March 1, 1925
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RADIO PROGRESS

"Always Abreast of the Times"

In This Issue

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

PUBLISHED TWICE A MONTH

RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 1 Number 24

Contents for

MARCH 1, 1925

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Looking Forward to the Next Issue

During the eclipse a while ago, you heard a lot about using a telescope to find the exact location and length of the corona. In radio, direction is often found by using a loop on a sensitive set. But do you know that the direction as found in this way is not exact? This is explained by Goldsmith in **"Using the Radio Telescope."**

There are various articles from time to time which tell you how to build your aerial. The ground connection is also often discussed. It is not very frequently, however, that you see an intelligent description of the way to install a lead-in. You can doubtless improve your own after you read, **"Installing Your Lead-in,"** by Morton.

Are you one of the lucky fans who have heard the Victor Concerts recently? Every two weeks special preparations are made for these highest class artists. You will enjoy reading about it in **"Broadcasting the Victor Artists."**

Some broadcast announcers are very popular, while others do not get much applause. Do you like the one announcing from your favorite station? If you do not know why one excels another, and are interested to know in what order the popular ones are rated, look up **"An Ideal Radio Announcer,"** in the next issue.

The number of single-circuit squealers probably is larger than any other tube sets. Do you realize that the squeal can be largely eliminated, and at the same time the set improved so that it will cut out locals better? In **"Sharpen Your Single-Circuit Set,"** you will find not only directions, but reasons for the change.

The interview by Freed, **"Weeding Out Bad Tubes,"** is being looked forward to with interest by those who have trouble with their vacuum bulbs. Don't miss it.

Another Aid to Help You With Your Hook-ups

Even the absent-minded professor picks up an idea quicker from a picture than he does by reading over a written description.

Even if you are an expert at radio circuits you will find that a drawing catches your eyes and gives you quicker information than a write-up, however clear it may be.

At the request of many of our readers we are going to adopt a method which gives a picture of each piece of apparatus used in all our hook-ups. Of course, we shall also give the usual wiring diagrams as well. And, by the way, have you noticed how much clearer our hook ups are than those in most magazines? You will find that there are fewer wires crossing and much fewer corners in the lines than is usual. Of course, this makes such a diagram easier and quicker to follow.

Although this means a lot more time and expense, we are going to bring about this improvement in showing the connections in an early issue.

RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. 1, No. 24 MARCH 1, 1925 15c PER COPY, $3 PER YEAR

What Set Names Mean

This Gives You a Road Map of the Different Styles

By HORACE V. S. TAYLOR

DO you remember a few years back that most of the big newspapers carried a column, headed, "Advice to the Lovelorn"? Many of the correspondents asked what certain boys and girls names meant and there was paragraph after paragraph, telling the significance of Tom, Henry, Mary, Dorothy, etc.

Very likely a good many of these names really did once mean what the editor claimed. But a lot of them seemed a trifle far fetched and undoubtedly a few of the more peculiar ones were made up on the spur of the moment by the parents and so had no real meaning at all.

What Does "Kodak" Mean?

Another illustration of names is the word Nabisco. Quite evidently this is made up of the first letters of the manufacturers—National Biscuit Company. "Mazda" as applied to electric lamps is reported to come from the Persian and to mean light. The Eastman Company, on the other hand, say that their trade mark, Kodak, was coined by George Eastman, the founder of the business, as a word which was different from everything else and had no meaning at all until he gave it one.

In the same way some of the names of radio sets have a real meaning, while others are merely variations in spelling of the original label and still others are entirely arbitrary words which are made up to fit the product of a new manufacturer. Besides this there are a few which are really used in error—that is they have been given to a certain style of hook-up and then someone else wanting to get credit for something he hasn't got will steal the name and apply it to a substitute circuit, which is not as good.

What is Regeneration?

Probably the word which you see oftenest as applied to a hook-up is regeneration. Many people use this rather loosely and don't know exactly what it means. However, it is a very definite thing and if you once learn the idea you will easily identify any set which uses this principle. It was first invented by Armstrong (as we are assured by the Radio Corporation) or by DeForest (see DeForest Radio Company). These two concerns are still fighting it out in the courts as to which one saw it first.

To get the idea of this action, let us consider a steam hammer in a big foundry or machine shop. As shown in Fig. 1, the hammer is driven by a piston working in a cylinder. The steam is admitted to the bottom of the piston to raise the hammer to the top when a powerful blow is wanted. To control this action there is a valve which admits the steam to the upper or lower part of the cylinder. The valve is worked by a control handle, which is operated by the man who does the forging. When he pulls the handle down, it makes the piston come down with a powerful hammer blow, and when he raises it, up goes the piston.

Putting on a Self Starter

In pounding out a heavy piece of metal the operator keeps working the control handle up and down and so gets in a series of blows on the red hot ingot. That is quite easily understood. Of course, for ordinary work that is all that is required since the judgment of the man is needed as to how many blows must be struck. But suppose we have an operation requiring a very large number of small blows. Of course, by keeping at it long enough the method just described will get there in the end, but it is quite tedious. If the fellow at the handle is a bright chap he may rig up a rod connecting the hammer itself and the control handle in such a way that when the piston gets near the end

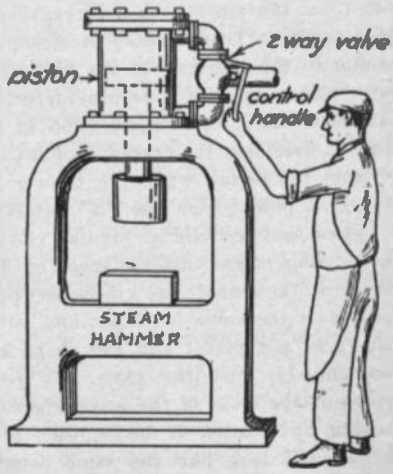


Fig. 1. Feed Back on Steam Hammer Like That in Tube

of its stroke it will automatically turn the control in the opposite direction and so make the piston keep oscillating back and forth without the need of the operator pushing the valves all the time.

As a matter of fact, history tells us that this kind of development happened with the steam engine shortly after Watt invented it. A small boy was at first used to throw the valves first to the left and then to the right and so keep the oscillation of the big piston going. Finally, however, the valve boy had a bright idea, which lost him him his job. He connected a wire to the working beam and the valve, so that the engine moved its own control. That idea is used by all steam engines at the present day.

Applying it to a Tube

Now getting back to radio we have a detector tube with a grid which serves as the input side and a plate which

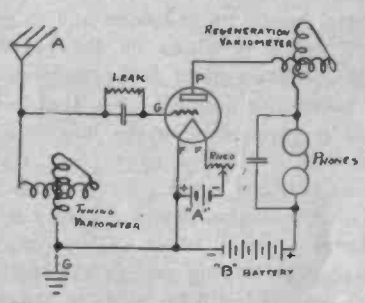


Fig. 2. Regeneration from Tickler

releases the output. By this is meant that when a vibration which we may say has a strength of one, as applied to the grid, a similar vibration will come out from the plate with a strength of four or five. This increase in strength is due to the presence of the "B" battery. That is why a crystal detector can never have any amplification in it since it uses only the energy supplied to it from the aerial, while the tube gets its extra power from the "B" battery.

Notice that we said a "similar vibration". This means that the speed of oscillation (measured in kilocycles per second) is the same for input and output (grid and plate) and the shape of the curve is just the same. If you represent the looks of the wave when it goes in by a batch of dough, then the output will look like the same dough after it has risen. The general shape is the same and any hills and valleys which were found at first, will appear afterwards. The only difference is that everything is now on a much larger scale than before.

Raised by Your Bootstraps

If we take some of the energy from the output and connect it to the input, we shall be doing the same thing as hooking up the steam hammer to the valve, and the result will be that a continuous vibration of current, first in one direction, and then in the other, will be sustained indefinitely. In other words, the tube oscillates. If this connection, or coupling, as it is called, is made weaker and weaker, then a point will be reached at which the energy fed back from the output will not be quite strong enough to keep the set oscillating. However, at such a point the signals will be much louder than before since the grid will now act as a trigger and the recoil (output) from the plate will help to push it. It seems like raising yourself by your bootstraps, except that the "B" battery supplies the energy.

There are two ways of getting this feedback from plate to grid. The better one is by using a tickler coil in the plate circuit, which is placed near the grid coil. Such a hook-up is shown in Fig. 2. By turning the rotor, which is in the plate circuit, more or less of the output energy is given back to the grid.

Variometer Not so Good

The other way to get feedback is to use a variometer in the plate circuit. This appears in Fig. 3. By tuning this plate control to the same frequency as is coming in on the aerial some of the oscillations are fed back through the capacity of the detector tube to the grid circuit. The objection to this scheme is that tuning the output is much more critical and difficult to get than adjusting the feedback of the variocoupler hook-up of Fig. 2.

RF and AF Amplifiers

You frequently hear of radio and audio frequency amplification. The difference in these two is quite marked in theory. When a wave comes in the vibration is so fast (about one million per second) that no ear drum can follow and so nothing is heard. After going through a radio amplifier the speed of oscillation is just the same as before but the wave is a lot "louder". We say louder because if we could hear it at all the volume would be much greater. Since we can not hear it we must depend on electrical instruments, which measures the intensity. After passing each step of RF the meter will read about five times as big as before.

The detector reduces the speed of vibration from that of a sending station, as just described, down to the slow audio frequency of a few hundred per second, which our ears are accustomed to hear. The range of the middle notes on the piano is from about 200 up to 1000. The electrical pulsations from the plate of the detector tube may be fed direct to head phones and they will make music.

Stepping on the Gas

If now we feed these vibrations not to the phones, but to a step of audio amplification, the result is like that you get in driving an automobile. When you step on the accelerator the power your foot uses is small, but the engine steps it up to 20 or 30 horse power in the car itself. The harder you push (input) the faster you travel (output). So the amplifier takes the feeble waves which the detector feeds to it and raises them to five or ten times their previous strength. Of course, a second step of audio increases the loudness another five or ten times.

Notice that radio frequency works before the set has made any music and so does not increase the loudness of the program as much as it extends the range of the set. It is oftentimes used to step up the feeble vibrations received by a loop so that they may be

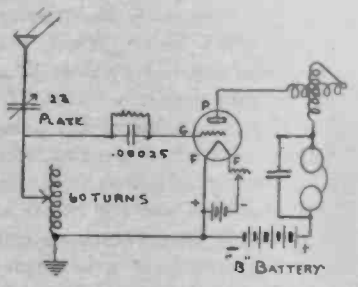


Fig. 3. Regeneration from a Variometer

strong enough to work a detector. An audio step would not be of any use in such a place because the detector would not make any music at all to amplify. It is like the passerby who offered to double the money in the tramp's pocket. But it was not much of a help because he had nothing at all.

The audio step on the other hand, will not greatly increase the distance which a set will pull in, but will change a whisper into a shout when heard in the phones or will work a loud speaker which needs about five times the energy required for a head set.

Why "Tuned" Radio Amplification

Many sets are advertised as using steps of "tuned" RF. Others do not use this tuning. What is the advantage? The idea behind it is that any circuit which will respond loudly to only a certain frequency (wavelength) will actually sharpen the selectivity of the set and make it easier to pick up distant stations even while the local ones are running. This, of course, is an advantage. There is the drawback that it means a separate dial to tune for each circuit that uses this idea. And if the tuning really is sharp as is intended, it requires an accurate adjustment of one more knob before you hear any music.

