September 15, 1924
15 Cents a Copy

RADIO PROGRESS

"Always Abreast of the Times"

IN THIS ISSUE:

The Inside of a Power Speaker
Special Article by H. V. S. Taylor
New Kinks in a Neutrodyne
Giving Horse Power to the Voice
Long Versus Short Wave Lengths
Twin Coils Have No Fields

YOU WILL UNDERSTAND THIS MAGAZINE--AND WILL LIKE IT

PUBLISHED TWICE A MONTH

RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 1 Number 13

Contents for

SEPTEMBER 15, 1924

PAGE

THE INSIDE OF A POWER SPEAKER 5
SOME SENDING STATION STORIES 8
REBROADCASTING THE CORRECT TIME 9
TWIN COILS HAVE NO FIELDS 11
GIVING HORSEPOWER TO THE VOICE 13
NEW KINKS IN A NEUTRODYNE 15
MacMILLAN'S MAINE STORY 19
AMERICAN RADIO RELAY LEAGUE 20
A REAL SENDING STATION ON WHEELS 21
EDITOR'S LOUD SPEAKER:
BELIEVING IN SIGNS 23
REFILLING VACUUM TUBES 23
LONG VERSUS SHORT WAVE LENGTHS 25
A STATION RUN BY GHOSTS 26
PORTRAITS OF POPULAR PERFORMERS 27
DR. RADIO PRESCRIBES 28
FONE FUN FOR FANS 29
LIST OF BROADCASTING STATIONS 31

The Round the World Fliers, who are at present in the United States, are getting a good deal of attention. Do you realize how much these globe girders are depending on radio? In the next issue of RADIO PROGRESS there will be an article by a United States Army Radio Officer discussing some of the problems of the Round the World flight.

To many broadcast listeners the nightly concert seems to come like rain from heaven. The actual origin of the entertainment is a most interesting masterpiece, that is, the transmitter. In the October 1 issue is an article by Dr. Goldsmith on this apparatus.

The article on "Filters" and how they are used both in sending and in receiving sets will appear next time.

COMING SHORTLY—You can buy books that give 100 to 200 hook-ups, most of them useless. We shall publish shortly a collection of fifteen worthwhile hook-ups, which can be depended upon to work. Do not miss this issue.

RADIO PROGRESS is issued on the 1st and 15th of each month by the Oxford Press at 8 Temple Street, Providence, Rhode Island. John F. O'Hara, Publisher. Yearly subscription in U. S. A., $3.00. Outside U. S. A., $3.50. Single copies, 15 cents. Entered as second-class matter, April 4, 1924, at the Post Office at Providence, R. I., under the Act of March 3, 1879. Address all communications to RADIO PROGRESS, 8 Temple Street (P. O. Box 728), Providence, R. I. Title registered at United States Patent Office.

RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. 1, No. 13 SEPTEMBER 15, 1924 15c. PER COPY, $3 PER YEAR

The Inside of a Power Speaker

How This Horn Differs From Other Loud Speakers

By HORACE V. S. TAYLOR

YOU have probably seen a cartoon in a funny paper showing a man listening intently while he whirls his dials and yet can't seem to get anything. A little later on in the comic strip he discovers that his loud speaker was not connected and its cord is dangling loose. It does not require an experience like this to show the need of a loud speaker or phone, but perhaps some listeners don't realize how important it is to have a good make of instrument.

It is the phone or speaker which actually converts the electrical energy into the form of sound waves, which make music when they strike our ears. From this it is evident that no matter how good our set is to tune in the distant station we want and cut out undesirable noise and interference, still if the final device does not make good music out of good electrical waves, then we shall not get the best results, especially when good musicians are playing.

Radio Phone vs. Bell Phone

In these days nearly everyone is familiar with the telephone receiver, at least in a general way. The style which is used in radio is the same in principle as that which is connected to the Bell telephone system. The main difference between these two is in the winding. The radio phones work on a very small amount of current at a fairly high voltage—the "B" battery usually supplying from 22 to 120 volts. This small current requires the use of a very large number of turns and since the voltage is high it is not necessary to use very large wire. So it is customary to wind with several thousand turns of No. 40 enameled wire.

The Bell phone (that is, the kind you use every day), on the other hand, uses considerable current and the voltage is not nearly as great as in the radio set. The low voltage requires that the wire be of rather large diameter and the larger current allows us to use fewer turns. As a result of these differences the Bell phone will have a resistance, as measured by direct current, of around 80 ohms, while the radio head set measures from two to three thousand ohms. Since there is such a big difference in the resistance of the two styles, it is impossible to interchange them. If one is used on the circuit which requires the other, then very poor results will be had.

Horseshoe Magnet in Phones

Most loud speakers on the market at the present time might be called glorified telephones. That is, the operating mechanism is just like that of the head set. A circular permanent magnet (much like a horseshoe magnet except for its shape) has two small coils, one on the end of each pole. These coils are wound with very fine wire as just explained. The coils are brought as close as possible to the center of the diaphragm, which is made of a thin piece of sheet iron. When current is run through the coils in one direction it strengthens the magnetism of the permanent magnet and this attracts the diaphragm. When current reverses its direction in the windings, then it weakens the horseshoe magnet and the diaphragm, being quite elastic, springs away from the magnets. It is this action vibrating back and forth which causes the sound waves that we hear.

A Teaspoonful of Air

When we listen to a head set, which is clamped on our ears, it gives very good performance because the amount of air which it has to set in motion is very small—you might say a teaspoonful or so, which is contained in our ear passages. If the phones are laid down on the table then the amount of air between them and our ears is apt to be quite large and for this reason the station has to be very loud before we are able to hear well. In such a case if a horn is attached to the phones, then the sound is much plainer than before. Of course, this is not because the horn has added anything to the energy. All it has done is to direct it in such a way that it reaches us better. A well designed horn will have considerable amplifying value, if the word "amplifying" is used in the sense just described. No further energy is added as is the case when we use one step of audio. In the latter case actual power is added from the "B" battery and so the amount of vibration is considerably increased.

Most loud speakers as has been said are really head sets with a horn. As a matter of fact, some of the speakers on the market consist only of a metallic horn with an attachment in the base for clamping a head phone to it. Such loud speakers are very good indeed if a suitable unit is used in the base. There are

1—Socket into which horn is fitted.
2—Metal cover protecting sound chamber and diaphragm assembly.
3—Large scientifically constructed sound chamber.
4—Leads from movable coil to step-down coil.
5—Specially designed non-magnetic diaphragm.
6—Hanger connecting movable coil to diaphragm.
7—Top plate (one pole of electro magnet).
8—Air gap in which movable coil floats and which becomes strong magnetic field when current flows through field winding (10).
9—Famous "movable coil" (wound with fine copper wire through which flows current from receiving set) whose movement causes corresponding deflection of diaphragm.
10—Electro magnet through which current flows from filament battery, strongly magnetizing pole pieces (7) and (11).
11—Iron core (not a permanent magnet)—center pole of electro magnet.

Fig. 1. Inside View of Speaker

a number of manufacturers who supply such parts; one for instance that is quite popular is the Baldwin, which has a mica diaphragm, instead of a metal one, as was just described.

The Power Speakers

Some forms of horns, however, work on a different principle. Of these there are two, the Magnavox and the Thorophone, which use a vibrating coil and also power from the "A" battery. They are called "power speakers." As the operation of these two is similar electrically we shall describe the details of one only.

The two big differences between the Magnavox and the other type just described is, first, that a permanent magnet is not used, but the necessary magnetism is obtained from running current from the "A" battery through a large coil; second, instead of having fixed coils to take the output current from the radio set, use is made of a vibrating coil, which dances up and down and carries the diaphragm with it. Besides these differences there is also required another unit, a transformer, which changes the current from the radio set to make it suitable for the movable coil.

Fig. 1 shows a diagram of the inside construction of this unit. A horn, which might be any convenient shape, but in the Magnavox has a rather distinctive form is fitted into the socket 1. 2 is a cover or cap, which fits over the operating mechanism to keep out the dust. The sound chamber is shown in 3. This has been designed after some considerable development work as it was found years ago by phonograph manufacturers that the sound chamber had a rather important bearing upon the tone. The diaphragm 5 is not of iron or steel, as in other speakers, but is constructed of an alloy, which has been found to be very springy and elastic. It is not flat but is corrugated in rings to make it stronger. In this way it is kept very light as well as strong and so can easily follow the high speed vibrations of a soprano voice. The three cornered piece 6, is a link or hanger which connects the coil to the center of the diaphragm.

The Electro Magnet is Distinctive

So far the mechanical part of the unit has been described. We now come to the electrical end. 7 is the top plate of the electro magnet and carries the magnetism from the outside to the center hole, right through the coil. An air gap 8 separates this top plate from the coil 9 which vibrates up and down when music is coming through. A larger electro magnet, 10, supplies the magnetic flux which threads through the movable coil. 11 fits inside the movable coil and conducts the magnetism down again.

In operating this instrument the first thing to do is to close the switch, which turns on the current through the winding 10. This consumes from a quarter to one ampere (depending on the model) from a six-volt "A" battery. Notice the very large number of turns in coil 10. This big current through so many turns gives very powerful magnetism, much stronger than can be obtained from a permanent magnet. That is one reason why this unit is so loud.

The path of the lines of magnetic force are up through the center of the coil through pole piece 11, then horizontally across the air gap into the top plate 7, down the outside of the coil and back to the center pole piece. This gives the magnetism a path from the center out in all directions, as will be explained later in Fig 3. The current from the radio set is run through coil 9. This consists of a few turns of fairly good size wire and since it lies directly in the path of magnetism it will oscillate up and down when current waves are passed through it. It is wound on a very light bobbin or spool. This spool is attached by the link 6 to the center of the diaphragm, and so its motion is faithfully followed by the sound waves, which the diaphragm creates. The fact that the coil moves itself as a whole, instead of merely magnetizing another piece of iron and making it move, is a very good feature of this style of construction.

Why Use a Transformer?

It will be observed that this coil consists of a few turns of large size wire

It may be asked how this will work in view of what was explained earlier in this article. As a matter of fact, it would not work at all if the output from the last step of the radio were fed directly to this coil. It would not be practical to wind the moving coil with such very fine wire as it would be likely to get out of order easily and furthermore, the large amount of insulation carried would be a decided disadvantage in that it would make the coil too heavy. So to get around this difficulty a transformer is used to step up the radio current from a small value to a large one. This transformer is usually mounted in front of the Magnavox proper on the same wooden base.

It has two windings; the primary, a large number of turns of very fine wire, and the secondary, a few turns of heavy wire. This transformer is like an audio frequency transformer in your radio set except that instead of stepping the voltage up and the current down as usual, it does just the opposite. The current is increased and the voltage reduced. Since the voltage is not what operates this instrument, it does no harm to work at a low pressure, as long as the current is multiplied to a large degree.

The hook-up of the loud speaker with the last step of the audio amplifier is shown clearly in Fig. 2. The primary of the transformer just mentioned is connected from the plate of the vacuum tube plate to the plus of the "B" battery. This connection is made through the six-foot flexible telephone cord, which is plugged into the jack of the radio set. The secondary of the transformer carrying say ten times the primary current is in series with the vibrating coil or vibrator. This fluctuates up and down in the air gap of the electric magnet, as has just been described. If the switch is left

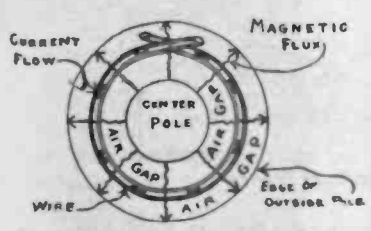


Fig. 3. Current and Magnetism

open there is usually enough magnetism left in the center pole to make the coil vibrate a small amount, so that the music can just be heard if it is a fairly loud station. When the switch is closed it connects the coil directly to the "A" battery and the magnetic flux is now very powerful which gives a pronounced vibration to the diaphragm.

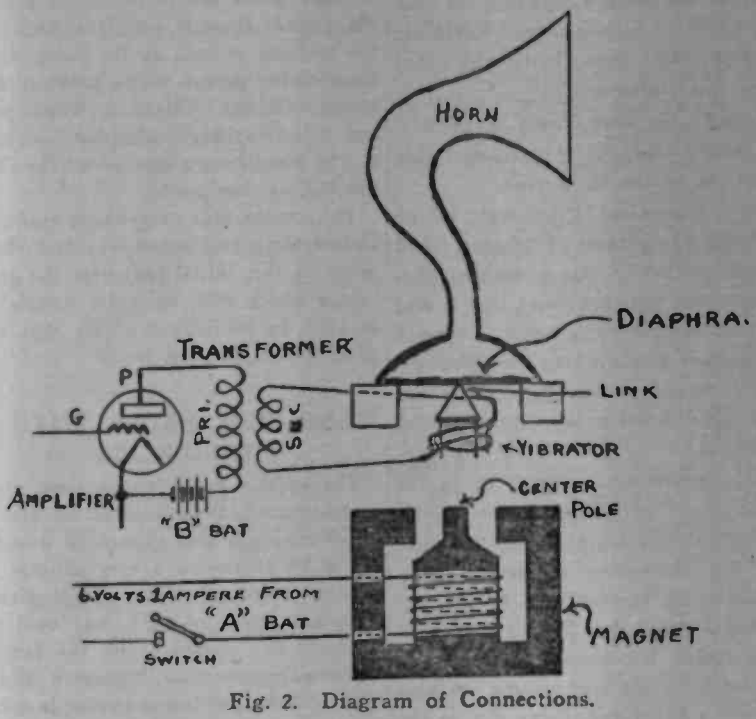


Fig. 2. Diagram of Connections.

It may be asked just how the flux and the current happen to give an up and down motion. This can be seen from a reference to Fig. 3. You will remember that whenever a wire carries current at right angles to magnetic flux or lines of force, that the wire tries to move at right angles both to the current and to the magnetism, that is, into the third dimension. This is one of the laws of electricity. Fig. 3 shows that the current flows around in the wire which represents one turn of the vibrator coil. This is a top view of the instrument and so the direction of flow is horizontally in a circle. The magnetism, on the other hand, flows radially, (like the radius of a circle) from the center pole outwards across the air gap. This is shown by the wavy arrows. The current and the magnetism are thus at right angles and motion will be as explained—at right angles to both. The only direction which is at right angles to both arrows is straight up and down and that is the way the wire and the diaphragm moves.

