is your bulb socket and each clip holds a prong of the bulb in a vise grip.

Grid Condenser

Cut two hardwood blocks two inches square, and on one bore a hole in each corner.

From the tin box cut two pieces one inch square with a lug or extension of tin extending out. See Fig. 1.

On the unbored block place one plate and over this place a piece of waxed paper or writing paper two inches square, followed by the remaining plate with its lug in opposite directions. Screw the bored hardwood block down firmly. You now have the grid condenser with a capacity just about right for a 1½ volt tube.

Tuning Coil

Remove the wire from the bell magnet coils and also save the two binding posts on the bell or buzzer, for these will be your aerial and ground posts on the panel, and may be attached at any time.

On one edge of the cardboard tube punch three holes and weave the wire through them, leaving eight inches or so for connections. Wind 80-inch turns on the tube and fastened as described for the starting.

A tack at each edge will hold the tube to the baseboard.

Variable Condenser

Procure a piece of brass pipe two inches long with a diameter of from two up to three inches. A smaller piece of pipe the same length must also be procured. This should be a loose fit.

Over the smaller length of pipe glue a strip of linen writing paper about 2½ inches wide and fold the edges inside the tube. Also fit a rubber cord or wood block in one end, and to this in the center fit a long machine screw, bolt, rod, or a piece of large gauge wire.

The larger tube is to be mounted on the baseboard with the opening facing the panel. It can be held in place by four bent-over nails.

The smaller tube is placed within it and the point marked on the panel at the rear where the rod touches. A hole is then bored in the panel to allow the moving rod to come through. This is for the purpose of moving the smaller brass tube within the larger one, which varies the capacity. A wire is led off from each tube for connecting this condenser in circuit. See Fig. 2.

Rheostat

These can be purchased for 25 cents, but for those who do not desire any expenditure outside of the alloted cost, the following will prove satisfactory:

Select a small length of test tube or any glass tube and force a cork firmly into one end. Drill a hole in the center of the cork and put a flat headed screw in from the inside of tube. Fill the tube one-half inch with powdered carbon used from the terminal of an old dry cell. Drop in any circular metal substance that is a close fit. If the right size tube is used, a penny may be substituted. Take a rubber cork and drill a hole in the center and force a battery cap nut within. A screw is then inserted and adjustment of filament current is made by the screw. Mount this on baseboard with the screw end facing the back of the panel and close to it, the screw, in this case, coming through the panel. This will hold the cork against the panel and prevent it from being forced out by the adjusting screw. Connections are made from the two end screws. This gives a very good adjustment, but it must be remembered that close fitting of

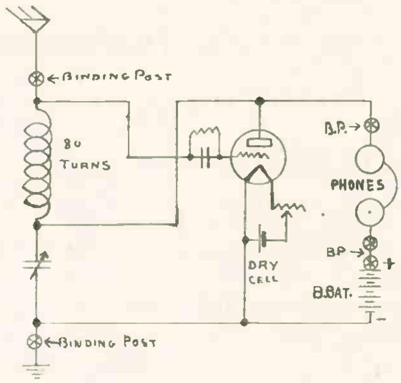


Fig. 3. Easily Made Hook-up

the grain holder must be made, otherwise some of the carbon might go astray.

Battery and Phone Posts

On the right side of panel mount the binding posts, which may be machine screws, with a battery cap as the check nut and cap. The phone posts may be two spring magazine clips, the same as used for the bulb socket, or may even be regular binding posts that sell for five cents each.

The connections may be made with the same wire from the bell magnets, and make all these connections in accordance with diagram, which is self-explanatory.

Marking the Terminals

Before making any connections to the spring clips, mark the lower left-hand corner clip No. 1, the upper left-hand No. 2, the upper right No. 3, and the lower right No. 4. Numbers 1 and 4 are the filament connections and No. 3 the plate; No. 2 is the grid connection. In placing the bulb within the clips always have the pin on the base facing the rear of the panel and between No. 2 and No. 3. Watch this closely. Use a WD-12 tube.

In tuning this set do not allow the set to reradiate or cause interference. Keep the rheostat turned back just enough to insure good reception.

This instrument will cover some remarkable distance, even if it is constructed from "junk." It is cheap and gives the layman a bulb receiver at the cost of a crystal set.

QUIET HOURS CHANGED

The changes in radio transmitting schedules caused by the observance of daylight saving time in some sections and standard time in others have prompted the American Radio Relay League, at the suggestion of the Department of Commerce, to agree to the temporary expansion of amateur "quiet hours" to include the period 7:00 to 10:30 P. M., standard time, (8 to 11:30 P. M. daylight saving time). Amateurs are being advised of the expansion by the Department and are asked to attach the notice to their station licenses.