Builders of sets which use untuned RF transformers like the idea of having a very simple control. With such units, all frequencies coming in will be amplified equally and the whole are fed to a tuner on the detector, which picks out the one which is wanted. Of course, if this tuner has good enough selectivity in itself, then the other controls as just mentioned, are like the fifth wheel of a coach. When well built, either the tuned or untuned RF steps are about equally efficient.

Two for Price of One

After understanding the idea of radio and audio amplification the thought occurs why not use them both in the same tube. If you do, the set is called "reflex." The scheme is this. The waves from the aerial are fed to a radio amplifier, which increases the range of the set. After being multiplied through this step, the detector reduces them to audio frequency so they can be heard.

These slow speed vibrations are again returned to the amplifier tube where their loudness is increased so that they may be heard on a loud speaker.

Of course, two or even three such tubes may be employed. In that case the radio waves travel through amplifiers one, two, and three, then the detector tube changes them to audio. Again they thread tubes one, two, and three, and go to the horn. If, after being converted to sound frequency, the waves are fed through the tubes in the reverse order then the set is called an "inverse" reflex. Such a receiver uses the tubes in this order— one, two, three, detector, three, two, one.

The Neutrodyne Idea

A neutrodyne is a five tube set like what has just been described. But in order to get rid of the undesirable feedback, and oscillations which we mentioned above, a small condenser is connected from one RF tube to the next in such a way that a little energy is fed back intentionally. By the proper connections this latter is just exactly out of step with the leakage which goes on in the set. For this reason it is called a "neutralizing" condenser, since with the correct setting it cancels out the tendency to squeal or oscillate. Such a neutrodyne hook-up is shown in Fig. 4.

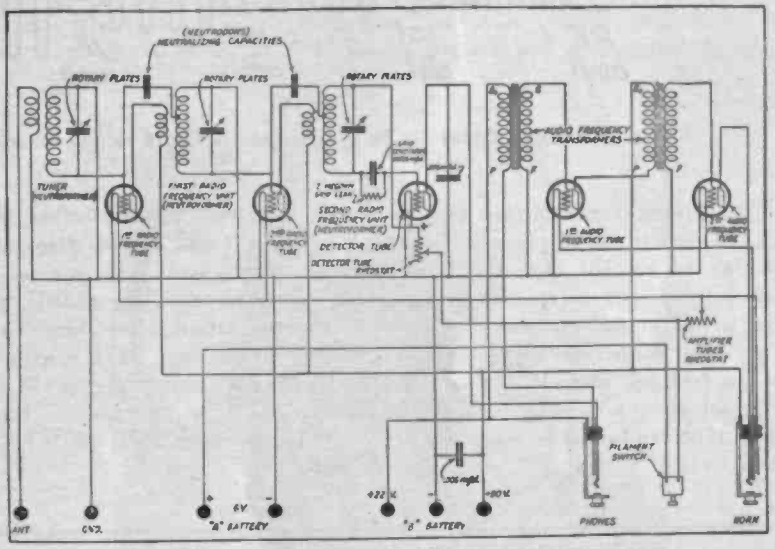


Fig. 4. Neutralized R. F. Amplification in a Neutrodyne

The Five-Tube Set

We hesitate to tell you the name for this since there are at least two dozen. Whenever you see an unknown kind of "dyne", or "plex", or "flux", the chances are strong that it is nothing but two radio steps, a detector, and two audio stages. Such a hook-up is quite popular because it has a range of one or two thousand miles and operates a loud speaker without squealing.

We say "without squealing", but that is true only if the set is unusually well built. With most such sets, especially when put together by amateurs, there is apt to be a little leakage of electrical energy from one tube to another, which is apt to cause squealing.

In this hook-up the two tubes at the left are the first two steps of radio frequency amplification. The grid coil or tuner for each tube has an adjustable condenser across it which shows that it uses tuned RF. The neutrodons appear at the top of the drawing. The third tube is the detector and the fourth and fifth are steps of audio frequency amplification.

How a Superheterodyne Works

We now get to what is probably the most complicated of radio sets, called the superhet for short. The scheme of this may be seen from Fig. 5. A seven tube set is illustrated here although other tubes may be added as will be

explained later. Also some models reflex one or more tubes and thus reduce the total number.

The radio frequency comes in at the left from the aerial, through a tuner which selects the particular frequency or station which you want to hear. Tube one is an RF amplifier. Notice that the output from this step has the same frequency or distance between waves as before, but that the height (loudness) of the waves is greater owing to the amplifier action.

Tube two is the oscillator. It acts like the feedback control on a squealing regenerative set. The only difference is that the squeal is made use of in this style of hook-up.

Two Detectors are Used

Tube three is the first detector. It takes up the output from the tubes one and two and combines them into a lower frequency. As a matter of fact this is equal to the "difference" in the rate of vibration of the two inputs. Thus, if one vibrates a million times a second and the other 900,000 then the output from tube three will be 1,000,000 minus 900,000 or 100,000 oscillations per second. This is called the intermediate frequency. The latter is fed through amplifiers four and five, which each boost the loudness without changing the frequency. A third intermediate transformer is oftentimes used, but is not illustrated here.

From there the waves go to tube six, which is the second detector. At this point the speed of oscillation is dropped to the audio frequency of a few hundred per second. The action here is no different from that in any ordinary detector set. Then tube seven boosts the tone in the regular AF way. A second step of audio is often added beyond tube seven.

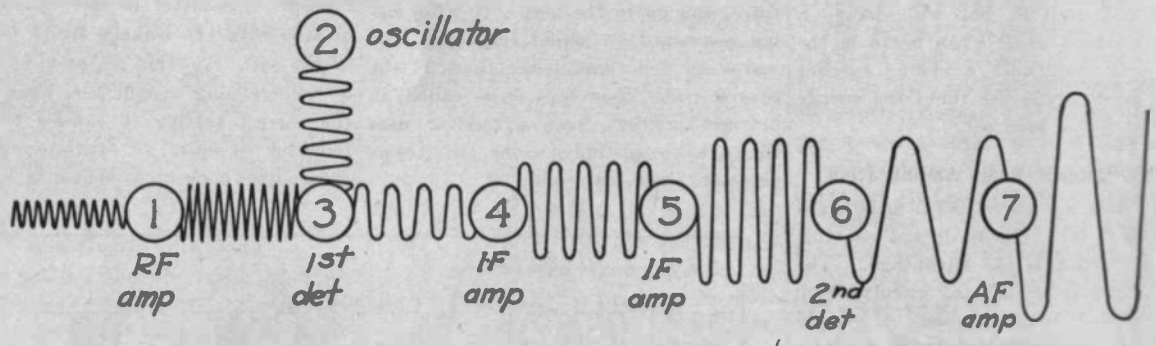


Fig. 5. What the Tubes Do in a Superhet. R. F., A. F., Detector, and Oscillator Tubes Are Needed

If You Don't Mind the Price

This style of set has many variations, but the basic principle is the same for all of them. It represents what is probably the last word in complication and also in selectivity. Its chief objecton is its cost and the difficulty of locating any trouble which might develop.

In conclusion, we may say that other set names mean slight and for the most part unimportant changes from the styles which we have just described. It is something like the different makes of typewrters. There are only a few different kinds of action but a great many manufacturers and each one has to have something to talk about to sell his particular machine.

PHEASANTS DON'T SWEAR

If you see a beautiful parrot who swears loudly and fluently in Portuguese don't mistake him for a pheasant; just mark his location and notify the postmaster at Fillmore, N. Y. Friends of a Fillmore lady have asked WGY to broadcast for the missing bird; they are afraid that hunters will shoot him.

Dividing the Air Among 563 Stations

How the Government Treats the New Broadcasters

By HERBERT HOOVER, Secretary of Commerce

IN view of the very rapid changes in radio in the last six months, and in order to give greater clearness to the policies of the Department of Commerce, it seems to me desirable to review the situation.

There can be but one point of view in the consideration of radio regulation and development. That is to assure increasing service to the listener. Radio is steadily enriching our homes. Particularly to our farmer folks, it is bringing more of those contacts that the town populations have alone enjoyed up to this time. The road of progress is to stimulate the development of the art; to prevent interference between broadcasting stations through competition; and, to secure better reception, increase in the number of stations which may be selected, and better programs.

Don't Count Radio Golf

There are to-day 563 broadcasting stations either in operation or being built. Of these, 455 are Class A (of 500 watts power or less) and 108 are Class B (over 500 watts). It is generally believed that Class A stations have a radius of good practical reception of not more than 25 or 50 miles, while Class B stations with their larger and increasing power have a much wider radius. By "practical reception" I do not include the pick ups which radio listeners are able to get by playing radio golf, but the effective, useful, reliable reception of programs which must be the real purpose of radio.

The recent policy of the Department is to allow the broadcasting stations to raise their power toward a possible maximum of 5,000 watts. This will mean that the distance such stations can be heard serviceably will be greatly increased, and the reception itself within the present radius will become very much more reliable. This is of particular importance to our agricultural people, especially in summer and during the daytime. The present plan in this particular is to permit advance in power use in blocks of 500 watts, resting at each stage (1500, 2000, etc.,) to determine what interference with other stations results. Probably 20 or 30 Class B stations are now planning to increase their power, or have already done so. It is quite possible that good serviceable reception will be obtained for a radius of several hundred miles from such stations, thus increasing the alternative programs for listeners to choose from. This advance toward 5,000 watt stations has no relation to the so-called "super power" 50,000 watt stations.

Cutting to 7 kc. Won't Do

The most difficult problem in radio regulation and development is the assigning of wave lengths to the various stations so as to prevent interference between them. There are in all 86 different frequencies (number of vibrations per second) available if we keep the stations ten kilocycles (10,000 vibrations) apart and stagger the assignment of waves geographically so as to prevent overlap in the area of effective

Cherry-Blossom Listens to an American Made Set That Can Talk Japanese

reception. Recent experiments were made by the Department in attempting to increase the number of different waves by decreasing the difference in frequency between them. This difference was reduced from 10 to 7 kc. However, this proved unsuccessful with the present development of instruments.

Class A stations (500 watts or less of power) were assigned the frequency of 1,080 kc. (278 meters) and faster, by recommendation of the Radio Conference and there are in this area 39 possible waves. Owing to their limited radius and the irregular character of their programs (largely churches, educational institutions, etc.) Class A stations have not presented so many difficulties in wave assignment and interference as those of Class B, although there are 455 of them to be squeezed into these 39 channels.

Dividing 47 into 108 Pieces

Class B stations present a far more serious situation because of their wider radius and their regular performance. There are 47 waves (which with the 39 just mentioned make a total of 86) to be divided over a total of 108 stations now operating or under construction. That is, there is now an average of less than one wave for each two stations, which means that they must divide their time of operation. The Class B stations are the ones which furnish most of the regular programs and from which the public receives its most effective service. Most of them naturally want to operate every night as the cost of overhead is much increased by dividing time.

The Department has asked Congress for money with which to carry out a test to determine the effective service area of different stations and different amounts of power. Such an investigation may show the way to a better basis of frequency distribution.

The Two Worst Cities

One of the great difficulties in giving out the different waves arises from the tendency of stations to crowd together in the big cities. The worst conditions are at Chicago and New York. At Chicago five wave lengths are available for 10 operating Class B stations and there are several others in course of construction. For New York there are six wave lengths to be dealt out among 8 Class B stations and more are being built.