Reversing the Wires

Notice that the arrows showing magnetism flow only in one direction, that is outward. Of course, if the polarity of the leads to the "A" battery were reversed, it would change the direction of these arrows to inward. However, that would not effect the operation of the instrument. At any given instant when, before reversing the leads, the diaphragm happened to move up it will now move down and vice versa. Naturally the exact direction cuts no figures as long as it keeps oscillating at any given speed. The arrows of current are shown double headed to indicate that it is not continuous but alternating in character. The reason it changes or reverses its direction is because the radio waves sent out by the sending station are alternating, and although the detector in the radio set reduces the speed of vibration from one million or so per second down to a few hundred (depending upon what tone is sung) still, it keeps the nature of the current unchanged, that is, alternating.

It is fortunate that the current through the vibrating wire does reverse in direction because from the description just given it will be clear that if *direct* current flowed in this wire it would react

Continued on Page 30

Some Sending Station Stories

SEEING RADIO WAVES

Radio is responsible for so many miracles these modern days that the public is ready to believe almost anything. Here's a tale from Pittsburgh that proves this statement:

It seems the star Venus is particularly bright every third year, and this happens to be the third year.

Many citizens of Pittsburgh, seeing the dazzling brightness of the star, could not believe that it was a natural phenomenon, but were convinced that it was an illuminating miracle being performed by engineers employed by the Westinghouse Company, whose main works are located just outside the city of Pittsburgh.

Many letters were written in to the company, and are still coming in, requesting information about the "electric star," for which they suspect the company of being responsible. In the letters it was hinted that the writers "could not be fooled, but knew that the Westinghouse Company was putting the star out every evening and taking it in in the morning." Some letter writers thought that the company had sent up a balloon five miles in the air with an electric star attached. Some even suggested that the brightness of the star was due, in some way, to radio waves emanating from KDKA. And, the strangest part of it all is that when the Company officials claim that nature is responsible for the brightness of Venus, and nothing else, the public is skeptical.

OPENING A BRIDGE

There seems to be no limit to the places where the all-hearing little microphone can penetrate, on land and sea, under the sea, or far aloft in the air. An announcement by the Secretary of the Delaware River Bridge Commission in Philadelphia states that on August 8th, the members of the Commission from the States of Pennsylvania and New Jersey celebrated the first actual linking of the two States by walking across the temporary footpath which had been built, high, high in the air, between the two great towers on either side of the river. Directly over the center of the teeming stream, at the point where the swaying narrow plank pathway dips lowest, Station WDAR, Philadelphia, had a microphone placed to broadcast a brief word from a member of the Commission, as they passed.

Thus radio fans everywhere could, in their imagination accompany the official party on this initial tour over the great bridge which will, upon its completion in 1926, be the longest single span suspension bridge in the world.

AND THE BASS SINGING BASS

The opening of the Young's Million Dollar Pier Studio in Atlantic City, which broadcasts by land wires through WDAR in Philadelphia every Friday evening, brought forth thousands of congratulatory letters from listeners-in. Among this lot were the usual comedy letters which help a studio director to enjoy life.

One fan wrote in to Captain Young, who is famous all up and down the coast as an expert on sea fishes, suggesting that he broadcast "the croaking of the croakers and the barking of the dog-fish."

MEASURING RADIO WITH A YARD STICK

The average radio fan has been given to understand that radio waves are intangible things that cannot be detected except by employing a very delicate receiving instrument. But Mr. S. Kruse, technical editor of QST, has used the methods first employed by the famous German experimenter, Heinrich Hertz, back in 1888, and has succeeded in measuring radio waves with a common yard-stick. His investigation was started by the ruling of the Department of Commerce, by which amateurs are permitted the use of short wave bands below 80 meters. The standard type of wavemeter commonly employed for such measurements has been found inaccurate for these very short waves, so he used an improved method.

This can best be illustrated by comparing the wave motions set up by an oscillator with the curves in a line of rope when one end is fixed and the other moved up and down with a steady motion of the hand. When two parallel wires are connected to the oscillator, or transmitter, and just the right tuning is obtained, the oscillations passing to and fro will build up one upon the other just as the curves in the piece of rope do when a regular motion is maintained, forming what is known as "standing waves." Fig. 1 shows three such waves, each 10 feet long in a 30-foot rope. The right point in the tuning can be detected by means of a neon-filled tube connected across the ends of the wires opposite the oscillator. Neon is one of the rare gases, found in small quantities in the air. The tube lights when the wire system and the oscillator are in resonance.

Now if a sliding "jumper," or piece of copper, is connected across the two parallel wires, in some places the tube will go out; in others, it will light. When the places where the tube continues to glow have all been located, they indicate the points of maximum voltage. The distance between them is equal to half a wave length. It is a simple matter then to estimate the length of the wave with a yard-stick or a meter rule. It is *half* and not a *whole* wave length, since it is only from a positive to a negative loop.

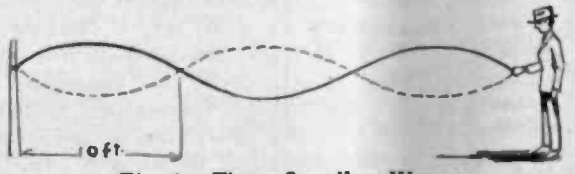


Fig. 1. Three Standing Waves

Rebroadcasting the Correct Time

Radio Helps You to Keep Your Watch Running True

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

AT five minutes of ten every night, Eastern Standard Time, or one hour later, if you happen to keep Daylight Saving Time, you hear the announcer say, "The program will be interrupted for five minutes while we relay the Arlington time signals." Then you hear the radio go tick-tick-tick, leaving out a few beats every once in so often, and finally, just on the hour, a dash is given. This is the correct time, exact to a fraction of a second. Very likely you are using this service to keep your watch running correctly, but do you know how it reaches you?

In the first place, in the United States Observatory at Georgetown, near Arlington, there is installed a clock which has every refinement to make it keep accurate time. It is corrected from time to time, as necessary from observations taken on the stars, so that it is always correct within less than one-half second. This is the standard for the

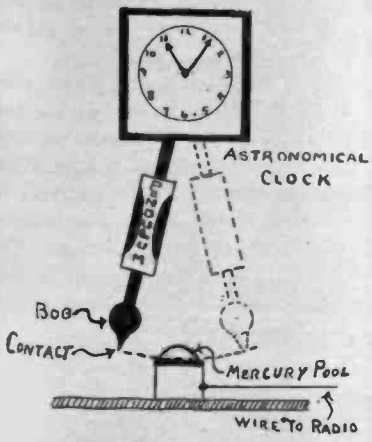


Fig. 1. Where the Ticking Starts

United States and probably for all of North America.

In a Pool of Mercury

Of course, it is no small achievement to construct a clock which is so accurate that the sun rises by it in the western hemisphere. However, after it is built, the radio problem is only just started. How are the signals to be sent out? Figure 1 gives a sketch of the method employed. The clock itself carries a massive pendulum, which oscillates back and forth once a second, that is—has a frequency of 30 cycles a minute. It is only 30 rather than 60 because you recall a "cycle" means a vibration back and forth, and this pendulum takes one second to go to the left and another to go to the right. The bottom of the pendulum bob carries a pointer with a contact on the end of it. This contact dips into a pool of mercury which is spaced so that it is under the exact center of the arc, through which the pendulum swings.

With this spacing, the contact touches the mercury pool once every second, first swinging one way and then the other. The clock itself is connected to a battery and the mercury pool has a wire running to the radio sending station. The result is that every second a contact is made and the current from the battery runs to the transmitting tube. This, o course, gives the tick-tick-tick which we hear over the radio.

Omitting Some Seconds

Inserted in series in the line is a timing contactor, which works on the principle illustrated in Figure 2. There is a drum which is driven by the clock itself and keeps exact time with it.

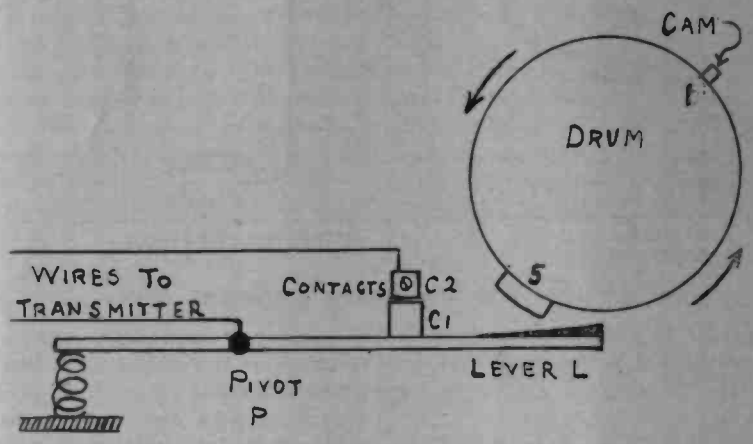


Fig. 2. How Certain Seconds Get Left Out

This drum carries two cams, 1 and 5, which project out a little bit from the surface. These cams strike the lever "L" below, which is pivoted at the point "P." The lever carries a contact, "C1," which connects with contact "C2." The drum revolves once a minute, as shown by the arrows. Since these two contacts are in a series with the transmitter circuit, then when they are closed the pendulum ticks off the seconds. But when the drum rotates so that cam 1 or cam 5 strikes lever "L," then the contacts are open and the ticking stops. Cam 1 is a short one and is arranged so that the contacts are open for only one second, while cam 5 is much longer and holds open the circuit for five seconds.

The timing of the drum is such that cam 1 operates at the 29th second, while cam 5 cuts out the 55th to 59th, inclusive. What we hear over the radio then is a series of impulses starting at the beginning of a minute and continuing to the 28th second. The 29th is omitted, and then, starting with the 30th, we hear

through the 54th. Leaving out 5, the minute starts again, etc., for 4 minutes. On the last minute before 10 o'clock a cam still longer than 5, but which is not shown in the diagram, holds open the circuit for 10 seconds. This is to let us know that it is the last minute, and then the dash comes exactly on the hour.

Why You Don't Hear Arlington

The Arlington time signals are sent out with a slow period of oscillation, which gives a wave length so long that ordinary radio sets cannot receive it. This would do the ordinary broadcast listener no good at all, so the wave length must be changed to get it within the 250 to 550 meter range of the ordinary sending station. Furthermore, the radio fans located in Central and Western United States would not be able to hear such a long distance unless their sets were unusually elaborate. That is why a good many broadcasters relay these time signals.

In relaying the signal it has to be picked up at the Arlington wave length and reradiated at the local length. To do this successfully was at first quite a problem for the engineers. The reason is illustrated in Figure 3. Here we have a receiving station at the left with aerial and set which is tuned to NAA (Arlington). Near by is the sending station (shown at the right). This would look like a simple proposition, but the trouble is that the waves sent out by the transmitter are so very close to the receiver that they are apt to make it oscillate, even though it is tuned for another wave length.

The Trouble in Re-Broadcasting

The diagram shows some of the waves from the transmitting aerial reaching

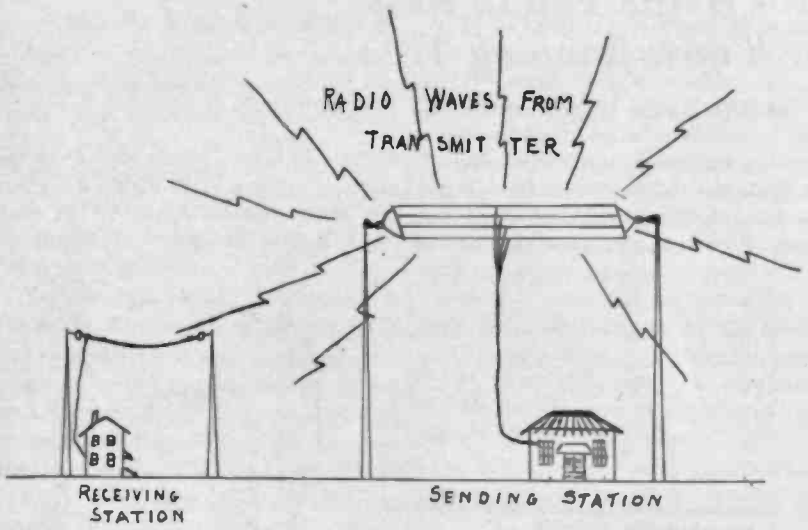


Fig. 3. Why it is Hard to Rebroadcast Well

the receiving antenna. If this action *should* occur it would result in the following operation: First, a wave would come from NAA and, striking the receiver, would be carried across the telephone line connecting the two to the transmitter, which would put the wave on the air. At the same instant this air wave would strike the receiving aerial and operate it again. It would again be carried over to the sending station and another aerial wave would result, which, going to the left, would keep on repeating the cycle indefinitely. As a result, when the first dot was received, the sending station would make a continuous dash of it, which would last all night.

If you have ever tried to operate a good radio set within a mile of a powerful station, you will know that it is almost impossible to tune out the local wave completely and still be able to pick up a station several hundred miles away. Perhaps you may be able to reduce the nearby music so low that you can hear the distant program very nicely through it. But this would not do at all for relaying. The local station must be absolutely silent in the receiver, or else it will send out a continuous dash, as just described. And remember further that the two stations are not a mile apart, but are both located on the same lot. That is what makes the problem so difficult.

As an illustration of the way this is worked out, observe Figure 4.