Amateur telegraph operators have been observing the period between 8:00 and 10:30 P. M., standard time. This new arrangement which allows the broadcast listeners an extra hour of quiet during the evening is regarded by the Department of Commerce and the A. R. R. L. as an emergency measure which will be in effect only until October 1, 1924, the period that daylight saving time is in force. With the resumption of the observance of standard time in the fall, the regular "quiet hours" of 8:00 to 10:30 P. M. will again be recognized by the Department.

While many of the states in the western and northwestern part of the country are not at present observing daylight saving time, it was thought that the change of hours should be made uniform throughout. The "quiet hours" were first designed for the benefit of broadcast listeners, but with the advent of daylight saving time this spring, much of the protection which they had been receiving was offset by the change in transmitting schedules and interference resulted.

In continuation of its policy of cooperation on behalf of the broadcast listeners, the A. R. R. L., the national association of transmitting amateurs, has readily agreed to the new measure and is urging its members to conform cheerfully thereto, particularly in view of the fact that at most it is only a temporary regulation.

ARCTIC CIRCLE LISTENING

Word has been received from the Hudson's Bay Company that the experiment to test the reception of KDKA's concerts in the Arctic Circle has proved a complete success. Eight receiving sets were set up at the various posts of the company, many of them well above the Arctic Circle, and all the reports state that the only interference encountered was due to Northern Lights. Fur quotations are now broadcast from KDKA, and they are proving of great assistance to the traders, saving the company large sums of money through immediate knowledge of any drop in the fur market.

BALLOON AERIAL

Behold the phenomenon of a fine antenna wire suspended perpendicular to the ground. Oh! it's a bear! Greater results guaranteed. Have one on hand for peak reception. Costs only a few cents each time for recharging. Price $5.00 all complete with duraluminum antenna wire: large, rapid winding windlass; gas fixtures for a jug, and three 30-inch balloons.

EVERETT SCANLON, Radio Specialties, Lakewood, Rhode Island.

PLENTY OF MUSIC FOR BROADCASTERS.

The damage suit recently brought against Station WLW, the Crosely Radio Corporation, by Remick & Co., music publishers, has been decided in favor of the broadcasters. The American Society of Composers, Authors and Publishers, to which Remick & Co. belong, took the position that when broadcasters used copyright music, they should pay for it. On the other hand, the broadcasters thought that since they performed the concerts without any pay and since the result was to advertise the music, that they should not have to pay any royalties.

Judge Hickenlooper handed down a decision dismissing the suit, stating that nothing in the copyright act prevented a broadcasting station using copyright music when the music was transmitted through the air to radio receiving sets.

But in spite of the fact that the studios can now legally use any music they like, some of the big sending stations have decided that they will continue to avoid using any copyrighted music coming under the control of the Society of Composers. They feel that the advertising value of their broadcasting is considerable, and that they will not give free advertising to this society, which in the past has been unfriendly. So they will continue to use only the music which is written by composers who give them permission to use their productions.

NIGHTINGALES LATEST TALENT

Recent news reports from England describe an experiment which may cause some American broadcasters to stop and consider whether they have developed the art of radio entertainment to its highest degree of perfection. The dispatches stated that British listeners were treated to a concert by nightingales and other native song birds. The enterprising manager of the broadcast station, who conducted the test, had the microphone cleverly concealed in the native haunts of the birds so that their singing might be enhanced by the natural setting.

The chief difficulty encountered would apparently be that of training birds to stop their singing occasionally and step up to the microphone and say, "This is Station WXYZ."

The plan is not so different from that already accomplished and popularized by means of the motion picture camera. Explorers have gone out into the forests and fields for the purpose of photographing wild animals in their natural surroundings. Why should not radio be utilized to accomplish for the ear what the camera has done for the eye? It would appear far better to allow the birds to roam about with absolute freedom and enjoy their singing than to keep them caged. Moreover, it would be a rare treat for the city dweller who does not have either the leisure or facilities to enjoy the country.

LISTENING FOR THE S. O. S.

Few radio listeners know that behind the scenes in the broadcasting station there is stationed a licensed code operator whose only duty during the period the station is on the air is to listen in for distress signals. While music and addresses are going out from an adjoining room, he sits at a receiving set that is tuned to 600 meters, the wave length of ship and coast stations. At the first signal of distress he notifies the engineer in charge and the broadcasting stops at once. The air is left free for the unobstructed transmission of S. O. S. signals.

On Saturday evening, March 22, shortly after 11 o'clock, while WGY, the Schenectady, N. Y., station, was in the midst of a dance program from Albany, an S. O. S. was picked up from a ship at sea. Instantly WGY left the "air" and remained out until permission was received to resume. This is the first time, during two years of operation, that WGY has been interrupted by distress signals.

What Call Letters Mean

Broadcasting station call letters usually have no other meaning than simply to designate a radio station. However, some stations are fortunate enough to have assigned to them letters that do mean something. For instance, the Chicago Tribune, whose slogan for years has been "The World's Greatest Newspaper" has the call letters WGN. Whether this was by luck or by good wire pulling does not matter.