It is impractical to increase the number of different waves available to these cities, first because they are all in use in other communities, and also, because it is absolutely necessary to have a wide separation in frequency (kilocycles) between stations so close together. Otherwise they would neutralize each other. Such an increase in these centers gives no better service to the public, and if further dividing up the time is forced, it will decrease the value and efficiency of the stations already running. Neither under the present law nor under the provisions of the White Bill was there any limitation of the number of stations. It is important that those who think of entering the broadcasting field should clearly understand that there is no assurance that they can be allotted a Class B frequency, and justice maintained to radio listeners. The Department cannot give what it hasn't got. One reason for delay in passing radio laws has been the hope of determining whether or not it would be necessary to restrict the number of broadcasters.

VIOLINIST JOINS WJZ—WJY STAFF. New York City — The Broadcasting Division of the Radio Corporation of America has announced the addition of Godfrey Ludlow, famous Australian concert violinist, to the staff of stations WJZ and WJY, New York City. Ludlow is the first concert artist of international fame to enter the radio broadcasting field professionally. He is shown here holding his $50,000 Stradivarius violin.

Where the Code Comes From

There is so far but little interference between broadcasting stations. There is considerable annoyance from telegraphic code transmission, although it does not destroy the listeners reception from nearby stations. The code transmission is a problem of harmonics (double and triple frequencies) from telegraphing at lower speeds of oscillation (longer wave lengths), and is also a problem of foreign shipping. A good deal of such interference has already been removed and exhaustive studies are under way for its further elimination.

The great body of radio listeners in the country to-day have a choice of good practical reception of three of four different programs, and with the gradual advance in power in various parts of the country the number of effective alternative programs will shortly increase up to 8 or 10.

Will Big Groups Kill Locals?

The interconnection of stations has made distinct progress in the last six months. Programs are being broadcast from a number of stations regularly over the northeastern states. There is evidence that regular interconnection into the Middle West will come in the near future. I believe that national interconnection for important national events is bound to happen, and is one of the most serious missions of the radio. It does not follow, as some have assumed, that this would displace local programs, for such events do not take place at the same time each day nor do we usually expect them (except political conventions!) to last more than an hour. The payment of artists for broadcasting has already begun, and it is my present belief that it is only a question of time until stations will join together in groups and bear mutually the cost of interconnection for national programs and events of importance

thus effecting somewhat the same organization which our newspapers maintain through the press associations.

A misapprehension which I would like at this time to correct is that any suggestion has been made by me or the Department of Commerce, that there should be a tax on the sale of radio material for the provisions of a national program. Such proposals were discussed at the recent Radio Conference but were abandoned and at the present moment it seems evident that from the vast increase in broadcasting stations there is no need for an indirect charge upon listeners in order to secure service.

The broadcasting stations deserve the appreciation of the public for their efforts to serve the listener, for the constantly improving character of their programs and the maintenance of a very high moral standard.

About That Radio Trust

There is no monopoly in radio broadcasting or any sign of it. There are only four or five concerns in the United States which own or operate more than one station, and of the total of 563 stations in action not more than four belong to any one of them.

Some misunderstanding seems to have arisen, due to failure of many people to read the White Bill and the recommendation which I made to Congress for the postponement of legislation for the control of radio until next session. The law of 1912 secures to the Government the fundamental control of radio, for it retains in its possession the channels through the air, just as effectively as it does the channels of navigation upon our rivers. There can be no monopoly unless the Government deliberately allows it, and that would be parallel to giving some one the exclusive right to sail upon one of our rivers.

Passing New Radio Laws

The radio laws proposed heretofore were based solely upon our knowledge of the development of the art now two years old. That legislation contemplated giving very great authority to the Secretary of Commerce, his discretion being almost unlimited, and very much broader than anything which I prepared as a temporary measure. There are some things, such as the assignment of wave lengths and limitation of power use, which are absolutely necessary for the conduct of radio. My recommendation for immediate action was narrowed down to this field, leaving the bigger issues of regulation until we have enlarged knowledge of the art and of the problems which we are now facing. These milder proposals were in the direction of reducing departmental authority, not increasing it.

Nor has the Department ever proposed the control of programs, as has been said, but on the contrary always opposed it. The character of the matter sent out must be left to the stations themselves, and they in turn, must be governed by the wishes of their listeners. The public will unquestionably turn to the station from which it gets the most worthwhile material, and in any event, interference by the Government in the kind of programs would certainly mean censorship. It would deny the fundamentals of free speech and free spreading of information.

A Complete Flux

The whole art, both from the point of view of its expansion, the number of stations, kind of programs, and the purposes of the broadcasters is still going on in increased use of power and in improved instruments and better and wider radius of reception to the listeners, together with the complex social and legal problems involved, is in a state of complete flux, and it is my feeling that our ideas as to the character of government regulation will be clarified within another year. In the meantime, the fine co-operation of the industry is preventing any lessening of public interest, and free competiton in the development of the art is bringing fine results in public service.

WHEN VEILED LADIES WARBLE

Hist! Sh! Absolute secrecy is the watchword of the Brunswick Recording Laboratories every Tuesday evening. Heavily veiled ladies dash down deserted corridors and dodge hurriedly through quickly closed doors; puzzled radio operators sit in a locked antechamber and modulate the program coming from a microphone to which they have no access; a wondering orchestra plays accompaniments for a singer hidden from them by a heavy screen; and elevator-man and electricians stand in little groups with complete bewilderment written large on their faces.

The Radio Music Memory Contest started by the Brunswick-Balke-Collender Company early in February through stations WJZ, New York, WGY, Schenectady, WRC, Washington, and KDKA, Pittsburg, has brought into existence the most unique broadcasting methods ever employed. With hundreds of thousands of listeners in every part of the country competing for the $5,000 cash awards to be given to those guessing the largest number of artists' names and compositions, it is imperative that no whisper of the identities of the singers leak out from the Brunswick studios.

Announcer is Locked Out

For the first time in radio history an announcer introduces an artist whom he cannot see. The announcer is seated in a tiny room separated from the broadcasting studio by a heavy locked door; a tiny electric light is before him, connected to a button-switch beside the microphone in the studio. When the artist finishes each number the button is pushed and the announcer takes the air; when the next singer is ready the button is pushed again, the light goes out, and the announcer ceases talking.

The members of the Brunswick Symphony Orchestra, which accompanies the singers, cannot see for whom they are playing; a heavy screen separates the microphone from the remainder of the room, and the singer is behind the screen. The wave of a hand over the top of the screen is the signal for the orchestra to commence the next number.

They Whisk by Unknown

None of the artists singing in the contest programs know who the other artists are. Each artist is ushered into a tiny waiting-room immediately upon entering the Brunswick Laboratories, and there they wait until their turn arrives. Immediately after they have concluded their program they leave the building. They wear heavy veils or scarfs over their faces as they enter and leave the building, lest the elevator-men or any curious bystander recognize

Continued on Page 12.

Portrait of Popular Performer

Radio Traveller—WIRT W BARNITZ, editor of "Journeys Beautiful", has described over eighty queer corners of the earth to more than three-quarters of the population of the United States in his frequent "radio travelogues" broadcast by stations WJZ and WJY, New York City.

WHEN VEILED LADIES WARBLE

Continued from Page 11.

them. Cars with drawn shades whisk them to and from the studio.

Only one man in the country knows who all the artists are. William A. Brophy, Director of the Brunswick Recording Laboratories, arranged the programs; and he ushers the artists from waiting rooms to studio every Tuesday. Everybody else in the Brunswick-Balke-Collender Company and the Radio Corporation of America's broadcasting division are asking themselves the same question that countless radio fans are asking—"Who are they?"

HOLIDAYS HELP HEARING

The fascination of the "rumble of a distant drum" is apparent in the interest which foreign radio fans, especially those of the British Isles, find in logging American broadcasting stations.

A few days after a holiday the foreign mail of WGY, for instance, shows a very decided increase in volume. The English fan is enthusiastic enough to lose a few hours sleep to hear America but he prefers to listen on the morning of a holiday.

LIGHTNING'S HARM REPAIRED IN 15 SECONDS

A review of the year's operation of WGY, the Eastern station of the General Electric Company at Schenectady, N. Y., shows that the station was on the air 1630 hours during 1924, an average of about four and one half hours per day. WGY is not running Wednesday evenings except on very rare occasions under special permit from the radio supervisor and Monday evenings the station leaves the air promptly at 9 o'clock at which time WHAZ of Troy, N. Y., is licensed to hold forth. In 1923 the total of operating hours was 1106.

The increase of operating hours for WGY from 1923 to 1924 is due to the larger activities of the station and also to the broadcasting of the national conventions of the Republican and Democratic parties as well as several campaining speeches by the presidential candidates.

The efficiency of the station, during the period it was on the air, was 99.99%. This record speaks well for the watchfulness and skill of the radio engineers who run the station. These men, who are never heard by the radio audience, are responsible for the quality of the signals, and on their quickness depends the continuity of the program. During 1924, there were seven interruptions of the programs from WGY, due to apparatus trouble, and five of these breaks came during daylight transmission. The total time lost was thirty-six minutes. On one occasion, lightning struck the antenna and burned out meters and condensers. Service was suspended fifteen seconds, the time required to bring spare parts into commission.

Cleaning Up a Fortune

"What are you crying for my lad?"

"'Cause father's invented a new soap substitute an' every time a customer comes in I get washed as an advertisement."—Radio Merchandizing.

Her Donation

Canvasser—"Madame, will you donate something to the new hospital?"

Mrs. Clancy (who has just finished an argument)—"Well, ye might step in an' take a look at Clancy. Maybe he'd do."—The American Legion Weekly.

How Radio Keeps Your Lights Burning

It Helps the Central Station to Keep the Lines in Order

By EDWARD W. SMITH

EVERY day we hear of some new application of the principles of radio. Since the advent of the vacuum tube and of radio broadcasting, more and more inventors and scientists are turning their minds and endeavors toward using the principles of radio for other means of communication.

We read in the magazines (See RADIO PROGRESS for January 15, 1925) of the successful transmission of photographs, and for that matter anything printed, way across the ocean. Recently radio has been adapted for use as a beacon to guide ships and airplanes along specified channels, perhaps saving the life of some friend of yours. It has even been used in experiments to transmit moving pictures. It is quite possible that before many years are over we shall be able to see the speaker at the broadcasting station as well as hear him.

This will be an advantage for some of the men who broadcast, who at present make the most elaborate gestures before the microphone. All the wavings of arms which are now wasted can then be seen by a spellbound audience.

Pinch Hitting for the Phone

One highly important field of radio which is not very well known, is its use on power lines to replace the telephone—act as an emergency channel of communication when the phone lines fail.

It is like the baseball game, when a crisis arises. With two out and the bases full the manager will often put in a pinch hitter who can be depended on to save the day. It has usually proved to be the case, in times of great emergency such as a terrible storm that the telephone line has suffered so much that its use as an emergency line was impossible. On all power systems of any size there is located usually in a central position a "load dispatcher," as he is called, whose duty it is to keep a general watch over the system, and to arrange for the supply of power to and from each generating station.

Watching the Needle

For instance, dark clouds suddenly gather in the southern part of the city. The dispatcher watches the Ammeter needle which indicates the load on the station supplying that section. Up and up it goes, showing 50, 60, 70, until it looks as if it would run off the scale. Immediately he calls up the station and tells the operator to switch on generator No. 2, which will carry the peak.