How WBZ Does It

Day in and day out Westinghouse Station WBZ is tuned out at a point in the same lot, almost directly underneath the antenna towers. This is the stunt which the operators perform successfully every day in the week. WBZ is tuned out by means of a special receiving equipment located in a small

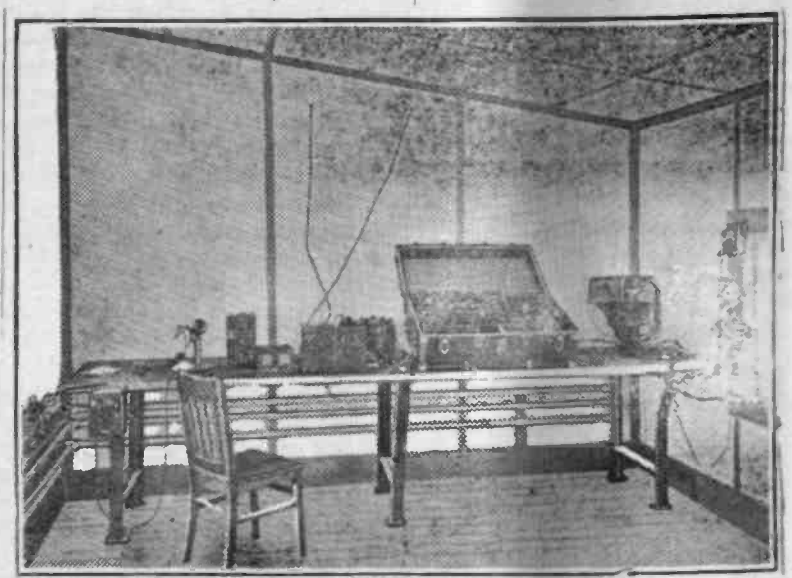


Fig. 4. Shielded Shack for Receiving—WBZ

(Continued on Page 12.)

Twin Coils Have No Fields

The Binocular Coil Has Many Advantages Over the Single Type

P. D. LOWELL, Research Engineer

HAVE you ever tried operating your set with the aerial disconnected? If a local station is running it is sometimes possible to get quite good results without any antenna. If you have been successful in this it is quite likely you have boasted to your friends what you can do. But perhaps it was not because your set was unusually good that this result was accomplished. Sometimes it shows poor construction to receive without an aerial.

If the reason that the station came in loudly was that the hookup was unusually sensitive, then it is all well and good. But many sets which are not particularly sensitive are still able to receive without the aerial. The reason is that the coils in the radio are acting like antennas themselves. This is not a good condition. The coils should have just as little external field as possible. That is, the magnetism from the coils should not effect outside apparatus, nor should the magnetism or waves from outside influence the coils. This can be seen by considering that if the aerial is tuned so that one station is coming in you naturally do not want your coils to be picking up anything else.

There is another objection to having magnetic action between the coils if you are using radio amplification.

The Binocular Coil

Various experimenters have been working on this problem. The laboratory of A. H. Grebe & Company (pronounced Gree-bee) has recently designed a new form of winding, which is called a binocular coil.

This form of inductance unit is composed of two long coils mounted closely together with the axes parallel and with the two windings connected in such a manner that their electro-magnetic fields are opposing each other. See Fig. 1.

This means that as soon as one coil of the unit starts to radiate a magnetic field, the other coil of the set at the same time radiates a magnetic field of equal intensity but of opposite direction and the two fields immediately counterbalance each other and the resulting effect becomes zero. It is called the "binocular coil" because of the similarity in appearance to the lens barrels of a field glass or binocular.

The great advantages in the use of such inductance units in the tuned stages of an amplifier are very apparent. The units may be mounted in almost any position with respect to one another and their location does not need to be as accurate as with the usual form of coils.

Magnetism is Balanced

Another advantage gained by using these "Binocular Coils" is due to the fact that they will not pick up radio signals as is usual with the ordinary cylindrical type of winding. Due to their novel construction any exterior electro-magnetic fields which strike the units is instantly balanced out and no e. m. f. (electro-motive force) is produced across the terminals of the inductance.

This will be explained in a few minutes. This feature becomes especially useful when a tuned stage amplifier is to be used within a few miles of a powerful transmitting station. With an amplifier using ordinary inductances, the coils themselves will actually pick up signals when they are loud enough. In a tuned stage amplifier it is undesirable that the coils of the intermediate stages shall pick up energy from a nearby interfering station, because this will cause an increase in interference. If one or more of the intermediate stages picks up any interfering signals, much selectivity is lost.

This undesirable phenomenon has been entirely eliminated by the use of the no-field inductance units in the tuned stages and so selectivity is maintained, even when the set is operated very close to a local station.

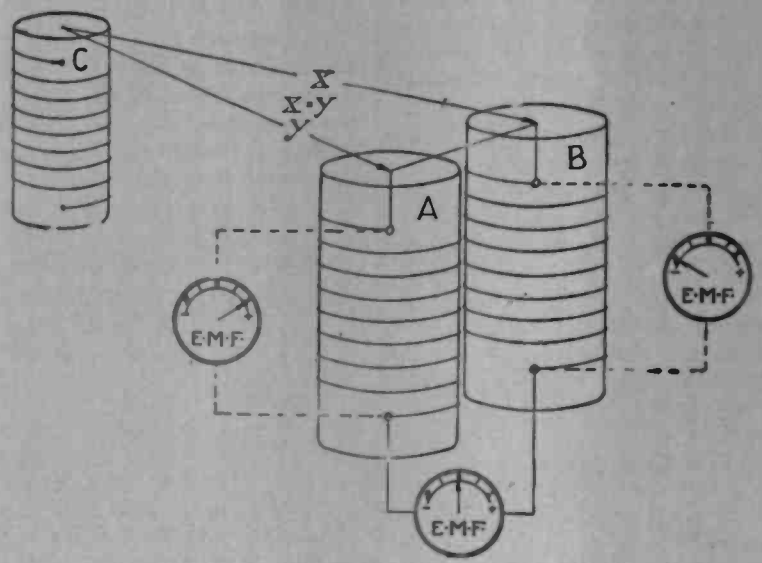


Fig. 1. Station C Does Not Bother Receiver A-B

(Continued on Page 12.)

COILS HAVE NO FIELD

(Continued from Page 11.)

Explaining This Action

The explanation of this action can be seen from Fig 1. The two parts of the binocular coils A and B are connected in series. When the current from the previous step is flowing through these coils, the magnetism at any instant will run up in one coil and down in the other. For this reason the lines of force will not branch out very far into space and so effect other coils.

Let us see what happens when a local broadcast station is going. Let this be represented by coil C which gives out magnetic waves at high frequency. These waves will travel from C along path Y and down A. Similar waves will go along X and down B. The effective terminals of the two coils are shown connected to the voltmeter seen at the bottom of the sketch. The voltage on the left hand meter is measured from the bottom of A to the top. It shows plus two units of voltage. The right hand meter across B gives the same voltage, that is, two, but it is minus, since it is measured from the top of B down. Then the total pressure across the two coils is from the bottom of A to the top, across the top of B and down, and this will be zero as shown by the center meter; that is, the plus two and the minus two added together gives zero. That is why the broadcasting station, although it may give out powerful waves, is unable to cause interference in these coils.

If Coils Are in Line

In diagram distance X is shown the same as Y. If the source of disturbance happened to be in line with the two coils, then one coil would be closer than the other, but if the station were say three miles away, then the distance to A would be three miles and to B three miles and two inches, which is so nearly the same that the magnetism through both coils would be just alike.

In designing and constructing a radio frequency amplifier having several tuned stages, it is extremely important that all magnetic induction between the coils of the various steps shall be eliminated, otherwise a feeding back of energy will occur, so causing the whole amplifier circuit to oscillate strongly. These oscillations, of course, are very objectionable, and an amplifier is entirely useless in this condition.

It has been customary, in order to reduce the magnetic induction between stages, to mount the coils in such a position that their axes are at right angles with one another. This method is satisfactory, provided that they are really positioned at exactly the 90° angle.

Hard to Get Exact

It is very clear, however, that this would be a difficult practice to follow, since the slightest variation from the 90° angle will cause instability in the operation of the receiving apparatus. The same reasoning holds true for any method where the axes of the coils must be at a certain definite angle with respect to one another in order that the magnetic effect shall be reduced. The binocular coil avoids these difficulties.

REBROADCASTING THE TIME

(Continued from Page 10.)

radio shack in an out-of-the-way position on the Westinghouse grounds at East Springfield, not more than 1000 feet from the building on which the antenna towers are built.

The radio shack is an interesting story in itself. It is but a small wooden affair, not more than eight feet high. It is located out on the easterly side of the yard, removed from any of the other buildings. Inside the shack is the special receiving equipment and apparatus used in rebroadcasting the short meter pickups from KDKA at Pittsburg. This enables WBZ to relay any especially good programs which may be coming from the former station. The time signals, so important to the farmers, are received from Arlington in this shack and sent to the broadcasting station on the roof of a building 1000 feet away by means of a lead-covered cable. This operation is performed twice daily, once at 11:55 a. m. and again at 9:55 p. m., eastern standard time.

Shielding the Trunk

The special receiving apparatus shows up well in Figure 4. The special trunk in which the equipment is placed was propped up to allow a better picture. The trunk contains the receiving apparatus, the amplifiers, and all the batteries. Everything in the trunk is shielded and there are no leads outside to pick up the energy from the station. The trunk is copper lined and also grounded to prevent any pickup from the station antenna.

Beside the trunk are to be seen the two wave traps which tune out WBZ while the Arlington signals are being picked up. These are highly efficient, low-loss traps. Two must be used because the signal sent out by Westinghouse WBZ is so tremendous. All of the equipment in the shack has been installed so that not the slightest interference from the station itself is experienced. If the receiver were not shielded, as described above, it would act as antenna and get a pickup from the station.

Further assurance against station interference is the reason for placing the shack out in the yard, some distance from the antenna towers. The aerial for the Arlington receiver is 50 feet long and 20 feet above the ground. The fact that it is so short and low improves its selectivity.

Two telephones are in the shack for communication with the studio, as well as a loud speaker to enable the operator to tell if everything is working right.

No Man to Work It

The Arlington receiver is automatically controlled from the station itself. When the switches on the station control board are operated, the necessary relays in the receiving shack are closed and the shack equipment is put in operation. This automatic control from the station removes the necessity of having an operator present in the shack every time the Arlington time signals are rebroadcast.

In the other end of the room is the equipment for short wave reception from Westinghouse Station KDKA at Pittsburg. The programs from Pittsburg are sent out on a wave of 68 meters. The short-wave apparatus picks it up and sends it into the station for rebroadcast.

It is surprising how few amateurs and radio fans appreciate that a sending station is picking up the time signals from Arlington at the same time that it is rebroadcasting them, and that in spite of this simultaneous operation, with the receiving set right under the towers, no interference is experienced.

Giving Horsepower to the Voice

Everybody On Earth Couldn't Yell As Loud As One Station

By ALFRED N. GOLDSMITH, B. S., PHD.,

Fellow, I. R. E., Director of Research Radio Corporation of America

A BROADCASTING station is roughly a one-horse-power voice. This novel but correct way of regarding a radio transmitter is justified by the amount of power which leaves the aerial wires of the station to be picked up in millions of homes. It might be added that one-horse-power is used in lifting half a ton from the ground to the top of a 33-foot building in one minute, and that one-horse-power therefore, is a fairly considerable amount of power.

We usually use another unit of power in speaking of broadcasting stations, that is, the "watt." It takes slightly less than 750 watts (746 to be exact) to make a horse power; the average highgrade broadcasting station sends out a power of between 500 and 1,000 watts. The energy sent out from the broadcasting station travels in all directions and is, in part, picked up by a myriad of receiving sets. It is much more than ample to feed all the radios within its range, considering the fact that modern sets strengthen the signals they receive by power from local batteries to an enormous extent, and so require very little power to feed them.

100,000,000 Yells Per Watt

To go back to broadcasting speech—it is probable that in no other case is anything strengthened to the same extent as the voice of man in a broadcasting station. Careful measurements have indicated that the power of the human voice, in loud speech or song, is only about one hundred-millionth of a watt. Yet this incredibly tiny amount of power is sufficient to be heard by the ear for a few hundred feet. The ear is therefore a most sensitive instrument and, in fact is about as sensitive as the eye itself so far as the amount of power required to give a definite sensation is concerned.

But in radio broadcasting we want to extend the range of the voice of man from a few hundred feet to hundreds or even thousands of miles. So that we have to produce an approximate "one horsepower voice," or, as it is more usually called, a 500-watt transmitting station. It must be considered that this means that we have to increase the power of the human voice over fifty billion (50,000,000,000) times. In other words, if everyone on earth were to get together in one room and shout at once, the voice power produced would still fall far short of the strength of the voice of a broadcasting station. In fact, the world's call would be only about one-

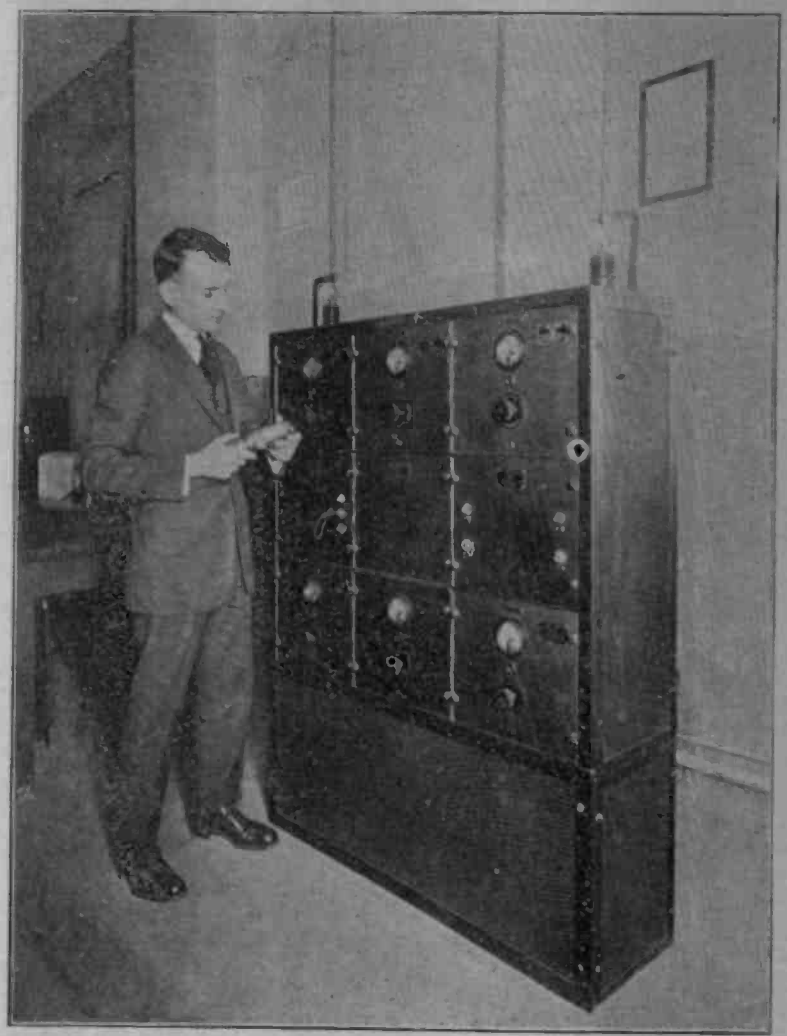


Fig. 1. Amplifying Panels with 50 Watt Tubes

thirtieth as strong as that of the broadcaster. It is little wonder, therefore, that sending stations can be heard so far under favorable conditions. Good conditions are obtained, naturally, when the night is "electrically silent"; that is, free from electrical disturbances or static which cause noises or crackling sounds in the receiver and thus prevent hearing clearly the distant call of the transmitting station. So we are quite literally justified in calling radio broadcasting "the voice of the world."