WFAA at Dallas, Texas, had to stretch it a little but finally evolved the slogan "Working For All Alike" out of their call letters.

WAAW, station of the Omaha Grain Exchange has been translated to mean "Where Agriculture Accumulates Wealth" and then there is the station of the Detroit Police Department, whose call letters are KOP.

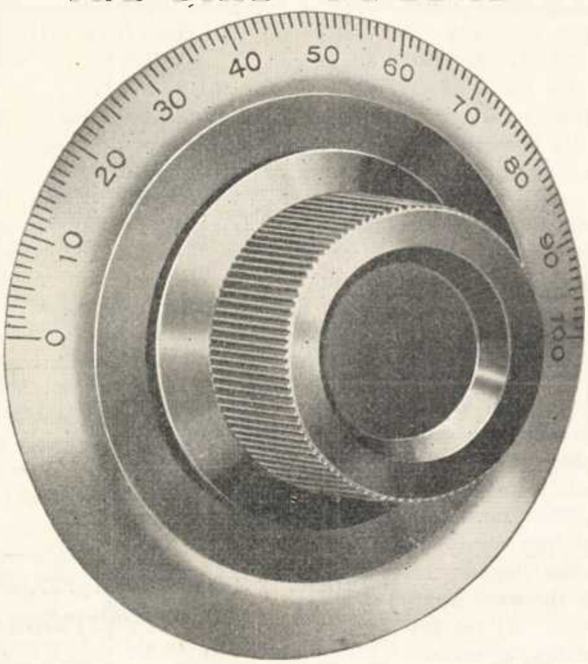
WTAM, radio station of the Willard Storage Battery Company, Cleveland, has been neglectful in hunting down an expression to fit their call letters. This expression was supplied in an applause letter following the midnight concert broadcast in connection with the National Balloon Race when the Willard station remained on the air from midnight, to 5 a. m. The appreciative fan claimed that at first WTAM meant "Waiting Tensely At Midnight" but when the concert began it was very evident, he said, that the letters stood for "Willard's Transmissions Are Marvelous."

DEATH TO FOREST FIRES

Another way that radio is helping the world at large is the aid it is giving to the government in suppressing forest fires. As is well known, these fires annually destroy a very large quantity of lumber. By using airplanes, equipped with radio-sending apparatus, the government finds that fires can be discovered before they grow to large proportions. The radio conveys the information to the bases where fire-fighting outfits are kept, and firemen are rushed to the scene. This service has saved a great deal more than it costs.

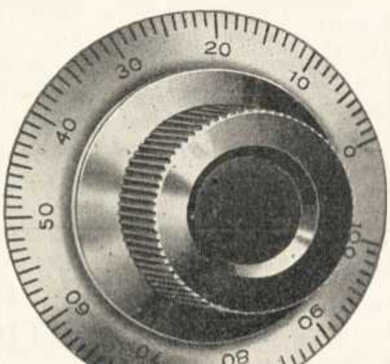
42 MAVERICK SQUARE **TRU-FIX** TRADE MARK REGISTERED RADIO PRODUCTS EAST BOSTON, MASS.

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

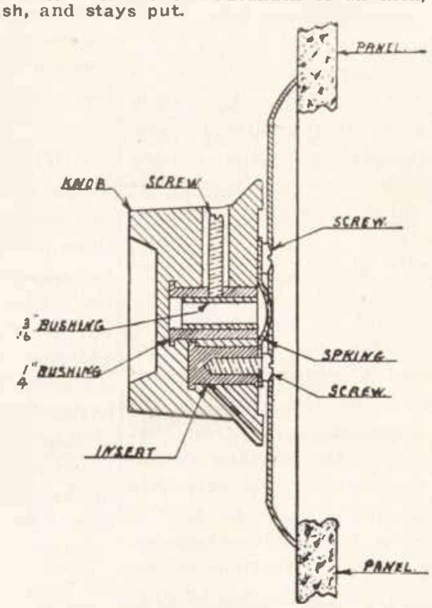
TRU-FIX Dials are made of selected sheet brass .023 of an inch thick. The edge is very thin with a gradual contour to meet the panel and is finished in bright nickel with 100 division scale running from left to right, etched in the surface, inlaid with black enamel, thereby making TRU-FIX DIAL easily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

ALIVE ALL OVER!

Why Use a Fixt Crystal That May Deteriorate Quickly ?

There is no pleasure in fishing for a sensitive spot on the ordinary crystal. Just when the music is best the cat whisker may slip and before you get the proper adjustment the station has gone.

We are selling the

AUDION CRYSTAL

Which is alive all over. Drop the cat whisker anywhere and you can hear the music. Unlike a fixed crystal, if it is damaged by a shock or by static it need not be thrown away, as only that one portion is injured.

Price of Audion Crystal 25c. Postpaid

We also supply GOLD-PLATED CAT WHISKERS wound up to shape, at 15c. postpaid.

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