In times of severe storms or other conditions which may cause the shut down of certain stations he must be able to keep in touch with all generating plants and arrange for supplying power by some other means to the stricken district. Up till now, all communication was carried on by means of the wire telephone, these lines sometimes being leased from the local telephone company, and sometimes built by the power company paralleling their transmission lines for their own use.

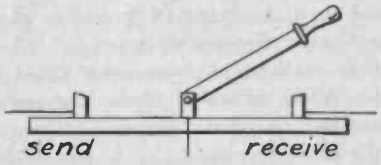


Fig. 1. Old Scheme—Listener Must Throw Switch

In addition to the heavy expense of leasing lines, building them or paying for roll calls, there was the further difficulty that the telephone lines frequently were in difficulties at the same time as the power system.

Only a tornado or a heavy coating of ice will break down the big cables used for carrying light and power while a much lighter storm often puts the small telephone wires out of business.

This frequently was the cause for longer lapses in the power supply than otherwise would have been the case. The load dispatcher, in order that he may keep the system running smoothly and with maximum efficiency, must be supplied with some means of communication at all times. It cannot be a system which is going to break down at the very times when it is most needed and cause endless trouble at the moments when a great deal depends upon its working smoothly.

The imperfections in the present method of point to point communication along the line led to the consideration of some new channel of communication which could be depended upon at all times. Such a new scheme must have charactertistics somewhat as follows: First of all, it should be something that could be depended upon to allow quick and accurate conversation at all times. This of course means that it must not fail at crucial moments when it is most important that it should be working. Next it should be capable of use at any and all points no matter what the condition or nature of the country. By this is meant that it should work over rough and in inaccessible country. When the snows of winter drift to ten feet deep in valleys, it will hardly do to have to send out a lineman to fix up the insulators that the frost has damaged. And when a sudden thaw in springtime sends the currents down from

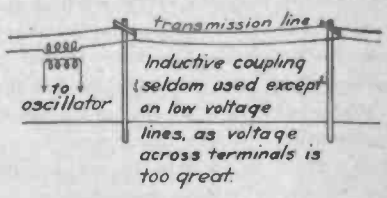


Fig. 2. Coupling for Small Stations

the mountains and floods the country, (as is happening at times this spring) the Central Station does not want to report to its customers that their lights will be out for a week or so until the flood subsides.

Must Talk Both Ways

A third need is that the cost of operation should not be much greater than with present systems. Calling must be simple and quick and "duplex" operation should be incorporated whenever possible. "Duplex" means operation as with the ordinary telephone—that is, the operator can talk and hear at the same time.

Otherwise the operator may tell the chap at the other end the story of his life only to find when he finishes that something has happened and not a word of his long talk has got through. Have you noticed that on a telephone if the person at the other end has a long mes-

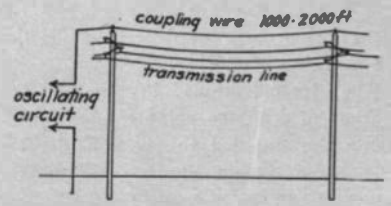


Fig. 3. Broadcasting to the Electric Light Wires

sage to deliver, he expects you to say, "Yes," or "Um-Hum," or the like every few minutes to show that the conversation is reaching you.

Ordinary Radio Won't Do

It is not satisfactory for such load dispatching to use ordinary radio for several reasons. In the first place it is not reliable enough. Remember how static and storms are apt to disturb reception, even over a comparatively short distance. And some of the electric light companies' wires extend for 150 or 200 miles, particularly in the West.

Another objection is the difficulty of getting a wave length to use. The government requires every sending station to take out a license, and you know how much trouble Secretary Hoover is having right now to divide up the few available wave lengths among the many broadcasting stations which want to use them. If it is so hard to get permission to use a certain frequency of vibration (wave length) for public use, it is so much harder to try to monopolize one of these sending channels for private needs.

Interrupted the Funny Story

Still another drawback would be the good will lost to the Central Station by a large proportion of their customers. Suppose right in the middle of a funny story being broadcast just as the point was reached, you suddenly heard your electric light company butting in with the remark, "Throw No. 2 generator over on Line F and cut out the third oil circuit breaker." Such interference would give any company a black eye. No, it will not do to use ordinary broadcasting as a substitute for the telephone lines used in the past for load dispatching.

With these ideas in mind investigation was commenced by several large companies looking toward the use of radio frequency vibrations directed by the power lines themselves to carry the voice currents, as this seemed to be the most feasible method of meeting the requirements. Experiments were carried on with a view to determine which particular frequency (speed of vibration) or band of frequencies would be the most suitable. These frequencies ranged from a few thousand cycles (oscillations per second) up to about 150,000 cycles as these were the only frequencies allowed by the government for such use. It was found during this experimentation that at the lower frequencies, that is, in the neighborhood of 10,000 cycles, resonant effects were encountered in the transformers.

Waiting for Wandering Wave

In other words, the transformer coils acted just like the coils in your radio set. When you want to pick up a given station like KDKA you adjust the tuning to the point where you know they will come in. Instead of that, it would be possible to turn your dials to some position and then wait until a sending station went on the air with the particular frequency or wave length which happened to correspond with the setting which you had made. Of course, the coils in the transformer can not be adjusted, but they will tune to some particular frequency. When this speed of vibration happens to be impressed on the line, then a horrible howl will be heard in the phones which of course, prevents this speed from being used.

Wasting the Energy

As the frequency was increased this trouble from resonating or tuning in the transformers disappeared. But the attenuation or weakening of the signal by losses increased very rapidly. The faster the oscillations are, the more absorption there is by surrounding objects like transformer cases, switch gear, metal poles, and the like.

Needing a License

Also the higher frequencies radiated a large portion of the energy instead of transmitting it along the line. Such a condition would require the operators of the stations to have government licenses, in addition to the fact that tube radiation might cause considerable interference.

A middle path was chosen between low and high wave length with the idea of avoiding both resonance losses in the transformers and the bad attenuation at high frequencies. This of course cut down to a great extent the number of available channels, which we shall see later causes considerable difficulty.

How to Talk and Listen

The feature of duplex operation which is highly desirable in a system of the sort we have been considering, has been solved by two different schemes of operation. As many amateurs know true duplex operation can be carried on only by the use of two different frequencies far enough apart to prevent audible beats between them. Thus one of them is used for "A" to talk and "B" to listen, while the other lets "B" talk while "A" listens. Since they are both going at once, both stations can talk at the same time if one wishes to interrupt the other for an instant.

One of the systems now on the market employs the above method of using two different frequencies to accomplish duplex operation. This method is excellent where the number of stations on one line is limited to two or three but, as may readily be seen, when several more stations are needed the lack of sufficient number of channels becomes quite a problem.

Switching the Speech

While true duplex operation as has been mentioned above can only be accomplished by the use of two frequencies, a very close approximation of it has been accomplished by another prominent concern by the use of only one frequency. With this system it is necessary that a switch be provided to change from the "send" to the "receive" position and back again. In the early models this was carried out by means of a switch which had to be thrown by the speaker himself. This was found to be rather inconvenient. See Fig. 1. But further development resulted in marked improvement. The manually operated switch was removed, and the change from "send" to "receive" automatically brought about by the speaker's voice.

As soon as the operator at one station started to speak the change in pressure on the diaphragm of the telephone was utilized to operate a relay which threw the set into the transmitting position. As soon as he stopped talking, the set went back to the "receive" position. The resultant effect is the same practically as true duplex operation, and in addition it saves one frequency band which is very desirable with the scarcity of available channels.

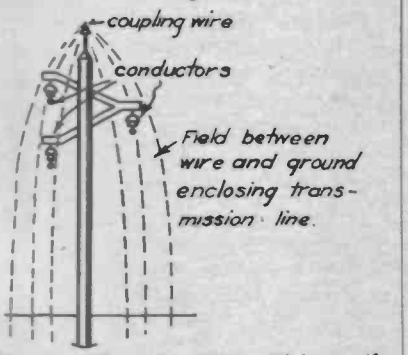


Fig. 4. Why the Wires Pick-up the Music Waves

Getting the Waves on Line

The problem of coupling the oscillating circuits of the transmitter to the power line is possible by either inductance or capacity. The inductance method is like using a variometer or coil to tune your set, while that of capacity corresponds to tuning by means of a condenser.

Experience has shown that the capacitative method is the better for systems that are to couple on to a line of 33,000 volts or higher. With the inductive scheme it is almost impossible to get enough coupling without having a very high voltage across the terminals of the coil. With the capacity method a wire is suspended on insulations above the transmission lines, (Fig. 3) or as near this position as possible. Placing the coupling wire in this position puts the transmission line into the "field" (influence) between the coupling wire and earth and allows maximum transfer of energy. It is the only practical method so far developed for coupling to the lines. See Fig. 4. Hooking up through condensers has been attempted, but the construction of a condenser able to do the work satisfactorily is a problem which has not yet been solved.

Large Power on Tap

Transmitting sets now on the market for use on power lines for load dispatching and the like use an amount of power which will probably seem large to the radio fan who knows of fifty watt stations being heard several hundred miles. The two sizes most commonly used are 50 and 250 watts. The 50 watt sets are used on lines which are in the neighborhood of 30 miles or less in length and free from many taps or branches. Greater distances and lines having a large number of taps usually need the higher power. While this amount of power seems rather large, it is best that sufficient power be available at all times to overcome any noises that might develop in the line in order that uninterrupted service may be assured.

Since the whole idea of this new scheme is to make it reliable though the heavens fall, the waste of a few watts of power for extra sureness is not counted at all. The receiving sets at these stations consist of the ordinary detector and two stage audio combination similar to that of the radio fans and is either used with head phones or a loud speaker.

Why You Can't Hear It

Of course, since the speed of oscillation is low, which means a long wave length, it is necessary to be able to tune the receiving sets to the wave in question. This needs larger coils and condensers than will be found in the average radio.

The Sending Apparatus

The transmitter in one type of installation now on the market of the 250 watt size uses a 50 watt tube in a master oscillator system to excite the grid of a 250 watt tube. A 250 watt modulator bulb and the usual speech amplifier tube complete the transmitter proper.

The power supply which is used to heat the filaments of the bulbs and furnish the 2000 volts to the plates of the large tubes is obtained from a motor generator set. The latter is run from a storage battery which is kept up by a "trickle" charge from the mains. A storage battery power supply is almost invariably used, as it gives an independent source of power if the occasion requires it.

How to Operate It

Operation of the set when it is installed is simplicity itself. Calling is carried out by pressing a button which sends out a prearranged series of impulses, which actuate only the relays at the station being called. This lights the tubes at the wanted station and calls the operator's attention by either a buzzer or bell. Removing the receiver starts the motor generator for the transmitter and conversation is then carried on just as with an ordinary telephone.

In conclusion it may be said that carrier current systems for use in load dispatching and the like along the lines have been found very satisfactory and the increasing number of companies installing them is sufficient proof that they are practical and efficient in all respects.

Sat Upon

Dad—"Stella, who sat on that newly painted bench in the garden?"

Stella—"Harold and I."

"Well, you must have ruined your clothes—both of you."

"Not both—only Harold's."—American Legion Weekly.

Even As You and I

"Hello, old man! Whom are you working for now?"

"Same people. Wife and five kids."—Radio Merchandizing.