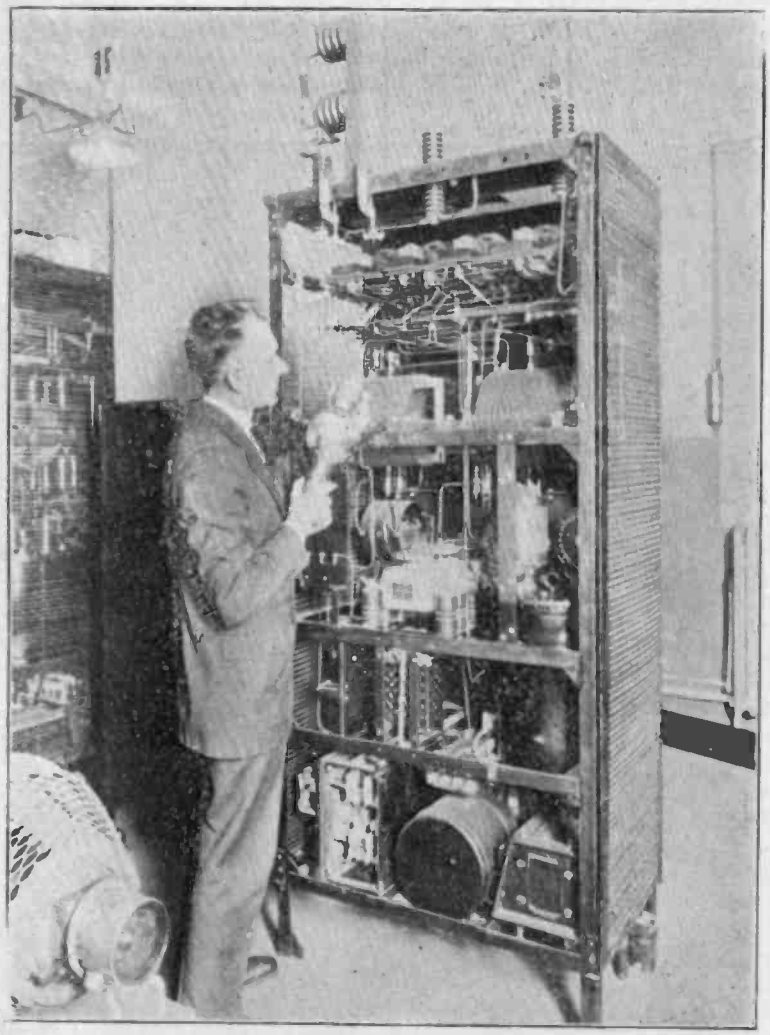


Fig. 2. Mounting of Four 250 Watt Tubes

Sixteen Centuries to Get There

Another way of getting at least some idea of how much the voice must be strengthened in a broadcasting station, is by considering how long it would take to pile up the necessary power out of units made up from the strength of the individual voice. Suppose that a man added the power of one human voice to his own voice every second, and that this addition of one voice per second were carried on day and night without stopping, month after month, and year after year. Suppose, too, that the descendants of this man continued the apparently endless task of piling up a voice as strong as that of a broadcasting station from feeble individual ones. Sixteen centuries would have come and gone before their long task would have been completed.

This modern miracle of science is accomplished instantaneously, however, through the powerful agency of the vacuum tube, which as is now so well-known, is a remarkable amplifier. It is not accomplished all in one radiotron, but generally in five or ten of these tubes and sometimes as many as fifteen of them. Each radiotron proportionately increases the power that is poured into it, until the final tubes give the full power.

Do Not Start With Power Tubes

The systematic amplification of the voice starts with some low power radiotrons, such as the Model UV-201-A tubes of which as many as twelve, or as few as three, may be used depending on conditions. From these are fed the more powerful UV-202 vacuum tubes, which give an output of five watts each. The power of the voice, now enormously increased, passes into 50-watt radiotrons, such as the model UV-203 tubes, and finally into the so-called "power tubes" of the Model UV-204 variety, each of which actually has an output of 250 watts. It will be seen that a graded series of tubes is used since it would be uneconomical to use power tubes at the beginning of the amplification where only small amounts of energy have to be handled. The power radiotrons are used only toward the end of the amplification where the power has already been raised to very considerable magnitudes.

A portion of this amplifying equipment is illustrated in the first photograph, which includes the 50-watt radiotrons of one of the "power amplifiers" in the transmitter room of Stations WJY and WJZ, of the Radio Corporation of America at Aeolian Hall, New York. It really consists of two such amplifiers, one on the top row and one on the bottom row of the panel, and with suitable equipment in the middle, so that either amplifier can be used as desired, thus avoiding the danger of stopping the service if a tube burns out. Each of the amplifiers contains three of the 50-watt radiotrons.

Every Part is Doubled

Four of the 250-watt radiotrons in the final amplifier of Station WRC of the Radio Corporation at Washington, D. C., are shown in their mounting at the top of the transmitter in an accompanying photograph, Figure 2. The tubes are held in a spring-supported mounting to protect them from shock. In addition, the entire transmitter is

(Continued on Page 18.)

New Kinks in a Neutrodyne

How to Get the Most Out of a Bought or Built Set

By LESLIE R. JONES

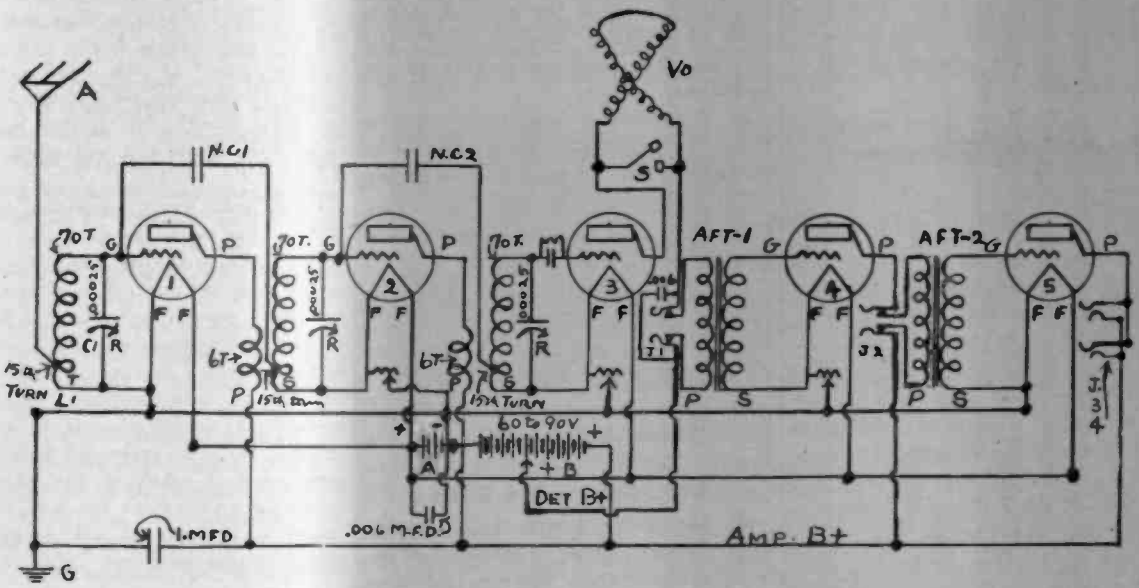


Fig. 1. Hook Up of Set. Note Plate Variometer, VO.

AFTER considerable expense and experimenting I have adopted the neutrodyne as being truly a most remarkable receiver. Probably no other radio except the Super-Heterodyne can excel its ease of tuning, reliability and exceptionally smooth tone. The hook-up of my present set is shown in figure 1, which gives the constants and details of the circuit.

A few changes in the conventional Neutrodyne hook-up will be discussed which, I believe, have added materially to the success of my set. The major difficulties which many fans have encountered are mentioned and positive remedies given in each case to correct these troubles. As happens with other types of receivers, so it is with the Neutrodyne, some sets work very much better than others, and for good reasons. These will be explained in the course of this article. Only the highest grade of parts and workmanship should be used if the best results are expected.

The following notes on the details of construction and operation are given to assist those who have tackled the Neutrodyne and found difficulties in getting the set to work right.

Selecting Coils and Condensers

First, let us consider the design of the Radio Frequency Transformers, or Neutroformers, as they are called. After trying several different windings on the secondaries I finally used a coil of 70 turns on a 3-inch bakelite tube. With a variable 11 plate condenser having a capacity of .00025 mfd. a range of from about 250 to over 600 meters will be obtained. I believe that this combination is more efficient than using a smaller coil and a larger condenser, say .0005 mfd. to reach the higher wave lengths. The former method keeps the capacity in the secondary circuits small in value, and insures high selectivity, which is very desirable. If lower lengths are desired fewer turns should be used. The tap for the neutralizing condenser is taken at the 15th turn.

A primary winding of 6 turns was found to give excellent results and the turn ratio of about 12 to 1 (70 to 6) will not be too high if care is taken in the layout of the parts and the wiring. In some cases small shields may be needed between adjacent condensers and also between the neutroformers if proper neutralization is to be obtained. However, these shields should be kept small or they will have a deadening effect upon the action of the set. I have not found it necessary to employ a panel shield, altho I have used small ones between stages. Everything depends upon the wiring of the set and unless extreme care is exercised at this point neutralization may be next to imposible without over-shielding the set.

Three Filter Circuits

Let us consider the operation of the three grid circuits in the radio-frequency transformer group. These three circuits are really filters and work on the resonance principle. Suppose an alternating E. M. F. (electro motive force) is impressed across the terminals A and G

by the aerial and ground, and let us assume that this voltage is one of 400 meter wavelength, that is, having a speed of vibration of 750 kilocycles. Then the maximum amount of energy will not be impressed upon the grid, G, unless the coil, L, and the condenser, C, are tuned to the wavelength of this input E. M. F. In other words, when the inductance of the coil and the capacity of the condenser balance each other properly in each of these grid circuits, then their reactance will be zero, and the greatest amount of current will flow.

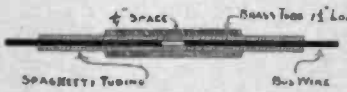


Fig. 2. Spaghetti in Condenser

From this discussion it is seen that frequencies or wavelengths other than that one to which the circuit is tuned, will meet with more obstruction and will be effectually tuned out by the filtering action of these wave trap circuits. The more marked this filtering action, the greater will be the selectivity. It should be realized, therefore, that the more efficient these Radio-Frequency Transformer Units are, the smaller will be the losses and the sharper the tuning. Also, the amount of energy transferred from one stage to the next will be at its maximum value. And the reactance of the circuits to all other frequencies will be greatest and so the interference from other stations will be eliminated to a large extent. This applies particularly to nearby stations.

Eleven Losses

In badly designed Neutrodynes the selectivity is quite poor and losses may be traced to several sources, namely:

1. Parallel Grid and plate wires. This will cause reaction from the output to the input side and will make a disturbance something like cross talk in a telephone line.

2. Dielectric losses. These occur if the insulation is poor at any place. For instance a fibre panel would cause large dielectric losses.

3. Condenser losses. If the condensers are made of poor materials, particularly the insulation of the end plates, then we must expect that the program will not be as loud as it should.

4. Long grid wires. This increases the undesirable capacity of the tubes and prevents reaching as low a wave length as could otherwise be obtained.

5. Magnetic coupling between neutroformers. This is apt to cause the tubes to oscillate and so to squeal.

6. Capacity coupling between condensers. The same general effects are caused as by magnetic coupling. Oscillating tubes can not be properly tuned.

7. Poorly designed sockets. Considerable losses occur in the bases of sockets made of so called "moulded mud". Use only Bakelite, porcelain sockets, or the equivalent.

8. Poor soldered connections and loose nuts. This increases the resistance of the connections and broadens the tuning.

9. Corrosion of soldered connections. Even before they are eaten off completely they cause a loss of energy.

10. Distributed capacity in the transformers and wiring. Instead of tuning sharply to one wave length it makes the set respond to a number.

11. Improper neutralization. Squeals and interference are evident in such cases.

Look Out for Bad Tubes

As the audio frequency amplifying units are much easier to construct or assemble, little stress will be laid upon this section of the set with the exception of a few general notes and remarks. Occasionally a defective tube will be the cause of more or less trouble, poor batteries do the same, but no one can expect success with any kind of receiver which has these deficiencies.

After considerable experimenting as to the proper adjustment for the neutralizing condensers I have found that the point just below complete neutralization is much better than any other. At this point the selectivity is greater than at other adjustments of neutralization in most of these sets. However, if the tuning is too sharp for comfortable operation in this condition, it can be easily remedied by simply adjusting the neutralizing condensers nearer to complete neutralization. Also, if the capacity coupling of the tubes is properly balanced out, a little inductive feedback or coupling between neutroformers will not do any harm. In fact, it sometimes aids things considerably. Of course, judgment must be used so as to not exceed the point where regeneration would be uncontrollable.

Results from Regeneration

The way it works is this: When the neutralization is complete, then the set may be compared to a non-regenerative ordinary hook-up. Such a set will have a very good tone and will be excellent in quality, but will not pick up anything like as great distances as it will when it regenerates. In the latter condition, however, there is danger of increasing the feedback so much that howling and squealing is heard. This is an extreme case. If the tickler coil is turned too far, but not enough actually to squeal, it will still destroy the clear tone of the music and will cause distortion.

In the same way a completely neutralized set has no feedback at all. An ordinary radio frequency amplifier will go to the other extreme. The various tubes will have enough action on each other so that oscillations will start and distort the music. Loudness will be there, but smooth tone missing. The happy medium in neutralizing is to get the benefits of both systems. This is accomplished by shifting the adjustable condenser away from the zero position enough so that the set is no longer completely neutralized, but allows a little

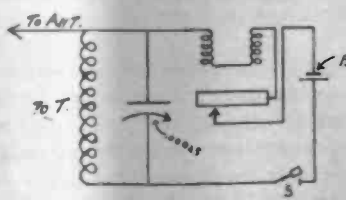


Fig. 3. Buzzer Used as Exciter

bit of feedback. In such a case the music is louder than before, and yet if the condenser is not shifted too much, the tone will still be smooth and undistorted. It is not always an easy matter to get the right setting on the condensers, but by trying out different positions and using your ear as a judge, you will shortly get the hang of it and be able to get a good setting.

Coils at 60 Degrees

Neutroformers should be mounted about six inches apart, center to center, and at an angle with the base board of about sixty degrees. Where shields are used, this angle is not very critical, a slight error either way being permissible.

A lot has been written on methods to tell whether or not your receiver is prop-

erly neutralized. But let me say right here that there is only one sure way and that is to use an exciter of some sort by which a high frequency oscillation may be introduced into the radio for this purpose. Unless this method is employed, it may be found next to impossible to get the set to work properly. A circuit which gives good results for this operation is shown in figure 2. The buzzer should be adjusted to give a high pitched note, and if care is taken to select a combination of coil and fixed condenser, (Micadon type), that will tune to a wave length of approximately 300 meters, it is not necessary to use a variable condenser as the fine tuning to resonance should be done at the set while neutralization is in process. Fig. 2 shows the connections for using this buzzer for an exciter.

Spaghetti in the Condenser

For neutralization condensers, I have found that a piece of spaghetti tubing, over which a brass tube is slipped, is quite good for all practical purposes.

While the spaghetti might absorb a little moisture in the damp weather, I do not believe it will be noticeable in its effect on the operation of the set. Fig. 3 shows the constructional details for making these neutralizing condensers. These are quite inexpensive and as sometimes it is necessary to try several different sizes and capacities before success is to be had, a little economy at this point can be easily effected.

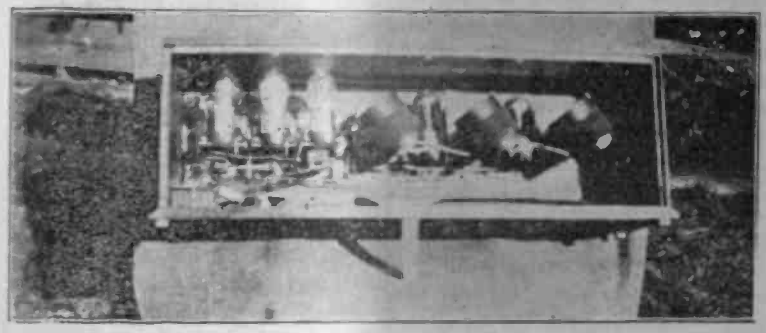


Fig. 5. Back Removed to Show Insides

To neutralize, connect A in Fig. 2 to the antenna post. Connect the ground wire to the ground post as usual. Light all the tubes to their operating brilliancy and adjust the detector tube to the proper point for receiving. After adjusting dials for maximum signal intensity for the oscillations from the buzzer circuit, (the dials should now read about 15 degrees or so), take out the first radio frequency tube, (tube No. 1), and insulate one filament prong, not both, with a piece of paper so that upon replacing the tube the filament will not light, but the grid and plate prongs are in contact as usual. Now adjust the first neutralizing condenser, NC-1, so that the buzzer oscillations will be entirely or nearly tuned out. Two stages of audio amplification should be used for this test. Now remove tube No. 1 and replace it again with the two filament prongs in contact as in actual use. The buzzer signals will now be heard again full strength. Then carefully reline the dials again for maximum signal strength from buzzer. Now duplicate exactly upon tube 2 the details of adjustment for tube No. 1.

It is generally best to go over this process two or three times. The set is now ready to be tested by the actual receiving of broadcast stations. If the radio is as sensitive as it ought to be when working properly, stations within a radius of fifty miles or so should be received without any aerial whatever in broad daylight. If you are not satisfied that it is as sensitive as it should be, try readjusting the neutralizing condensers so they will be just beyond the point where the buzzer signals vanish completely. This should change matters considerably, but if this fails, the trouble should be looked for elsewhere. Generally a slight change in the setting of these condensers will effect the dial reading a few degrees.

After the set is neutralized to your satisfaction, then it is necessary to line up the dials so that they will all read alike. As a general thing it is impossible to get three condensers which will be identical all through their range, and in the same way three coils, although they look just alike, will usually have small differences in inductance. The combination of coil and condenser is somewhat variable for this reason. That means that if all three neutroformers are set at 50 say, to bring in a station of around 380 meters or so, then they will not necessarily all read the same value when turned to say 80 or 15. In general some one dial will have to be moved a little bit more or less than the others.

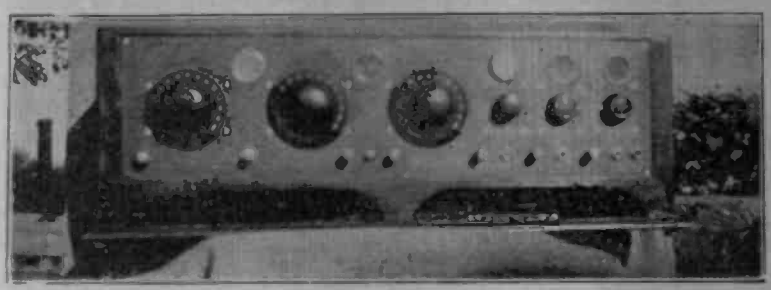


Fig. 4. Symmetrical Appearance is Good

The best way to take care of this small defect is to tune to some station which comes in around the middle of your dials. Turn each of the three knobs to get the sharpest tuning on this particular station, then loosen the screws which hold the dial to the shaft and shift the dial without turning the shaft until all three dials read exactly alike. The screws may now be tightened and the set returned for the same station. If this operation has been done right each of the three readings will still be exactly the same. If you are in luck the readings will stick together through the entire range of broadcast stations, but such a case is a little unusual. Discrepancies of two or three degrees between dials are not regarded as being at all bad.

Lining Up the Dials

The lining up of the dials is quite important, especially if the set is sharp tuning, to make easy the location of various stations without much fishing around. If a critical detector is used, such as a UV-200, do not think that your set is oscillating improperly or that it is not correctly neutralized, if oscillations are heard in the phones at certain settings. Especially when the variometer is used to control regeneration, this state of detector oscillation will be noticed. Of course, the most sensitive setting for the detector is just before it breaks into oscillation.

I have incorporated the use of regeneration, which is made optional by the switch (S), which cuts in or out the plate variometer. While regeneration is not needed ordinarily, I have found its use to be a benefit in receiving long distances, especially at the longer wave lengths. This may sound strange as regeneration is often considered a greater factor at lower wave lengths, but careful experimentation has convinced me that my neutrodyne, and most that I have seen, have operated more efficiently on a lower wave-length. The aid of regeneration on higher wave-lengths is a useful factor as it tends to make up this loss in efficiency.

Filament Control May be Used

As to filament control, any one of the usual schemes may be employed. In the hook-up only three rheostats are shown and the first and last tubes do not illustrate any control, to simplify the wiring diagram. As a matter of fact, it is customary to connect the two radio amplifiers to one rheostat, the two audio to a second, and use a third to operate the detector tube alone. The complicated form of jacks which come with the standard neutrodyne sets has no advantages over the simpler styles.

For tubes, 201-A and 301-A's may be used throughout, but where improvement is desired, the combination of four hard tubes (UV 201-A) for amplifiers and a soft tube (UV 200) for detector, is the best I have been able to find. A soft detector, such as a UV 200, is by far the best. The 216-A tubes may be tried; for pure reception and heavy volume, they are unsurpassed, even on a B battery voltage of only 90 volts. Of course, unless one has a rectifier with which to charge his battery when necessary, these larger tubes may be prohibitive.

It is Well to Include "C" Battery

To insure pure reproduction a "C" battery should be used and the proper bias in this way applied to the grids of the amplifier tubes in the usual way.

Another very important feature is the aerial. If selectivity is to be maintained, an aerial much longer than 80 feet should not be used.

Needless to say that a good ground is just as important as a proper aerial to get the distant stations clearly. Grounding to a cold water pipe is considered the best practice.

If these suggestions are followed out, your neutrodyne will certainly repay you for your trouble. Certain difficulties which arise from errors in constructional and neutralizing details have been covered and a positive method given to correct each of them. As has been said before, the neutrodyne receiver is hard to beat when reliability and simplicity of operation is considered, and if stations are logged, resetting to the same dial readings will bring in the desired stations with unusual faithfulness.

GIVING HORSEPOWER

(Continued from Page 14.)

every station of the Radio Corporation is provided in duplicate to prevent breakdowns from affecting the service.

The control room amplifiers which contain the lower power radiotrons were shown in an earlier article on "Picking Up Popular Programs," in the August 15 issue of RADIO PROGRESS, and really resemble the "power amplifiers" closely in appearance.

Each of these amplifiers requires considerable personal supervision to make sure that all power supplies are in perfect condition, that the tubes are working perfectly, and that the amplification which is being used is sufficient and suited to the purpose. Special attendants are therefore required, making another link in the long chain of individuals who make reliable broadcasting service possible.

The Condenser Transmitter

There is one case of amplification of power in broadcasting which goes even further in increasing power than in the case mentioned in the previous description. This is when a "condenser transmitter" is used for picking up the concert. It so happens that the condenser transmitter can be made to give unusually excellent quality of reproduction and is therefore used at times. It requires, however, far more amplification than the usual carbon transmitter or microphone, because of its construction and method of use. In fact, instead of requiring the usual amplification of the transmitter power of fifty billion times, it requires millions of times more amplification even than this. This means that still more radiotrons must be used, and that amplifications running into trillions or quadrillions of times are required. But the mind cannot follow or appreciate the meaning of such huge quantities, and so it is not worth while to say more than that a scientific feat in voice amplification far surpassing the wildest dreams of twenty years ago is thus daily accomplished for the entertainment of the broadcast listener.

LEARN ABOUT BATTERIES FREE

"The Proper Use and Care of Radio Storage Batteries" is the title of a booklet just off the press. While the booklet is written around radio batteries, the information contained in it is applicable to any lead-acid storage battery.

The text contains valuable hints and directions on the use and care of this type of battery as well as diagrams on the proper method of hooking them up, taking off detector voltages and tapping for "C" battery voltages. This booklet may be had free at any Willard service station or by writing the Willard Storage Battery Company at Cleveland, O.

SPANISH SPANS AMERICA

Some months ago the Westinghouse Company broadcast the first concert from its station in a language other than English for the benefit of the Latin inhabitants of South America. Spanish compositions were selected for the program and the concert was rebroadcast through the Westinghouse station at Hastings, Neb., KFKX, so that the signals would reach the most remote corners of South America. Hundreds of letters were received from Cuba, Mexico and the South American countries emphasizing the enthusiasm with which the radio concert was received and requesting that these concerts be continued.

MacMillan's Maine Story

Fans Are Interested in the Tales of Radio He Will Tell

ON several different occasions the people of Wiscasset, a little community in Maine, have witnessed the arrival of Captain Donald B. MacMillan from his dangerous missions in the Arctic with a deep personal interest in the success of the undertakings. Huge throngs of visitors from far and near, moved by feelings of curiosity or a sense of novelty, have been present at the local dock to see MacMillan step ashore. But the natives of this town and those of Freeport, MacMillan's birthplace, have been on hand for the purpose of welcoming an old friend.

This month, probably about the 20th, these Maine folks, including several of the real old-timers, who have known the explorer since he was a boy, will again turn out to show the traveller that Maine has lost none of its hospitality in the fifteen months that have passed since the "Bowdoin" disappeared from view. However, there will be a big difference this time. Much of the worry that has accompanied his previous expeditions will have disappeared and the home-coming will be one of 100 per cent. joy, for radio will bring advance tidings of conditions on board long before the ship's masts appear in sight of the landing.

A Radio on the Dock

There will be much less to tell when the crew piles ashore, for radio, like a reliable messenger, will have flashed the good news, including personal greetings from those on board to relatives at home, while the ship is yet off Labrador. By special arrangement of the American Radio Relay League, (the amateur radio organization that has handled all communication with MacMillan), F. H. Schnell, traffic manager, will install a radio transmitter and receiving station near the local dock.

This equipment has been transported by automobile from the headquarters of the A. R. R. L. at Hartford, Conn., and will be in readiness for the receipt and delivery of messages to and from the "Bowdoin" by the middle of this month. "1MO" will be the station's call. As soon as the transmitter has been set up, Mr. Schnell will call WNP, the explorer's station, and advise Donald Mix, the radio operator, that he is ready to receive any amount of messages through 1MO. A schedule will then be arranged for regular radio communication at specified hours.