American Radio Relay League

U. S. NAVY TO EXPERIMENT

At the request of the navy department, which is desirous of testing the possibilities of high frequency (short wave) radio communication, F. H. Schnell, traffic manager of the American Radio Relay League, has been given leave of absence so that he may accompany the Pacific fleet during its maneuvers next summer. He will be on active duty from the middle of April until about October 1st, with the rank of Lieutenant.

The high frequency transmitter which Mr. Schnell is to install and operate for the period of the cruise will be used for communicating with amateur members of the A. R. R. L., in the United States and foreign countries. The object is to compare the efficiency of this low power outfit with the regulation navy sets.

Will High Frequencies Do Better?

This investigation by the navy department through a civilian radio organization of national scope is regarded as an appreciation of the amateur development of short waves. The navy thoroughly appreciates the economical advantages of the amateur transmitter and it now purposes to determine how its range and capabilities compare with high power sets.

The amateur transmitting stations in common use are prohibited by the Government from operating with more than one kilowatt (1000 watts) of power while the navy sets employed on shipboard sometimes go as high as 30 kilowatts. There is also a tremendous difference in the expense of installing the two, the high power stations costing several thousand dollars, as compared with a few hundred required for setting up the average amateur set.

New Station Call

The high frequency transmitter designed for use during the cruise, has been given the call NRRL to identify it as the special navy station for communicating with the amateurs of the American Radio Relay League. While this set will operate on a frequency of 5,500 kilocycles, (54 meters), Mr. Schnell will take with him two personal transmitters for use on 7,500 kc. and 15,000 kc. (20 meters).

For a long time the Navy Department and the A. R. R. L. have been associated to a certain extent in an investigation of radio transmission by such waves. This was particularly evident during the transcontinental flight of the airship Shenandoah, on which was installed a special set for communication with amateurs. The result of this test was so important that navy officials commented upon it favorably and thanked co-operating amateurs.

The tremendous range covered by amateur senders with their one kilowatt of power has so impressed the Navy Department that a thorough study of their operations under all kinds of atmospheric conditions appeared to be worth while. The fact that Mr. Schnell has had both navy and amateur experience, doubtless had considerable influence in his selection.

He Took Wilson to France

During the World War, Mr. Schnell was connected for a time with the transatlantic control office of the Director of Naval Communications at Washington, D. C. He was also radio operator in charge on the U. S. S. George Washington, when it carried President Wilson to France. He entered the navy in May, 1917, and was stationed at Great Lakes until October of that year. While in Washington, he copied the peace acceptance message from Germany and acknowledged its receipt.

FINAL REPORT ON ECLIPSE TEST

The eclipse committee of the American Radio Relay League has just completed its final analysis of the reports turned in by 159 amateur observers relative to the effect of the eclipse on short waves ranging from 40 to 200 meters. The investigation was made in conjunction with the fading tests on broadcast waves arranged by the Scientific American. Fifty of the reports were sufficiently accurate to be used as a basis for study.

These showed very plainly that on the 4,000 to 3,750 kc. (75 to 80 meter) band there was a decrease in signal strength beginning or during totality while on the 2,000 to 1,500 kc. (150 to 200 meter) band there was an increase in signal during this time. This leads to the possibility, according to the committee, that the 2,000 to 1,500 kilocycle waves are best for night work while the other band would probably prove more efficient in daylight.

They Don't All Agree

The observers were by no means unanimous in their reports and the conclusions are drawn on the work of the majority. Some of the observers on the higher speed band reported an increase in receiving strength immediately after totality. Others placed five minutes after totality as the time of return to normal conditions. The majority on the same waves reported considerable fading. One exception was in the case of a Canadian amateur transmitter which three observers declared showed an increase in strength during totality.

There was a pronounced lack of any unusual phenomena although many observers reported that at the time of totality there was sudden static, frying noises, mush or crackling sounds; but, all of it may have been due to increased line current or power leaks from the electric light cables.

SINGING TO BEAT THE BAND

The Remington Typewriter band playing at WGY, Schenectady, accompained a church choir singing at Providence, R. I., broadcasting station, according to E. L. Fuller of the latter city. "The band," writes Mr. Fuller, "was playing a medley including 'Massa's in the Cold, Cold Ground" and the choir was singing the same song at exactly the same time. I made a split on dial setings and could get both. The band kept perfect time for the singing until the last few bars when the band won out."

When the Announcer's Phone Rings

Some of the Funny Questions and Stories Which Are Heard

An Interview with H. W. Arlin

ANNOUNCING radio programs might be called the world's most recent profession, because announcers for broadcasting stations were first introduced to the waiting world about four years ago when KDKA, the world's pioneer station was started by the Westinghouse Company at East Pittsburgh, Pa.

H. W. Arlin, the world's pioneer radio announcer made his debut early in 1921 and has been continuously "on the air" (but not up in it) ever since. Thus his long service entitles him to the honor of being the veteran of radio announcers.

He Needs Lots of Pep

Mr. Arlin's studio experiences have been many and varied. Life as a radio announcer is not a drab affair as there is a necessity of being continually on the "qui vive."

In this interview Mr. Arlin tells of a few of his studio experiences and some interesting contacts with his radio public.

"I am often asked the question, 'Do you become tired of announcing?' or 'Does radio work become monotonous?' My answers to such questions are always in the negative, thanks to an ever curious and an assisting public. By such an answer, I mean that any monotony which might otherwise creep into the almost continual execution of programs is quickly dispelled by a host of extra duties with which an announcer is confronted.

You Can't Please Them All

"Probably one of the most interesting phases of studio work comes through contact with the public, not entirely by personal association but also through the telephone and telegraph. No work can become monotonous or tiresome where the public is involved. On the contrary, I have found that a study of the whims and fancies of the public has been an exceedingly interesting one. Paraphrasing a famous expression, you can please some of the people all the time, and all of the people some of the time; but you can't please all of the people all the time. Not in radio, at any extent.

"This statement could be applied to the view of the public on any one phase of radio entertainment such as music or sports. When applied to all the phases of radio it becomes many more times effective. What one person likes, another dislikes and what one man condemns, another approves, so an announcer is almost justified in concluding that a fifty-fifty break with the listening public is fair enough. However, 100 per cent. satisfaction is always the goal.

(C) BY MOHAWK ELECTRIC CO.

The Lighthouse Keeper finds radio waves are more powerful than ocean waves, and likes them better, too.

Feeding Sick Babies

"In telling of the announcer's contact with the public we may, for instance, take in to consideration only one phase of this contact; that of telephone conversations. The nature of the telephone messages received, together with the conversations that follow, undoubtedly create a desire for the study of people. The thoughts and ideas which prompt these many calls are innumerable; perhaps some one conceives a scheme by which radio can be an aid to him in his own personal advancement or the furthering of some pet theory; or possibly someone wants some information which may vary from a query regarding the proper food to give a sick baby to that of certain details about a program to be broadcast several weeks hence.

"A few of the seemingly endless number of such questions and requests may be of interest. One of our good Canadian friends recently called to tell us about a circular parking station he had invented for automobiles which would handle two hundred cars and which could be operated by one man. Appreciating the need for better parking service and predicting great success for his venture he requested that we advise the radio public of his invention with full details as to where to purchase these stations.

Page the Pajamas

"A lady calls up and requests that we announce that she has just left a package of pajamas on the street car and would like to have the service of the radio in recovering them. After being informed that we never make local announcements except in cases of robberies, kidnapping, lost persons and such emergencies, she replies, 'Well, this is an emergency case, because it is the only pajamas I had.'

"An elderly lady, apparently a student of nature, calls and gives us the following important news item: 'Will you

please announce that there is about four inches of snow in my back yard and that I have just seen two cardinal red birds.' Of course, a very unusual sight for this time of the year.

Broadcasting to Ohio

"No sooner is the telephone receiver on the hook than the bell again rings and an innocent feminine voice pops the following impression. 'I just heard you announce that you had received a telegram from New York commenting on the program. I want to know if you are also broadcasting to Ohio to-night, as I would like to request a number for some friends out there who do not have the advantages of a radio.'

"It has also been brought very forcibly to my attention that radio has made a greater impression upon the public than has music. Of the many proofs of this statement I might cite an occasion on which a program was being presented by the great Fritz Kreisler. The telephone rings and the following question comes from one of our listeners: 'Do I have to listen to that novice all evening?' a very provoking question to ask an announcer on such an occasion. He was then asked if he knew whom he was listening to, and after replying in the negative, was very politely told that if his set was not working properly or that if he didn't appreciate the music, he knew what he could do. This apparently, answered his first question satisfactorily, and was an answer which fortunately savored very little of the thoughts that were running through the announcer's brain.

Singing "Red Hot Mamma"

"A lack of appreciation for the success of artists or for the numbers used by them sometimes results in requests which provoke a smile from the person to whom they are addressed. When presenting a program at KDKA recently, Mrs. Christine Miller Clemson, who before her marrage was one of the country's contraltos and a concert singer with an enviable record was requested to sing the jazz number, 'Red Hot Mamma.'

"Perhaps one of the most common requests received is that an artist sing a particular number. In spite of the fact that there are thousands of songs, a good many listeners cannot quite understand why the singer does not have with him the music for the particular number they ask for. Song pluggers are requested to sing 'Arias' and grand opera stars are wanted to sing jazz numbers by the well-meaning audience. It also happens quite often that in spite of the fact that we receive hundreds of requests for numbers during a particular evening some well meaning individual is at a loss to know why his particular demand was not granted.

New WJZ Star—WILL HOLLANDER, director of the Hotel Ambassador Dance Orchestra, has arranged a series of Tea-Time Radio Concerts to be broadcast every Wednesday and Friday afternoon by WJZ, New York City.

"One evening the following message was received from a new comer in town. "I have relatives living some place in the city but do not know where they are located. Inasmuch as they are not expecting me, will you please announce over the radio that I have arrived here and am waiting for them to get in touch with me?'

He Aged Very Suddenly

"One evening the announcement was made that Evan H. Lloyd, well known tenor, would sing a certain number at the request of an invalid woman, 83 years of age. No sooner had Mr. Lloyd finished the song than the telephone rang and one of our interested listeners said: 'Will you please congratulate Mr. Lloyd for me. It seems almost incredible that a man 83 years old can sing like that.'

"Oftentimes a party will call and ask the following question or a similar one. 'I have a five-tube neutrodyne set and cannot hear anything. Will you please tell me what is the matter with it.' The opinion seems to be quite prevalent among a good many listeners that the wave length determines the distance which a station can be heard, and usually the belief prevails that the distance a station can be heard varies directly with its wave length. This opinion is the cause of some very humorous questions being asked.

Being General Information

"Among the innumerable questions asked are such inquiries as these: What time is it? Where is station WXY located? What is the name of the waltz that the band played last Saturday night? What is the wavelength of station WXY? How far are you broadcasting to-night? Who is going to give your program on the 2nd of next month?' etc.

"And so the announcer soon finds himself converted into an information bureau from which the dissemination of news adds a very colorful diversion to his vocation."

LETTUCE UP TWO POINTS

Newspaper readers sometimes wonder why their favorite journal devotes space to shipping news, incorporations, surrogate's court news and other items of small interest. By the same token many radio fans wonder why a broadcasting station offers produce market news, a report on the movement of lettuce or the stock market quotations. There is a demand for every feature carried by a newspaper, or else it wouldn't be printed; so also there is a demand for every part of a radio program. For example, a correspondent recently wrote to WGY, Schenectady, that the chief value of his radio set has been the stock market reports received at 12:30 and 6 o'clock. "These reports," he writes, "have been both interesting and of intrinsic value to me and others who have received them about here."