Dark Tales to Unfold

And then from the "Bowdoin's" cabin, where the crew has been confined for long months of utter darkness, will come the thrilling story of the hardships and adventures that to MacMillan already are matters of history. Recent messages have informed a watchful world that the crew have come through unscathed, but there are, of course, many intimate accounts of happenings that will be awaited with interest.

Many friends of MacMillan's crew, of which there are a great number in this section, are already preparing messages which they hope will be sent to the ship through this station. Some have never seen an amateur transmitter and they are following every move of the installation. Others are more anxious to hear some word from WNP.

With this single exception, there is scarcely any sign as yet of the preparations for the explorer's welcome. While the townspeople can be expected to take the arrival philosophically, they are fully aware of the widespread interest in the event and never fail in their hospitality in behalf of the thousands who are on hand to witness the return of each expedition to the polar regions.

Meanwhile there is considerable speculation as to what MacMillan will bring back with him. It was recalled that a motion picture camera was included as a part of his equipment and some of the Maine folk have suggested that the explorer may have taken photographs of the Eskimos listening to the white man's radio music. The imagination rather tingles at the thought of seeing their reaction to the latest product of science.

Perhaps they have forgotten that the Eskimos have already been made acquainted with the "canned music" of the phonograph and it may take a great deal of persuasion to prove that radio is not more of the same kind of "medicine." They are said to have marvelous mechanical skill and MacMillan has told how easily they were able to take a rifle apart and put it together. He attributed the feat to their wonderful memories.

It is confidently expected that in these radio dispatches, Captain MacMillan will describe the results of the scientific investigations which were his main reasons for making the trip. He may tell about his observations of glaciers, which he said at one time were moving southward threatening another ice age. A number of scientists are awaiting his report on the effects of atmospheric electricity and the earth's magnetism.

What Has Already Been Done

Whatever may be the import of these things to the scientific world, Captain MacMillan with the help of Donald Mix, the radio operator selected by the American Radio Relay League, has already accomplished one feat of very great importance. He has proved to every one the value of radio as a practical aid to explorers. He has demonstrated its importance as a psychological relief to men who must be cut off from association with their fellows and its efficiency as a direct means of contact with civilization.

Never again will an explorer, wherever he may be bound, feel that for the duration of the journey contact with home is lost.

American Radio Relay League

New York Amateurs Form Division

The Second District Executive Radio Council has just been advised by the A. R. R. L. that its efforts have been rewarded. They aimed to have a separate traffic division to include the entire second radio district. This plan has been officially approved at a recent Board of Directors meeting of the League. This is the result of several months of discussion and work by the council on behalf of the amateurs of the Second District, which it represents, to secure their own traffic and League organization.

Until now, the second district was a part of the Atlantic Division and had no official vote in the A. R. R. L. With the formation of the new division, however, amateurs of this district will run their own league.

The name "Hudson Division" has been given to this new unit, which went into operation on the first of September. This is the first time since the organization of the League that such a change in geographical division formation has been undertaken. The new manager will be announced later.

OHIO'S FANS WIDE AWAKE

Radio amateurs of all states will be welcomed in Cincinnati, Ohio, September 26-28 for the Ohio State A. R. R. L. Convention to be held under the auspices of the Union Central Radio Association, the leading amateur organization of this section. The Hotel Gibson will be headquarters for the convention.

Although the program has been arranged especially for amateur radio telegraph operators, the doors will be wide open to those interested in any phase of radio communication. In addition to the usual features of entertainment, there will be a number of technical lectures. These are sure to be helpful to those who want to advance their knowledge of the most recent developments.

New Bands Explained by Schnell

Amateur radio advancement, as well as recent activities of the American Radio Relay League will be discussed by F. H. Schnell, traffic manager, A. R. R. L., and A. A. Hebert, treasurer and field secretary. Mr. Schnell is expected to talk on the recent assignment of special short wave amateur bands and their use in connection with long distance amateur communications.

A number of important technical talks will be given by Professor Osterbrook of the University of Cincinnati. Arrangements have been made for the issuing of amateur licenses and government examination can be taken while the convention is in progress. Visitors will be permitted to take specially conducted trips to station WSAI and the best amateur installations in this section.

The radio station of the Union Central, call 8ARS, will be in readiness for all visiting amateurs to operate if they wish to communicate with stations in their home city.

FINLAND FOND OF FANS

There is a growing interest among radio amateurs of this country in private radio telegraph communication with operators in Denmark, Holland, Luxembourg and France. Leo Lindell, who is the owner of the local ameteur station 1NA and 2NA, has been heard in all of these places with unusual success. He is one of the directors of a Finnish amateur radio relay association, which is actively engaged in promoting the idea of international code communication.

For a small country, Finland has taken a most friendly interest in the welfare of its amateurs and the government has allotted them a maximum transmitting wavelength of 300 meters, and a power range of from 5 to 20 watts, depending on the nearness of the amateurs to the high power government transmitting stations. The use of the maximum amount of power is limited to the continuous wave sets.

Like the American League

Under the guidance of the amateur relay association, which is patterned somewhat on the organization of the American Radio Relay League, of the United States and Canada,, Territorial radio divisions have been assigned throughout the country and traffic routes suggested to help the handling of private amateur radiograms.

With about 150 amateur sending stations on the air at present and a number of others under construction for the fall season, it is thought that amateur radio activities in Finland will compare favorably with those in the larger countries in Europe, some of which have been much more slow to appreciate the advantages of having a body of trained radio men amoung their citizens. Finland is determined to develop the transmitting art to its utmost.

HELPING THE SANATORIUMS

Physicians and patients are agreed that radio broadcasting is doing much to relieve the monotonous hours of sanatorium treatment and by so doing, is to some extent aiding treatment. Recent letters from the Central Maine Sanatorium at Fairfield, Maine and the Pine Crest Sanatorium at Salisbury Center, N. Y., indicate that both of these institutions have gone to considerable expense to provide radio reception for all the patients.

At the Central Maine Sanatorium, Fred Soucie, the operator, reports that 126 head phones are connected to a central receiving set enabling all the patients, even in isolated buildings to hear distant stations. Over 2,000 feet of wire were required to make the installation. By means of a switchboard the operator may switch off any building he desires. In addition there is a microphone by means of which a member of the hospital staff may address all the patients at one time—in other words the hospital has its own broadcasting station within the limits of its buildings.

Pine Crest Sanatorium is the Herkimer County tuberculosis hospital. There are seventy beds. For the past two years, entertainment was received through a radio set installed in the main dining hall but many of the patients were unable to hear the radio music. Recently headphones have been provided for each patient and the receiving set is connected to all rooms and the open wards. Dr. V. M. Parkinson, the superintendent, reports that all the patients enjoy the radio.

A Real Sending Station on Wheels

How WJAZ Pulled Up Stakes and Hit the Highway

A VERY unusual event took place recently when a big metropolitan broadcasting station was sold by one of the foremost radio corporations. It was sold because the station jammed the air to such an extent as to prevent listeners within its vicinity from hearing any other stations. That not only showed a fine spirit, but was highly significant in a radio sense. It probably started a new era in broadcasting. Very likely it began the movement of having broadcasting stations located away from the big cities.

This unexpected policy was announced by the Zenith Radio Corporation, when it sold the well-known station WJAZ, then located on the Edgewater Beach Hotel, Chicago. Because of the tremendous interference caused by this broadcaster along the entire North Shore, the company decided to build a new station far enough away from the city so that it would not cause interference to the three millions of people who make up the second largest city in the United States.

They All Wanted the Station

On the heels of this announcement, Zenith was deluged with letters from the Chambers of Commerce of many of the small towns in the outlying districts of Chicago. Some letters came from places two hundred miles away. So urgent were many of the invitations from these smaller towns that it was decided to conduct a series of tests to find the best locality for broadcasting and to determine at the same time the place offering the least trouble from interference. The plan first suggested was to erect temporary stations in all the towns selected for test. Then difficulties developed. For a time it looked as though the plan of making tests would have to be abandoned because the difficulties were so great. But, after a lot of planning and experimenting in the company's laboratories, a way out was discovered.

The company is now building a complete broadcasting unit mounted on a one-ton Federal truck. There have been portable transmitting stations for code work, but from all available information, this is the first portable broadcasting station in history. It will be equipped with a one hundred watt transmitter and will have the unusual setting of a glass-enclosed truck, so that the public may see the operation of the station wherever it is taken. It is to be operated entirely from storage batteries. The aerial will be supported above the truck by means of telescoping masts. Nothing less than gold plated antenna wire will be used—gold reduces surface resistance, and, as a result, greatly increases efficiency in an antenna of this small size.

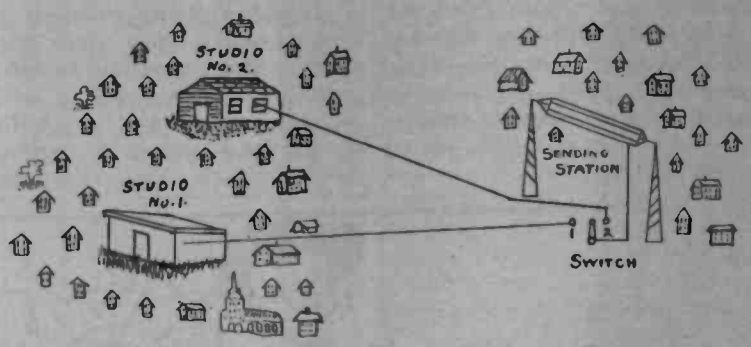


Fig. 1. City at Left—Town with Aerial, Right

How Far Will Each Town be Heard?

Arrangements are under way with the Chambers of Commerce of all towns which want to receive the new broadcasting station. Tests are arranged in each case for a definite night, and the officials of these cities will be invited to extend the greetings of their communities to the world by themselves speaking into the microphone of the portable broadcasting station. The contracts with two municipalities already provide for the local band taking part in the broadcasting. In every town prizes will be awarded for the longest distance reception. This will help towards an accurate radio diagnosis of conditions in each locality. The data gathered through these tests will be especially valuable to radio engineers. For, as is generally known, it is impossible even for radio experts to predetermine exactly the broadcasting value of any given spot without actual tests.

For this series of experiments, which promises to be so intensely interesting, the call letters 9XN, intimately and long familiar to the general public, will be used. They will be remembered as the call letters that played so important a part in the radio communication with the MacMillan Arctic Expedition. The same call was connected with the record-breaking transmitting reception episodes when music and messages from Chicago were heard in Hobart, Tasmania, Melbourne and Sidney, Australia; and by the British Fleet off Tasmania, after Captain Waldo Evans, U. S. N., Commandant of the Ninth Naval District, extended the compliments of the United States Navy to the British Navy.

From Two to Six Hundred

E. F. McDonald, Jr., President of the National Association of Broadcasters, when interviewed, made the following statement:

"Five years ago there were only two broadcasting stations in the United States. No one listened to them except a handful of amateurs who were delving

into this new and interesting science and who were experimenting with it in terms of dots and dashes. Today there is a network of about six hundred broadcasting stations in the United States, and instead of a few amateurs finding entertainment with radio, the number of broadcast listeners runs well into the millions. It has become a national pastime, and is today the world's greatest scientific source of education. In the light of this universal interest, the wishes of the radio listening public must be considered.

The first receiving set was an inefficient, short-distance piece of apparatus, used only near a broadcasting station. Sending stations themselves did not reach out very far. But fans wanted long distance reception, and this required increasingly powerful broadcasters, and better radio sets. Development of both receivers and transmitters progressed together. For evident reasons, broadcasting stations sprang up in the big cities. Most of the radio talent and most of the money available for the new enterprise was there. But the presence of broadcasting stations in the big cities developed difficulties.

Distance Lends Enchantment

The spirit of romance natural to a human being wanted radio adventure. That meant 'reaching out' as far as possible. But while high-powered local stations were in operation there was little chance of satisfying that instinct. The public was often willing to listen to a mediocre program just so long as it came from far away. I had occasion to study the public mind in this respect for I read many of the letters that were sent to our station and a fair share of them were strong protests against the interference with outside reception. I recall many letters from Chicago stating that while the writers were listening with interest to California, they were suddenly cut off by Station WJAZ. But I also remember many letters from California, bewailing the fact that in the midst of listening to an interesting program given by our station WJAZ, a local California station ruthlessly interfered. Letters of this nature were so numerous that I recognized we were face to face with a serious problem, and that the only solution was the location of broadcasting stations in sparsely settled places, where the chance of interference would be at a minimum. Quite true, there are a few localities especially favored by geology or artificial conditions, where a sending station in the heart of the residence section might cause only slight local interference. Such cases are rare, however.

Studio in Gold Coast

Our new transmitter will be located in a small community, where broadcasting can be done with the least possible interference. The main studio itself will be near Chicago's center, in the Gold Coast district, at the Club Chez Pierre, and in the exquisitely beautiful studio of Pierre Nuyttens, the artist, where the atmosphere is so uniquely impressive as to inspire any one of artistic temperament. It will truly be delightful for those who will have the opportunity to radiocast there. Remotely controlled studios are no longer a problem with the excellent service that is furnished by the American Telephone and Telegraph Company over great distances. Of course, the transmitting station will be erected only where the community desires it. It goes without saying that a lot of advertising benefits will go to the place that will get the new station WJAZ."

Our Diagram, Figure 1, shows the general scheme of operations. The City of Chicago is shown at the left. Here are two different studios, at each of which artists can go on the air. There are two connecting lines running to the suburbs. These lines are furnished by the local telephone company, and are standard except that especial pains are taken to be sure that they are not noisy, and that they transmit the signals without distortion. These two lines run to a switch installed in the sending station, which is able to pick out either one, and connect it to the sending apparatus. In the diagram the equipment is omitted for clearness, but it will be understood that it is between the switch and the aerial.