Seven Ages of Radio

Business and Legal Sides of the Art are Developing

By Dr. ALFRED N. GOLDSMITH, Radio Corporation of America

PRACTICAL radio communication is now more than a quarter of a century old, and may fairly be said to have passed out of its infancy and into its period of early maturity. Radio engineering is fast becoming a special and exact division of electrical engineering. Commercially, the radio field has reached

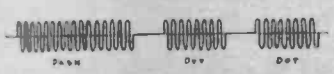


Fig. 1. Groups of Waves With High Damping

such proportions that it takes its place, at least in America, among the major manufacturing and sales industries of the country. It is interesting therefore, to consider the trend of the art during the last twenty-five years, and to study its evolution during that time.

The First Wireless Receiver

The first stage in radio may be termed the epoch of highly damped waves. A wave is called highly damped when it starts big and then rapidly peters out to nothing. This is shown in Fig 1. Notice that the first loop is large and that each succeeding one is much smaller. Each of these diminishing groups is called a wave train. It requires several such trains to make up a dot in Morse Code. And a dash needs even more of them. The relatively non-selective receiving methods of this time used voltage-operated detecting devices. The typical transmitter during this early period of the art was the spark coil which produced a succession of highly damped wave trains spaced far apart, in the antenna system. The radiation was very broad in its tuning since it covered a very wide range of frequencies, and was therefore sure to produce marked interference in all receiving sets. Such sets were not at all selective, and did not need to be.

The typical detector was the "coherer." This consisted of a glass tube with a small quantity of metal filings in it. A dry cell was connected through this tube to an electric bell or a buzzer. When no signals were coming in the iron filings had such a high resistance that no current would operate the bell. But when a train of radio waves struck the tube it made the little pieces of metal stick or cohere and this reduced their resistance so much that the bell would ring.

The Crystal a Big Improvement

The second period may be called that of the moderate decrement transmitter. In this case the waves would not die out nearly as fast but would act more like a pendulum, which swings a long while before it stops.

During this time spark transmitters, frequently of the rotary gap type, were popular. These gave a more frequent succession (close together) of moderately damped wave trains. They still covered a wide range of frequencies and did not permit truly selective signaling. The receiving set was only moderately selective, as it was hardly worth while to increase this quality to any considerable extent, when using such transmitters.

On the other hand, a great improvement was made in the receiving end. Crystal, and also electrolytic detectors were employed. Such units were better suited to use with reception by ear than the coherer, and accordingly the speed of operation was greatly increased.

Enter the Vacuum Tube

The third epoch may be termed that of the low decrement transmitter and the highly sensitive receiver. The one most typical of this epoch is the quenched spark transmitter which produces a large number of regularly spaced wave trains of low decrement each second. This method of sending produces a musical tone in the head set, and the listener can recognize and read dots

Fig. 2. Continuous Waves from a Tube Oscillator

and dashes in this tone, even though the noise of static is louder than the signals.

The receiving set was either the crystal detector, or employed the three-electrode vacuum tube. Audio frequency amplification also came into vogue. The new tubes soon showed that receivers of low decrement and high selectivity could be built, and that they would have a great sensitiveness. As a result one could choose the station which was wanted, and tune the others out, and it also became feasible to signal over long distances, especially at night and during the winter.

When Interference First Started

It became clear at this stage of the game that the scope and usefulness of the art were rapidly increasing. Whereas in the first place radio was used almost entirely for talking between ship and shore stations (and sometimes by the Army and Navy) its use for cross country signals increased somewhat during the second epoch; and during the third period it even began to be employed for transcontinental services. Powerful spark transmitters enabled long distance communication, which was quite reliable.

As a result of this increase in the use of radio, the congestion of traffic in the ether became very noticeable. Engineers bent their best efforts to build a sending and receiving system which should enable the use of a narrower band of frequencies for each separate signal.

Now we come to the fourth period in radio development—that of the continuous wave telegraph transmitter. Such a wave is shown in Fig 2. Notice that the height of each loop is just the same as the one before—that is one reason why it is so much easier to tune to this kind of vibration. The transmitters in this case were either arc oscillators or radio frequency alternators. Unlike all earlier types, they produced continuous wave trains.

The receiving set was generally based upon the production of a beat note or squeal between the currents caused by the incoming wave and radio frequency currents of slightly different frequency produced by a local oscillator. This squeal is the same as the "birdie" which you get in your set when some kind neighbor turns up his tickler too high and then twirls his dials. The only difference is that in the latter case the squeal does him no good and makes you think dark thoughts while for receiving code signals such a whistle is what the operator wants to listen to.

The Present Age in Broadcasting

We now come to the fifth epoch in radio communication, which we are living in now. It may be called the age of continuous waves (shall we say, permanent waves?) While radio telephony had been known long before in an experimental way, it is only during recent times that it has become widely employed for broadcasting purposes. The transmitters used during this era for broadcasting generally employ powerful vacuum tube oscillators in place of the earlier arc or alternator.

A continuous wave which is varied in amplitude (loudness) by modulating it with the microphone is shown in Fig. 3. Just as soon as the vocalist stops singing the wave will go back to a shape where all the loops are the same height. The receiver is highly selective and depends, in the best sets, on several tuned electrical circuits either operating at radio frequency, or (as is the superheterodyne system) partly at a converted or intermediate frequency. Great sensitiveness is obtainable in these receivers, which employ a considerable number of the modern three-electrode vacuum tubes.

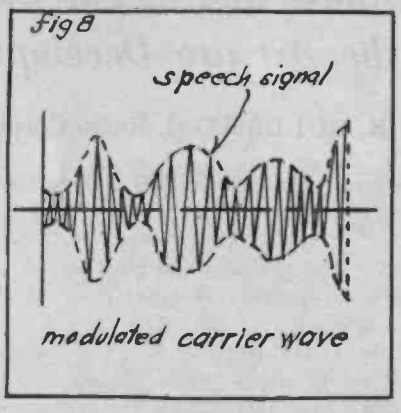


Fig. 3. The Varying Loudness Shows Wave Is Modulated

During this era, radio communication has become a household necessity in some countries through the advent of broadcasting. Radio telephony, between ships at sea, communication between persons separated by the oceans is at hand, but contrary to earlier opinions, the radio telephone service of maximum public value, has so far turned out to be broadcasting. Indeed, by its very nature, radio telephony is especially well adapted to covering large areas and addressing its message to great bodies of listeners. It "tells the world."

Commercial Development Interesting

The first commercial era, was that of individual apparatus. Small factories began to make transmitters and receivers, more or less experimentally, and almost always to meet the needs of a particular case. Only a few sets of a given model would be made for ship or shore stations, and because of the high rate of improvement, it was not possible to standardize even minor details of the equipment.

The second commercial stage was one which may be termed that of the manufacture of small groups of equipment. This came with the increasing development of commercial wireless, particularly on the water, and with the springing up of large numbers of wireless amateurs.

As shipping companies came to realize the advantages of wireless communication, they began to equip their fleets with sets on a large scale. The War Department of governments also saw the military advantage of such communication and so purchased increasing numbers of specially designed sets. The wireless "hams" bought mostly in parts, rather than as assembled sets. The resulting demand enabled a number of manufacturers to place on the market equipment which had been built in moderate quantities. The number of new inventions and the variable nature of the market were still such as to prevent much standardizing or modern large scale production methods. The sale of equipment was also conducted by only a few stores so that the buyer had to hunt for the market, and often could not find what he wanted.

One Million Dollars Per Day

And then, with great suddenness, the picture changed. We come to the third and present commercial era of radio, that of large scale production. With the advent of broadcasting, the market for radio equipment increased beyond imagination. The production of receiving sets and parts rose to huge proportions. The larger radio and electrical manufacturers applied the most modern and effective methods of large scale production in their factories. This brought about standardization of some parts, improvement in the quality of the product, and a reduction in its price. Vacuum tubes, hitherto almost a laboratory product, are now produced by the millions in lamp factories. In the United States, the radio sales business has risen to a million dollars a day.

From the Lawyer's Side

The first legal epoch may be classified as that of practically no regulation. Radio communication was either entirely prohibited (except for experimental purposes, or for certain other closely restricted fields) or else it was let entirely alone. In the United States, up to 1912 there was no radio law. In consequence certain abuses developed.

For example, in one of the largest cities in the United States, it happened that an important shore station was troubled by a nearby amateur. The lat-

ter had a powerful spark transmitter, that when he went on the air it jammed the commercial station and held up the paid messages. When business was pressing, the operator had to get the amateur on the phone and beg him to get off the air for a few minutes until he could get some important messages across. Sometimes the amateur would stop sending, but often he kept on pounding his key while the paid operator waited. It was clear that commercial wireless communication could hardly develop under such chaotic conditions, and in consequence much needed legislation was passed.

The second period might be termed the period of regulation by national laws. This covered in the main, marine, and in some cases, trans-oceanic communication. Call letters were given, and signals like "SOS" were agreed on.

We thus come to the third epoch, which we may call that of regulation of the radio art by *voluntary* co-operation among all interested.

Near-Music

Said the man who was trying his best to appreciate good music: "When a piece threatens every minute to be a tune and always disappoint you, it's classical."—*Congregationalist.*

Fooled Him

Professor (to Freshman entering class late)—"When were you born?"

Freshman—"On the second of April."

Professor—"Late again."—The DePauw Daily.

"SEE HERE! WERE YOU AND THAT YOUNG FELLOW SITTING IN TH' PARLOR WITH ALL TH' LIGHTS OUT??"

"OF COURSE NOT, FATHER DEAR. WE HAD THE TUBES IN THE RADIOSET LIGHTED ALL THE WHOLE TIME!"

Fone Fun For Fans

Speeding Problem

When a traffic cop overhauls you and asks you where you're going, tell him you were hurrying to buy tickets to the policemen's ball before they are sold out. This plan works anywhere, at all hours of the day or night.—Motor Age.

He Won

Ben Higgins never would be passed,
He bragged his car's endurance;
He passed six cars with backward glance,
His wife has his insurance.—*The Royal Family.*

Lady Shoppers

Mrs. Spriggs—"Do you need any shoes?"

Mrs. Briggs—"No."

Mrs. Spriggs—"Neither do I. Let's go into this store and rest while they try some on us."—Life.

Hinting It Gently

"I won't tell you what I think you are," stormed the floorwalker to the new clerk, who seemed balky and sullen, "but I'll tell you this: If I owned nineteen more just like you I'd hire out to haul borax!"

Satisfactory

Mae—"How did George take it when you told him you didn't love him?"

June—"Simply wonderfully! He carried on like a wild man."—American Legion Weekly.

Staggering Thought

"What would a nation be without women?"

"A stag-nation, I guess."—Mercury.

Sounds Reasonable

Teacher was telling her class little stories in natural history and she asked if anyone could tell her what a groundhog was.

Up went a little hand.

"Well, Carl, you may tell us what a groundhog is."

"Sausage."—Crosley Radio.

Identified

"Do you think that Professor Kidder meant anything by it?"

"What?"

"He advertised a lecure on 'Fools.' I bought a ticket and it said 'Admit One.'"—*Dry Goods Economist.*

DO YOU ENJOY PAINTINGS?

A series of talks on "Art in Everyday Life" is being given each week on Thursday evening from WEAF New York, under the auspices of the American Federation of Arts of Washington, D. C. The average American does not realize that art in various forms touches his life more constantly than any other factor.