Picking Out the Studio

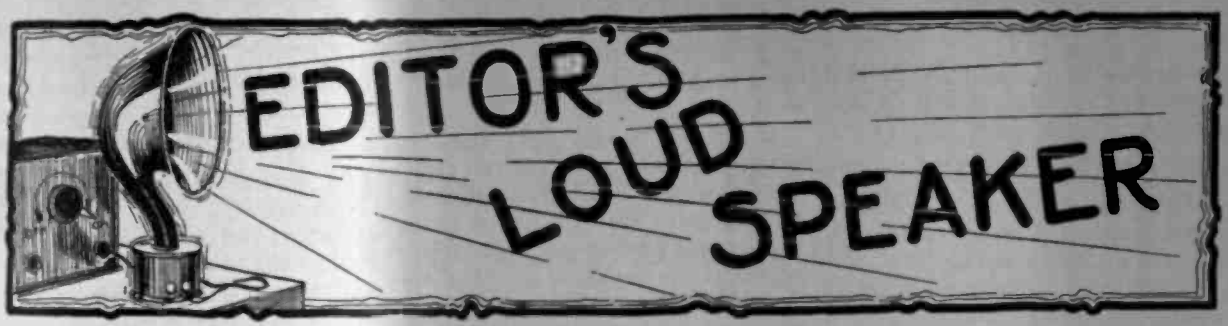
When it is desired to broadcast from Studio No. 1, then the switch is thrown to the left, and this puts the first one on the air. Similarly, Studio No. 2, or in fact any one of a number, may be connected to the aerial at will. Since the aerial is out of town, it does not cause interference with the Chicago receiving sets. This is a great improvement.

BROADCAST BILL'S BEST BALL

At the Radio Ball there's a mob;
B. Bill works each dial and knob,
As they dance
And they prance
And they throw him a glance,
To be sure that he's still on the job.

Such music is just what they need
For dancing, and then a good feed.
Tho it's hot
While they trot,
There is certainly not
An unhappy one there. No indeed.

By Del.



BELIEVING IN SIGNS

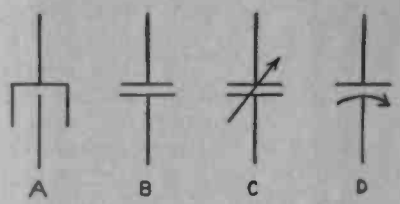
IF you ask most people whether they believe in signs or not, they will probably say "No," although they mean "Yes." We believe in signs to the extent of thinking that they shorten the amount of work required to draw out a hook-up or to understand it. They are a kind of shorthand which helps you to read a diagram at a glance instead of reading through a lot of descriptive matter.

Most of the signs which are in use to-day are comparatively old and date back sometimes as much as twenty years. Others, especially those in radio engineering, are of much more recent date. The new ones are changing from time to time, as better symbols are found. Take for instance the condenser. There is hardly a radio built which does not have at least one, and perhaps a half a dozen, concealed somewhere inside the cabinet. As every one is aware, a condenser is built by taking a number of metal plates, which are connected together, and connecting this set to one side of the line. A similar set of plates of about the same number (it may have one more or one less) is connected to the other side of the line. These two groups are separated by some kind of an insulator, which may be paper in the cheaper condensers, or mica in the better class.

If it is intended to make the condenser adjustable in capacity, then it is usual to use air for the insulator or dielectric between the two sets. Of these two, one is fixed while the others can rotate or turn in and out of mesh with the former. When the two groups dovetail closely together the capacity is greatest.

Various Condensers Symbols

The symbol for a condenser is intended to show the construction. The first such sign ever used is shown at "A" in our drawing. Two plates appear connected to one side of the line and one to the other, and these are separated by a space which stands for the insulation. This sign has been used for a great many years in all classes of electrical apparatus. However, it takes more time to sketch this symbol than many draftsmen want to allow, and for this reason a second representation like "B" in the drawing has come into use, particularly in



Evolution of a Condenser

radio work. The two plates separated by the dielectric are quite clear.

When it is desired to show that the capacity can be varied, it is usual to draw an arrowhead across the plates as illustrated at "C." This is in line with the usual scheme of using an arrow head to show that it is possible to change whatever it is drawn with; it may be resistance of rheostat, the inductance of a coil, or perhaps the voltage of a "B" battery. There is one disadvantage, however, of using this sign. It does not show which are movable and which are stationary plates. One of the radio magazines has recently adopted the rule that the head of the arrow shall point to the plates which are either movable, or stationary. The trouble is that we forget *which* it is and doubtless many readers will do the same. If we use a certain convention and can't remember what it is, then such a conventional representation is of no value.

A better scheme for showing a variable condenser is pictured at "D." This device has been in use for the past few months by the radio magazine "QST" and some others, and seems to be meeting with popular approval. It is quite evident from looking at it that the upper straight line represents the straight or fixed plates and the lower or curved line with the arrow on it means the curved plates, which move. After once seeing this symbol, it is doubtful if any one will ever forget it.

REFILLING VACUUM TUBES

If you have several dead ones, it is not surprising that the various advertisments of concerns who refill burned bulbs will be of interest. This has been mentioned before, but so many people are asking about it that we venture to repeat an explanation of the matter.

Probably the most valuable part of a tube is what isn't there —that is, the air which has been removed to leave a perfect vacuum. Even with the most modern exhaust pumps there is a very small amount of air left in the tube, so that perhaps it should not be called, "perfect." It is less than 1/1,000,000 (one millionth) of the amount that was in the glass bulb before sucking out all

the air that will come. It is this extremely vacuum which is expensive.

Not Wet by Water

When a piece of glass is dipped into a bowl of water it gets wet. This seems like a simple fact, but have you ever considered what it means. When the glass is pulled out of the water, some of it sticks to the surface and that is how we know that it gets wet. This may seem like a common-sense result that could be predicted by anybody, but when glass is dipped in mercury instead of water, then it is no longer wet, but when raised from the surface it will be found that no mercury adheres at all—that is the glass comes out perfectly dry. It is impossible to predict beforehand whether any particular liquid will wet a certain solid. If you want to dip a piece of wood in water and have it stay dry, buy some lycopodium powder at the drug store and coat the stick with it. Now when the stick is dipped into water it will not get wet. That is, when it is removed, you will find that the surface is dry and no water is sticking to it.

Wet by Dry Air

Air has the same effect on glass that water has—that is, little particles adhere to the surface. When a tube is pumped free from air, then the space in the tube may contain practically nothing at all. However, the walls will be wet by the air, or in other words, considerable will stick to the surface of the glass and no amount of pumping will remove it. If it would only stick there indefinitely, it would do no harm, but it is like a bottle which has contained water and which has been emptied out. In such a case you can see the bubbles of water on the inside walls. If you put a cork in such a wet bottle and let it stand for a few days, you will find that some of the moisture has evaporated from the glass and now exists in the form of water vapor all through the bottle. Of course, this vapor cannot be seen, but you know it is there just the same.

If the air would only stick to the sides of the tube all the time, then it would do no harm to a receiving set. But the same thing happens as just mentioned. Over a period of weeks or months the little particles or molecules of air, which at first would not let go of the glass walls, finally get discouraged and can no longer hold on. That means that they fly out into the center of the bulb and reduce the vacuum.

Returning to the bottle, how can we get it dry on the inside short of waiting several days for it to evaporate off? The easy thing to do is to put it in an oven with the cork out and heat it up. The heat makes the water leave the walls and of course it goes out into the room. Afterwards the cork can be put in to seal off the bottle and no water will be contained inside. This same method is used with the vacuum tubes. While they are being exhausted on the vacuum pumps, they are warmed up in an oven to nearly a red heat. This drives most of the air molecules off the walls and they are then sucked away by the pump. When this action is completed the tube is sealed off by melting together the tip and the result is that the high vacuum which has been obtained is preserved for an indefinite time.

Refilling These Tubes

It will be easily seen that such an operation requires an unusual amount of skill and also a large equipment. In refilling vacuum tubes (re-emptying would perhaps be a better term) the operation of putting in a new filament is quite simple. It is getting the vacuum so that it will stay put which is the trouble. So if you get refilled tubes from any concern which has the necessary apparatus and skilled men, then a refilled job is practically equal to a new one. But if your source of supply has not the right facilities for lasting work, then your tube may be "just as good" at the time you buy it, but at the end of a month or two you will find a very different story.

UNBROADCASTING THE NEWS

Of course, you know that a broadcasting station has quite an effect on you. But did you realize that the converse was true and that you have quite an effect on the station?

As an example of this, a recent occurrence shows the very strong force of public opinion. It was widely announced that one of the Chicago sending stations was to broadcast the details of a murder trial. There is no doubt that this trial was news. Besides that there were a great many people who believed that it was interesting news, and so at first glance it might seem that this broadcaster had stolen a march on his competitors. But from the first instant after the announcement was made, the broadcast listeners started in to tell that station what they thought and it was not very complimentary.

You Personally Can Help

This incident is interesting in two ways. As has just been mentioned, it shows what a tremendous force can be exerted by radio fans if they will only *make themselves heard*. It wasn't the listeners who disapproved and said nothing that accomplished the change, but those that wrote to the station.

The other thought which is brought to mind is that so far radio has entirely kept away from anything which can be classed as undesirable. Books and magazines continually carry messages which are offensive to a good many people. The movies often have a bad effect on the young folks who see them. In many cities a censor has been appointed to cut out the objectionable parts of films and judging from reports he does a good business. But so far we have never heard of any one complaining that any radio entertainment had a bad effect on the thoughts and morals of the young folks.

Long Versus Short Wave Length

How Many Meters to Cross the Atlantic Ocean?

By DAVID SARNOFF, Vice President and General Manager of the Radio Corporation of America

(Mr. Sarnoff has just returned from Europe, where he remained seven weeks visiting the leading radio engineers and scientists in governmental and private radio circles abroad. He still favors long wave lengths (around 10,000 meters) for trans-oceanic radio communication, after making a thorough analysis of the developments made in short waves in Europe.—Ed.)

I HAVE seen nothing, as yet, in this new field of short waves, say around 100 meters, either in Europe or at home, which justifies the claim that the present high-power long wave stations employed for commercial messages between here and Europe will be supplanted by the low power stations. Reliable radio transmission over long distances during the daylight and business hours must still be conducted with high-power and long waves, such, for example, as we are now using at Radio Central, on Long Island, N. Y. But the chances of radio developments in all its branches are too great and promising to permit any statement that its advance will stop here or there.

Marconi Believes in Short Waves

While I was in England I saw a good deal of Mr. Marconi and his experiments with short waves. These experiments have given fresh inspiration to the work of research men and radio engineers in the United States, where the short-wave field has been under scientific investigation for several years. It is expected that the use of short waves will greatly, and in a practical way, advance the art of communication in the field of wireless telegraphy as well as radio.

To my mind, one of the greatest advantages which will result from the experiments now being conducted with short waves is the increased knowledge we shall gain of the behavior of different wave lengths between the sending and receiving stations. Much has already been accomplished in perfecting the radio sending and receiving instruments, but much more still remains to be learned about what actually occurs to the radio waves in the space which separates the receiver from the transmitter. As we learn more about Nature's secrets, now hiding in the great outdoors, we shall come nearer our goal of completely eliminating static, interference, fading and other scientific problems still requiring solution.

U. S. Beats Europe Broadcasting

I investigated the broadcasting systems of England, France and Germany, and met the principal persons both in government and private circles responsible for the development of radio in Europe. My conclusions are, that broadcasting, which started in our own country, has advanced in the United States, both as a public service, and as an industry, so far as to make comparisons with European Countries almost impossible. In France it is just beginning, and in Germany it has hardly begun.

In England greater progress has been made than in other European countries. About 800,000 Government licenses have been issued permitting British listeners to receive programs from the air. But even in England, broadcasting cannot be said to compare favorably with the United States, either as to quality or variety of programs, or as to effectiveness, simplicity, or small cost of receiving apparatus manufactured and sold for home use.

No Convention News Abroad

Nor is there abroad the same freedom from censorship and restriction which exists here. For example, in England, where freedom of speech has been such a well-known tradition, political broadcasting is forbidden over the radio; all the sending stations are controlled by the British Post Office. In other European countries, governmental regulations and restrictions are even more severe, and these, in a large measure, restrict and retard the growth of the broadcasting art in Europe, and at the same time deprive their listening public of the freedom, enjoyment, and instructive information available to all in the United States.

I endeavored to interest the British, French and German broadcasters in the idea of increasing the power of their sending stations, so that the programs of London, Paris and Berlin might be easily heard by the American radio fans. At the same time I suggested the possibility of American stations sending over their programs,which could be regularly heard abroad. Much interest was shown in these proposals, and I believe that an era of trans-oceanic broadcasting is near at hand. The completing of such a plan would greatly increase the value of broadcasting to the public on this side as well as on the other of the Atlantic Ocean, and would help to bring the old and the new world a little closer together.

HEARS FRIDAY'S PROGRAM THURSDAY

A radio fan from Larkspur, Marin county, California, writes that he has been tuning-in Station KDKA since he first installed his radio set, and adds that he will continue to do so as long as it holds together. In his letter he mentions that during the broadcast of the Democratic Convention the announcer gave the time as 2:36 a. m., Eastern Standard Time, which corresponds to 10:36, Pacific Standard Time, so that he had the pleasure of hearing Friday's broadcast on Thursday. By means of radio, all things seem possible in this age of startling achievements.

A Station Run By Ghosts

No Attendants Needed in Sub-Station at Tipton, Ind.

DO you remember reading ghost stories about a haunted house in which the chairs were mysteriously arranged in a certain order and the table moved up to receive the dishes which were laid by ghostly hands? Pretty nearly the same thing is being done to-day at Tipton, near Indianapolis.

In this case, however, instead of having ghosts which cannot be controlled, radio waves are used to operate all the controls of a power station. This is a complete electrical station, entirely without attendants, which supplies all the light and power requirements of a city of 10,000 people.

A special design of relays is used to throw the various control handles. The radio waves come in over telephone lines, which have already been installed, and which are used for ordinary conversations all the time that the station is being operated. These high frequency waves are the same as those used in the so-called "Wired Wireless," which was invented by Major Squires of the United States Army. Sometimes they are spoken of as directed waves, as they are just like broadcasting oscillations, except that instead of being spread in all directions from a sending aerial, they are sent to one place only, being guided by some kind of metallic conductor, either a telephone line, street railway, power cables, or any other long conductor. When they reach the station, by a system of tuning they are separated and sent each to its own particular relay. These latter close local circuits, which turn the power on and off, open and close the circuit breakers, and do all the hundred and one things that other stations need an attendant to perform.