"Fortunate," says Goethe, "is he, who at an early age, knows what art is."

This series of short weekly discussions are offered as catch-up opportunities to many Americans to add much to the pleasure of life for the small price, in time, of "stopping, looking and listening." The subjects will be discussed in a plain, untechnical way and in the language of the layman, by eminent artists and critics on successive Thursdays from WEAF at 7:30 P. M., for a period of fifteen minutes.

COULD YOU USE $50.00?

Every Wednesday evening station WJZ will broadcast a series of weekly question contests inaugurated by *Time Magazine*, in which radio listeners will compete for a cash prize of fifty dollars. Fifty questions, based upon the news of the past week, will be asked each Wednesday, five seconds being allowed after each question for listeners to write their answers down. The prize will be awarded to the player answering the greatest number of questions correctly. In the event of a tie, the prize will be divided.

The questions will be on subjects of national and international interest which have occupied a prominent place in the news of the week. A sample question reads as follows: "A revolt was experienced in Tripoli. What European nation holds sovereignty there?"

"RADIO CURE" FOR THE INSANE

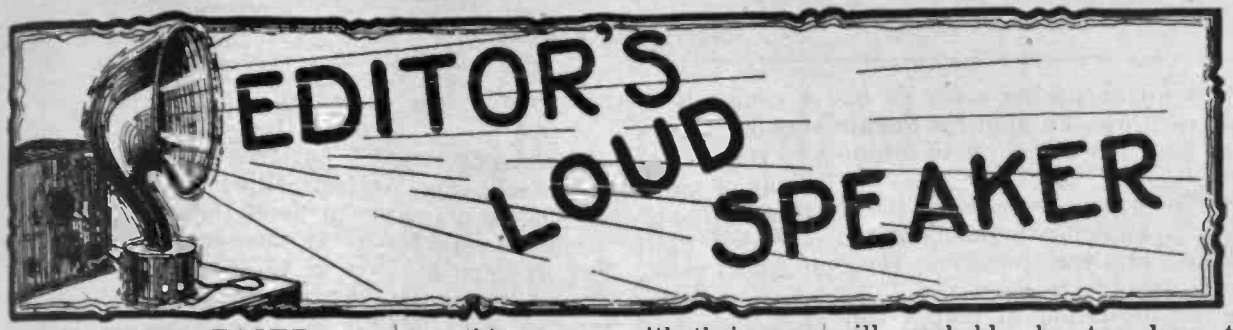
By William Allen Ward

Radio as a cure for insanity is to be given a trial in Texas, if plans being outlined by neurologists are carried out. The theory is that a hobby, if properly followed, will aid most nervous ailments. So state authorities have decided to install radio sets in the state institutions where mental cases are treated.

Neurologists will not attempt the "radio cure" on extreme or dangerous cases. But the radio hobby, it is believed, will aid in the cure of milder forms of insanity. The theory advanced by the nerve experts is that radio, being interesting, will give the victims of nervous breakdowns and other similiar type something to ponder over instead of their real or fancied troubles.

RAIN BY RADIO

The theory has been advanced recently that the unusually heavy rainfall last year, and, in fact, for the past three years, is directly due to radio waves and other electrical disturbances caused by power and telephone lines and broadcasting. It is maintained that the number of pleasant days will continue to diminish as long as radio is on the increase, and it is suggested that the only way to obviate this trouble is a reduction of the use of electricity. The advocates of this theory are evidently not acquainted with the rainfall statistics of the past 50 years, especially in France. The month of August, 1875, was considered the wettest August in well over 100 years in France, and still holds that record in spite of a close second by August, 1924. In 1875, Hertz and Marconi were unheard of, radio unknown, and electric power was in its infancy.



IS YOUR TASTE IMPROVING?

Everybody knows that the radio sets of this year are better than those of last. But there are lots of other ways in which the art is advancing besides the improvement of tubes, condensers, and the like. One interesting angle of the situation is—how is it changing your taste in music?

A few years ago probably the most liberal doses of music came from the hand organs played through the streets. At least it was largely true in the cities. It reminds one of the old conundrum—Why is a hurdy gurdy like a missing "M?" The obvious answer is, because it makes u-sic of music. And of course, the phonograph has given a great deal of pleasure to those who like to listen to music. But it is only in the last couple of years that everybody and his wife spend a few hours every week hearing harmonies roll from the radio.

As an indication of how popular demand has changed, it is interesting to see what kind of requests are coming into the big broadcasting stations. The big station of the American Telephone and Telegraph Company, WEAF in New York, gets upwards of 50,000 letters a month. Two years ago in January three-quarters of them asked for jazz music. One year later this had dropped to a third, and this year the proportion was down to one-twentieth. This shows a surprisingly strong swing away from this style to the more classical selections.

Jazz Is Like Pie

Right here let us say that people that can see no good in jazz and condemn it utterly are either talking for effect or else have something wrong with their ears. The one special thing that makes a tune jazzy is the particular rhythm and swing. There is something inspiring in a military march and if you see a long column of soldiers swinging down the street to the strains of the fife and drum you will have a thrill up and down your spine if you have any red blood in your veins. So a good jazz piece will occasionally wake you up and act as a tonic. It is very much like a piece of pie. No one would think of living on such a diet exclusively, but a generous slab of say blueberry pie certainly does hit the spot after a meal of more substantial food.

In the same way a song like, "All Alone," which is now so popular that it is beginning to get tiresome, must have considerable melody or it wouldn't be asked for over and over again. There are lots of other pieces, however, of a classical or semi-popular nature which are coming to be requested more and more, and this is undoubtedly due to general improvement in musical taste.

Eating the First Olive

Do you remember when you ate your first olive? It tasted like a mistake until you had gritted your teeth and chewed up enough of them so as to get used to the flavor. Now you like them so well that at a banquet you throw the pits on the floor so the waiter won't know how many you ate. It's the same way with music. If you hear a phonograph record of one of Wagner's pieces very likely you will not buy it because like the olive it seems rather strange. As a result, it never becomes an old friend and so is never liked. But when it is played from your favorite broadcasting station, you will probably be too lazy to switch to some other wave and so you hear it through. When this happens a few times you suddenly discover that you like it.

Only the radio could have accomplished such a result. The average chap is rather afraid of a classical concert and as he expects to be bored he won't buy a ticket. But when the concert walks into his den by way of the loud speaker, he finds it is not so bad after all. That is why we venture to predict that after a few years the average concert will contain a good deal of the highest class of music with a liberal sprinkling of semi-popular songs by good composers and a generous dash of jazz for seasoning.

WHO IS SHOVELING COAL?

The noise of unloading a ton of coal is very pleasant if you happen to know it is being dumped into your own cellar. But if it happens every night in your loud speaker, the keen edge of this pleasure is apt to be dulled.

If this were midsummer you might say that the trouble came from static, and very likely you would be right. But at this time of year such weather conditions occur only occasionally. If you have trouble of this kind, it is most likely caused by something inside the set.

How to Find Out

There is one way of telling whether the noise is from inside or out. Just take off the aerial wire and see whether the disturbance stops or not. If removing the aerial kills the noise then you know that the racket was coming down the wire and the cause must have been something in the air. But if the snapping and clicking

keeps up about the same as before, it proves an alibi for the air and puts the blame on the radio set.

In such a case the most likely place to hunt for trouble is in one of the audio transformers. These units are apt to develop a fault in the insulation so that a tiny bit of current can leak across from primary (which is connected to the "B" battery) to the secondary. Any such irregularity is impressed on the grid of the amplifier tube and the latter attends strictly to business and so amplifies it. As a result you hear of the trouble immediately.

To test out for such a difficulty the quickest way is to remove the amplifier tubes, and plug on the detector alone. If the noise has disappeared you will know that its source must have been in the amplifier. If it still persists, of course, it means trouble in the detector circuit. If you find that the transformer has broken down there is only one remedy. This is the simple one of throwing it away and buying a new one.

HOW MANY "B" BATTERIES?

One of the questions which is asked a good many times by radio fans is as to the amount of "B" battery needed to give the best operation on their sets. While this cannot be given a complete answer, without knowing which is meant, at least the general principles are easy to understand.

If you are using a crystal set we feel sure that no one will argue the point when we say the "B" battery voltage should be nothing at all. For a one-bulb set, the style of bulb makes some difference. If you are working with storage batteries then 18 to 22 volts on a UV-200 is what you need. With dry cells either 22 or 45 volts on a UV-199 or WD-tube is very satisfactory. Of course, the corresponding numbers of other makes of bulbs use the same pressure. Personally we have found that 22 volts on such a set gives just as good results in general as the higher pressure and of course is better from a cost standpoint.

How About Amplifiers?

Any of the amplifiers will work better as the pressure on the plate is raised up to a maximum of about 90 volts. You will find by experiment that an amplifier will let some music through even if the "B" battery is omitted entirely and the lead which should run to its positive terminal is instead connected to the "A" plus. A few volts of "B" gives much louder volume, however, and 22 volts makes a very satisfactory tone.

By adding a second block of 22 (total 45) the loudness goes up considerably but not anything like to double what it was. A third block (total 67) adds a little bit more and a fourth making 90 raises it still more. This last raise is very small.

What Does It Cost?

The current taken from a single block of 22-volt B by an amplifier tube is multiplied by three when two blocks are used. This is owing to the special characteristic of the plate. And notice further that this triple current is taken from *each* of two blocks. That is, since the two are in series they add up their voltage to make 45, but do not add their current. Since you are using three times the electricity from twice as many cells the expense is six times as great.

Let us put this in another way. You use your set a few evenings a week and find that a 22-volt battery lasts for six months. After adding a second block the life drops to only two months, since the current is three times as big. That means that every two months you now must buy two blocks. At the end of the year in the first case you would have paid for two "B" batteries while in the second you would have purchased twelve of them. Again this shows up as six times the cost.

Doubling 45 Volts

The same general argument holds in going from 45 to 90 volts except that with this higher potential it is customary to use a "C" battery which puts a small voltage called a negative bias on the grids of the amplifiers. This reduces the consumption of plate current to a lower value than it otherwise would be. But even at that the expense of doubling the plate pressure is much more than twice its former figure.

The question is then, what is the best all around pressure for the "B" battery considering cost as well as loudness. For local stations the answer is plain—22 volts is enough to give all the volume you need and the cost is 1/6 that of operation at 45. For distant stations a person in ordinary circumstances will probably find 45 volts is about right. If he is a distance hound and plays radio golf he will think it worth while to raise the limit and use 90 volts of "B" and 4½ volts of "C."

It should be understood that this discussion applies to all audio frequency amplifiers no matter what kind of a set is considered, unless resistance coupling between tubes is used instead of transformers. In that case higher pressures of "B" are needed since the resistances absorb some of the voltage themselves, and so only part is left for the tubes. As far as radio amplifiers go, 90 volts is not much of an improvement over 45.

Don't Make This Mistake

When testing to see how the "B" battery pressure affects your set look out for an error that is often made. Whenever a change of any kind is put through a hook-up you must be sure to retune the set. Of course, the shift of the dials will not be large—may in fact be only half a division—but if you cut the "B" voltage in two and then listen without retuning, you will probably be disappointed. After you have readjusted the set for the new conditions, you will probably find, as many another has done, that the high voltages often recommended with some sets are not really necessary.

The Sending End of Music

How a Whisper Is Magnified Into a Shout

By WILLIAM RADOS, IBFA

THIS is the second article explaining how transmitting is done by a broadcasting station. In the first article which appeared in the October 15, 1924 issue of RADIO PROGRESS under the title "How a Sending Station Works," a general review of such a station was given.