John Ferguson, manager of operation of the Indiana Electric Corporation, cooperated with engineers of the Westinghouse Electric & Manufacturing Company in designing the apparatus and it was installed under the supervision of Mr. Ferguson and C. A. Boddie, nationally famous as an inventor.

Two Power Lines

The city of Tipton is served by the Northern Indiana Power Company's transmission lines connected to a large transforming substation located at the western city limits. In order to insure that the electrical supply will be without interruption, two transmission lines from different sources of power are used—the Kokomo and Noblesville power plants, respectively. If either of these transmission lines should become interrupted by electrical storms, the supply can be resumed immediately from the other source. Until now, the operation of the oil switches to change over the source of supply has necessitated the constant presence of substation attendants, who have received their instructions for operating the switches by long distance telephone.

Telephone systems, however, are even more vulnerable than power lines to the action of the elements—remember how often your telephone is out of order compared with the times the the electric lights will not work—and power companies in the past have sometimes been unable to render continuous service during storms. The engineers of the Northern Indiana Company have felt that in these days the standard of electrical service is so high that every effort must be made to keep the power on the lines all the time. Two minutes interruption in the electric service often makes more enemies for the central station than high bills for a month. That is why they decided to do their utmost to make sure that the electric lights would not fail in any storm.

The present substation at Tipton, the operation of which is governed entirely by high frequency waves, is the result of their efforts and this new station marks a fresh era in electrical development.

Breaking 40,000 Horse Power

The station adjoins the roadside on the state road west of Tipton. It is controlled by two massive oil circuit breakers of 73,000 volt, 400 ampere rating. This is the equivalent of about 40,000 horse power. These circuit breakers are connected to the transmission lines, one from the north and the other from the south. If either of these lines develops any trouble, it is instantly observed on the power house instrument at Kokomo. In this event, the Kokomo operator immediately sends out a series of high frequency waves which open up the oil switch at Tipton connected to the defective line and close the oil switch which is connected to the reserve line, the entire operation being completed in a few seconds.

The method by which this is accomplished is as follows: The operator at Kokomo dials a certain number on a telephone of special design similar to an automatic telephone. This automatic dial is connected to a radio transmitter and the action of dialing sends out a series of modulated radio impulses to the antenna at Kokomo. Upon receiving these impulses the antenna at the Tipton station leads them down to a five tube radio receiving set and amplifier, where they are multiplied in volume while still retaining their form characteristics. They are then carried to a series of selector relays, which in turn operate the storage battery switches which actuate the oil circuit breaker mechanism. A special wave length entirely outside the broadcasting range, is used and the series of impulses is as complex as the combination lock of a safe and in no way subject to outside influences. The tests which were just completed have demonstrated that the apparatus works with infallible accuracy.

Just Like Ali Baba

In spite of the massive nature of the apparatus which is controlled by this infinitesimal force, the tests have shown that instead of dialing a number with the finger, the radio controlling appa-

Continued on Page 27

Major A. G. Rudd

BROADCASTER FINDS SWEETHEART

Lt. W. Nephew King who appeared on WEAF's program some time ago under the auspices of the Lecture Bureau of the Board of Education reports an extraordinary experience. No sooner had his address been given, which was a feature of WEAF's morning program, than he received a call at the studio from his brother whom he had believed dead for more than twenty years. A few days later he received a letter from the first sweetheart of his youth from whom he had not heard for fifty years. Lt. King told the radio audience thrilling stories of "Mexico in Peace and War."

POLO AND THE PRINCE

The recent polo events at the Meadowbrook Country Club enjoyed unusual prominence. This was largely because the Prince of Wales was one of the performers. Although America does not think highly of most of European Royalty, still this popular young nobleman has caught the eye of the whole country. During the polo matches, Major A. G. Rudd of the United States Army, who is a well known polo expert, was at the microphone of Station WJZ. He gave a very interesting recital of the match as it progressed.

Clarence W. Allen

CHURCH COMMUNITY CHORUS

Every Sunday afternoon the Church Community Chorus of New York goes on the air through Station WJZ. It is unusual to find such a large band of people who can sing so well. A large measure of the credit for these performances is due to Clarence W. Allen, the Director.

BROADCASTING IN HOLY LAND

Even the Holy Land has succumbed to radio. The installation of radio apparatus in Palestine was given official sanction by a government ordinance permitting all inhabitants to install radio sending or receiving instruments. The British Government is planning to install a powerful broadcasting station on the Mount of Olives, the report said.

A STATION RUN BY GHOSTS

Continued from Page 26

ratus is so sensitive that the oil circuit breakers could be actuated by the human voice, and that the modulation could be so arranged that the feat of Ali Baba in opening the cave by the words, "Open Sesame," could be duplicated. It would be possible actually to adjust the apparatus so that the operator at Kokomo need only say the words, "Open, circuit breakers," and the breakers, 25 miles away, would open. This shows more intelligence than is apparently possessed by some human beings.

Rx DR RADIO PRESCRIBES.

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

Question. What is the advantage of the built-up inductance switches?

Answer. The inductance switches which are already built up, consist of six or more switch points mounted usually on a piece of Bakelite sheet, which also supports a rotating arm. This arm contacts with the various switch points, as it is termed. It differs from the ordinary inductance switch because the latter is bought as individual pieces and is mounted on the panel by the builder himself. It is usually considered better than the home made style for two reasons: In the first place, it looks a great deal better, because the switch points are entirely concealed behind the panel, and so do not show from the front unless the lid is raised. The only thing that is visible is the neat dial and knob. From the operating point of view it is somewhat better in general, because the contacts are protected from dust and dirt and so are not as likely to be bridged by conducting material and so short circuited. Furthermore, the material in which they are mounted is usually a very high grade of insulation and so may be better in that respect than the insulation of the panel itself.

Question. What is meant by anti-capacity jacks?

Answer. These jacks are advertised sometimes, although not as much as formerly. They differ from the usual style in that the capacity between parts is kept as low as possible. In the usual form you will remember that the contacts consist of long springs which are parallel and fairly close together. These springs act like the plates of a condenser and so cause capacity between the two sides of the circuit. The anti-capacity jacks are built with springs much shorter and also separated farther apart. In both these ways the capacity is reduced.

As to the advantage of this style, it is hard to see any. In many parts of a radio set it is a very great advantage to have the capacity as low as possible, but the jacks are always in the output circuit on the audio frequency side. The audio waves, you will recall, will not pass through a small capacity, whereas the high speed of the radio waves lets them through easily. On the audio end of the set, that is after the music has already passed through the detector, there is supposed to be no radio frequency at all. If by chance any is still left, it is *desirable* rather than the reverse to short circuit such waves and

Continued on Page 29

Fone Fun For Fans

Wise

"What do you do when you get something ending with 'R. S. V. P.?'" asked the social novice.

"Don't let 'em fool you," answered the radio fan. "There isn't any such sending station."—*Washington Star.*

The Philanthropists

Wife (with first checking account): "Oh, John, the bank sent me back all the checks I paid bills with last month, so I haven't spent anything!—*American Legion Weekly.*

Ticket Agent: "Your train is 1:50."

Cohen: "Vell, make it vun forty-eight, und I take it."—*Crosley Radio Weekly.*

She Knew "Pop"

This chap sat in a fashionable coiffeur's shop with his little daughter, while his wife was having a marcel wave put in her hair.

The little daughter, as she played about, patted her father's bald head and said in a loud voice, that all customers could hear:

"No waves for you, daddy—you're all beach."—*The Silent Partner.*

Plenty of Others Like Him

Not long ago I was told of a bank which takes on a number of young men during the summer, and on their salary receipts is printed a legend something like this:

"Your salary is your personal business—a confidential matter—and should not be disclosed to anybody else." One of the boys in signing this receipt added:

"I won't mention it to anybody. I'm just as much ashamed of it as you are."—*Old Colony News Letter.*

Too Plain for Politics

"This radio is a wonderful means of reaching the public."

"It has its disadvantages," commented Senator Sorghum. "If you happen to say something you want to take back next day, there isn't a chance to come out and say the interview was garbled."—*Washington Star.*

Unanimous

Judge: "What brought you here?"

Prisoner: "Two Policemen."

Judge: "Drunk, I suppose?"

Prisoner: "Yes, both of them."—*New York Times.*

Likes Fairy Tales

"You sold me a radio set about two weeks ago."

"How do you like it?"

"I want you to tell me everything you said about that set all over again. I'm getting discouraged."—*Birmingham Age-Herald.*

DR. RADIO PRESCRIBES

Continued from Page 28

for that reason a stopping condenser of about .001 mfd. (microfarad) is used across the terminals of the transformer to the phones. The capacity of the jack is added to this condenser and to that extent helps out the action. For this reason whatever small capacity is contained in the ordinary jack is not a detriment. On the other hand, the anti-capacity jacks cost a great deal more than the standard style and so we see no advantage in using them except in experimental work or on special circuits.

Question. How should the rotor of a variable condenser be connected in the input circuit?

Answer. As far as the theory of the circuit is concerned it makes no difference whether the rotor or stator of the variable condenser is connected to the grid. But when you start to operate the set there is a decided difference. If the condenser is properly shielded, as it should be, then considerably less body capacity will be observed if the condenser is connected correctly. The rule to follow is that the stator plates must always run to the grid.

The reason is this: The shielding consisting of copper or tin foil on the back of the panel protects the stationary plates from any effect of your hand. The rotor *plates* are also protected, but not the rotor shaft, which must project through a hole in the shield and come out of the panel to carry the dial and knob. Since it is impossible to shield this shaft, the way to do is to make sure that the unshielded part is not connected to the grid. That is why the rule says, always to connect the stator to the grid.

Question. Some of the "B" batteries advertised recently have been built with a vertical rather than a horizontal spacing of the cells. Why have these been changed?

Answer. Some sets have a cabinet with a shape which accommodates a tall battery much easier than it does one which is short and broad. For the convenience of such sets, the battery manufacturers have recently designed the "B" batteries which you describe. They occupy considerable less floor space in the bottom of the cabinet. They have the same life and performance as the more ordinary arrangement of the same size of cells.

REMARKS FROM READERS

St. Paul, Minn.,
August 26, 1924.

The Editor:—

Just a few lines regarding your RADIO PROGRESS.

I wish to state that I gained a lot of knowledge about radio and its workings through your one issue of August. It is so clear and easy to understand, I will surely see that I get them regularly.

I have purchased the *Radio* ——— and *Radio* ——— for about one year, but your one issue has given me a better understanding than the other two for one year.

We are not all college professors and not all familiar with some of the drawings, as they are often marked poorly or not at all. The old bucks are now taking to radio more than the young ones and are willing to spend more if they are set right. Wishing you success and will boost it whenever I get a chance.

Yours truly,
J. HENESCH,
317 Iglehart Avenue.

(We are glad that Mr. Henesch likes our efforts. As we have mentioned before, this magazine is designed for a class of readers who are intelligent, but lack a technical training in radio engineering. Suggestions or criticisms from our readers are always welcome. If you think of any way we can improve our articles, please send a memorandum of it into the editor.—Ed.)

INSIDE OF POWER SPEAKER

Continued from Page 7

with the magnetism to cause the diaphragm to move *either* up *or* down but not a succession of both. This would give a single knock in the loud speaker but no musical tone.

The Non-Power Types

The description of the instrument just given applies to only one of the models put out by the manufacturers. In another style there is a horseshoe magnet of particular shape which supplies a large amount of flux and which needs no polarizing winding or connection to the "A" battery. Of course, the magnetic strength will not be so great in it as that obtained from the battery current.

"—And If I am Elected Just Watch Business Pick-up"

Which one of the candidates for President spoke these words over the radio? Are you getting the fun and the interesting information which is coming pretty regularly these days through the air to those who have crystal sets?

If you are missing the enjoyment and entertainment which is furnished by the wonderful programs now being sent out by the big broadcasting stations, and particularly at this time of the year, if you don't hear the way your favorite candidate shows how the other two parties would wreck the country, then by all means invest

$2.95 for a RADICLEAR Crystal Set

With this outfit and a pair of phones you can pick up local broadcasting in a way which will delight you.

The RADICLEAR Crystal set is unusual in that there are no sliding arms or handles to turn. This means that it is easy to operate and also that there is no loss through short circuiting of turns by the slider. As a result the speeches are unusually clear and loud.

This set includes the famous Audion Crystal, which is alive all over. This is sold separately at 25c.

TAYLOR ELECTRIC CO.

1206 BROAD STREET

PROVIDENCE, R. I.

Special Features for the October 15th Issue of Radio Progress

A big sending station shoots music into the air. Do you know how it reaches your aerial? There are two paths by which the waves may reach you and sometimes one is better, and sometimes the other. See "RADIO WAVES THROUGH SKY AND GROUND," by Dr. Alfred N. Goldsmith in the next issue.

When you look at a variable condenser and see the plates turn around and around, doesn't it seem foolish that these can switch the music from New York to Chicago and from Chicago to San Francisco? How does it accomplish so much in such a little space? It is simple when you read about it in "HOW CAPACITY WORKS IN A CONDENSER," by Horace V. S. Taylor.

Many fans have superheterodynes or are thinking of building this very popular set. Many articles have explained the detailed workings of the various parts, but it isn't everyone that can trace the path of the music through one tube after another, particularly when some of the tubes are reflex, as in the Radiola Model. A road map and description of the path of the program through the set will be given in "TRACING THE MUSIC THROUGH A SUPER-HET," by Oliver D. Arnold.

Are some of your friends good natured liars? If not, why is it that they can get so much more than you can with a cheaper apparatus? Some pointers on getting the best out of your set and also hints on checking up to see whether your friends are speaking the truth will be found in "WITH A GRAIN OF SALT," by Harry A. Nickerson, in the October 15 issue of RADIO PROGRESS.