The circuits, apparatus, and fundamental principals were covered, but not in any great detail as space did not permit. This article will explain in detail the how and why of the particular units in a broadcasting station.

The Microphone, or "Air Ear"

The music or speech which you hear in your home far away, always starts in front of a microphone. This we may say is the beginning of the whole process. It is well for us to know what this microphone is. It might be called the "Air Ear" as it is the unit which "hears" the sound waves and turns them into currents which finally go out into the air. Up to the microphone no electricity is used but beyond that point there is nothing else, except currents and voltages.

In general appearance, it is nothing very radical and is quite similar to your telephone transmitter. It's size is about that of a cigar box. The difference however between the telephone and the microphone or "mike" is in the electrical construction. The ordinary mike used in broadcasting is the carbon granule type. Two others that are being experimented with are the condenser and the glow type. Another style is the liquid jet, but this is not very practical. These radio microphones have low resistance, some only five or ten ohms and are of 50 to 500 watts capacity.

When it Shouts One Note.

The carbon microphone has a diaphragm which is rigidly stretched. The idea is to keep the metal disk from resonating at an audible frequency. By "resonating" is meant the vibration back and forth at the speed which the diaphragm itself naturally has. If you strike a tuning fork it oscillates at a given period or frequency and this determines the pitch of the tone which it sounds. In the same way the metal of the disk when hit naturally quivers back and forth quite rapidly until it finally dies down and comes to rest. If the speed with which it vibrates happens to be the same as the note which is being played, then the amount of vibration will be very large—much more than it should be in comparison with other notes. Such an effect is called, "blasting."

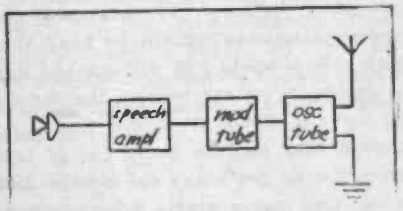


Fig. 1. Line-up, Mike to Aerial

You will sometimes get the same effect on a phonograph. It is usually a fairly high note and comes out a great deal louder than the singer intended. As a matter of fact, it is not his fault, since he sang it with the same volume as the rest of the line, but the diaphragm either in the recording mechanism or else in your reproducer wanted to shake at that particular speed, and so showed great partiality to that one note.

Tuning a Violin

Nothing can be done to prevent the disk from having *some* natural period of its own. But by proper design this note to which it responds can be made so high in pitch that it never is played in any ordinary music. Of course you understand that to raise the tone we make a violin string or a metal disk shorter or else put more tension on it. In playing a violin the performer gets the high notes by shortening the active part of the string with his fingers. To tune his instrument he can not change the length so he tightens up the string by means of the key in order to raise the pitch.

In order to keep the diaphragm stretched tightly there is a steel ring fastened to each side of it.

There are also carbon grains on both sides of the diaphragm, this making really two microphones. This double unit is much superior to a single mike in quality. This model, on account of the stretched diaphragm, does not give such a great output as the ordinary style, but the quality of the output is much superior.

This gives us a unit which will give excellent reproduction, but low quantity of output. The latter is stepped up by a carefully designed amplifier.

Why Omit Audio Transformers?

This speech amplifier has very complicated wiring, but it may be simplified down to three stages, using a five-watt power tube in the last step. The first two stages have tubes which give a large amplification. A Western Electric "D" tube has an amplification factor about six times as great as that of an

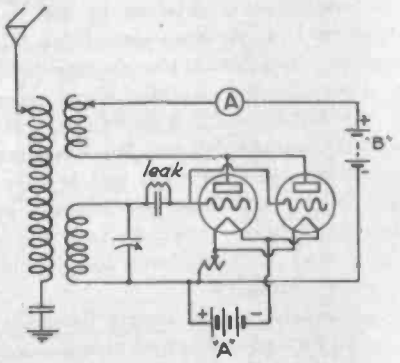


Fig. 2. Meissner Oscillator

ordinary UV-201A tube. These are connected by coils and condensers which take the place of the familiar audio frequency amplifying transformer. The use of coils and condensers instead of transformers, results in more nearly perfect amplification. The reason they are not used in an ordinary receiving set is because they take up a great deal

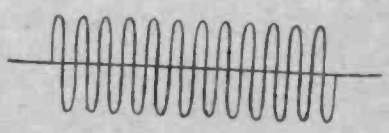


Fig. 3a. Carrier Wave Before Being Modulated

of room and are much more expensive.

As there is a wide variation of voices, musical instruments, etc., the amplifier must have some kind of adjustable device to accommodate the different variations. This is produced by a switch and twenty four taps, so that as little as one twenty-fourth of the total output may be obtained.

It Costs a Couple of Thousand

This, of course, would be used when the performance was particularly loud. A band concert, which runs heavily to the drums, or a campaign orator who waxes particularly eloquent in his efforts to save the country, would be cases in point. Meters, rheostats, etc., are on the panel of the instrument, so that current may be measured and controlled. The amplification obtained by this instrument is tremendous and of the first quality. But while the average fan's two-stage audio amplifier costs about twenty-five dollars, this instrument costs several thousand dollars. This amplifier is a telephone instrument and is regularly used by the telephone company in its long distance work. In fact, much of the work in "radio" was done by the telephone engineers.

The usual, in fact almost universal, hook-up for radio telephone broadcasting stations is the "Meissner" circuit with "Heising" modulation. This means that the oscillating part is connected according to the Meissner method of generating high frequency oscillations; while the system of putting the voice on the antenna is the Heising system. In Fig. 1, the square marked "mod tube" is the Heising modulator, and the square marked "osc tube" is the transmitter or Meissner circuit. (The names are pronounced My-sner and Hy-sing.)

A good outline of the Heising modulator was given in the part in RADIO PROGRESS for October 15. In that article, it was explained that two different waves must emanate from a transmitter at the same time; one the radio frequency or carrier wave, and the other, the voice current or modulated wave. For the present let us think of the former as a real carrier; i.e., a road, stream, wire, or anything along which we can propel an object. This object then is our voice which could not get very far if there were no "carrier."

No Shake in Your Motor

You see the trouble is that the oscillations of the voice are too slow to be projected very far. The carrier wave on the other hand, vibrates fast enough to be felt at a distance. If you crank the engine of your automobile by hand at a slow rate of speed you will not feel any vibration in the car because the pistons go up and down so slowly that even though they may be badly out of balance, you do not notice the motion. But when the engine starts firing and suddenly speeds up to the equivelant of perhaps twenty-five miles an hour, you will feel very bad vibration unless the engine has been balanced very carefully.

What is the difference? The amount of travel of the pistons up and down is just the same as before. The only change is that they are now going at a high enough rate of speed so that their oscil-

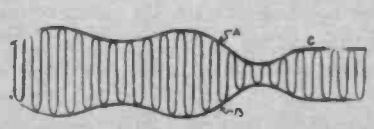


Fig. 3b. Like Fig. 3a, but After Modulation

lations are felt. The same thing is true in the radio line. The voice vibrations are too slow to penetrate out into space, but the carrier wave going one thousand times as fast, will cover the distance.

Water on the Plates

The carrier wave does not need to be generated by a vacuum tube for radio telephony. Arcs similar to arc lamps used for lighting the streets can oscillate and maintain a continuous wave. By using a generator or high frequency alternator, we also get a high speed wave. Both the arc and the alternator have been and still are being used to some extent. The trouble with them is that they are so big and expensive compared with a vacuum tube, that it seems foolish to use them. They were employed only because the tubes could not be built in sizes big enough to transmit the power that was wanted. However, new tubes are being built in larger and larger sizes, and the chief trouble with them, that of getting rid of the heat, has been solved by cooling the plates with running water.

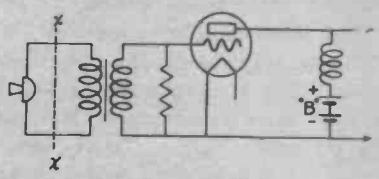


Fig. 4. Heising Voice System

Fig. 2 shows how the tubes are connected for generating waves as in the Meissner system. Two tubes in parallel are shown here, although this number may be reduced to one or further increased to get the necessary output. An "A" battery controlled by a rheostat, lights the filaments as usual. The grid is tuned by a variable condenser, as shown. The output from the plates runs through a tickler coil, which is adjustable to give more or less feedback action. It is the same idea exactly as what happens in your regenerative set if you are so careless as to turn up the dials enough to make the set squeal or oscillate. The amount of current flowing is measured by the ammeter "A". Of course the source of energy is the ordinary "B" battery, as shown. This tickler coil is the primary of the sending transformer. The secondary consists of a heavy coil of copper wire, usually with a condenser in series. By adjusting the number of turns in this secondary coil the send-

ing frequency (wave length) is varied to correspond with the assignment from the Federal Government.

Also coupled to the secondary is the grid coil. The energy picked up from the oscillating plate is fed back again to

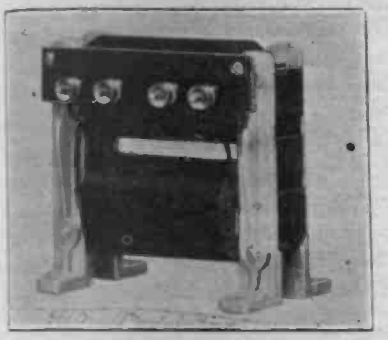


Fig. 5. A Modulation Transformer

the grid and this maintains the action. The wave put out by this system is shown in Fig. 3a.

What Squeal Looks Like

It is unmodulated, which means that it keeps going at full strength as long as the conditions are not changed.

When heard in an oscillating receiver this wave produces one long continuous squeal. If we can change the heights of the successive peaks the result will be as Fig. 3b.

This shows how the wave looks as it leaves the transmitter. The oscillator is continuously giving off such a wave as "A." When the announcer speaks, his voice impressed upon this wave changes its shape until it looks like "B."

Roughly speaking, the greater the change is from maximum to minimum, the better the modulation we have. Complete modulation would be when the curve "B" would vary from zero to twice the height of curve "A." This is never realized in a modern broadcast station and so we speak of "percentage of modulation." If complete modulation is 100 per cent., anything less than that will of course be incomplete or a certain fraction of modulation. Fifty or sixty per cent. is normal modulation.

A practical scheme is given in Fig. 4 and a photo of a modulation transformer is given in Fig. 5. In Fig. 4 the line usually represents a speech amplifier, but this diagram will be understood perfectly as is.

A Choke Coil is Needed

The action of the modulator (Fig. 4) is comparatively simple. The output from the microphone after being amplified (at the line) enters the primary of the modulating transformer. The secondary connects grid and filament of the tube. A variable resistance across this winding allows the operator to change the loudness of the wave being impressed on the aerial, and also improves the quality of the tone. The plate is supplied with voltage from the "B" battery as usual. But notice that there is a choke coil between the "B+" and the plate. This acts in the same general way as the coupling resisters in an audio amplifier using resistance coupling.

When an audio wave from the microphone strikes the grid it induces a similar vibration in the plate circuit. But when the current from the "B" battery is suddenly cut off by the action of the tube, this choke coil tries to keep the current constant, as before, and the result is that the pressure across the two terminals at the right of Fig. 4 increases quite a bit above the normal "B" battery voltage. On the other hand, if because of the audio waves the modulator tube suddenly allows plate current

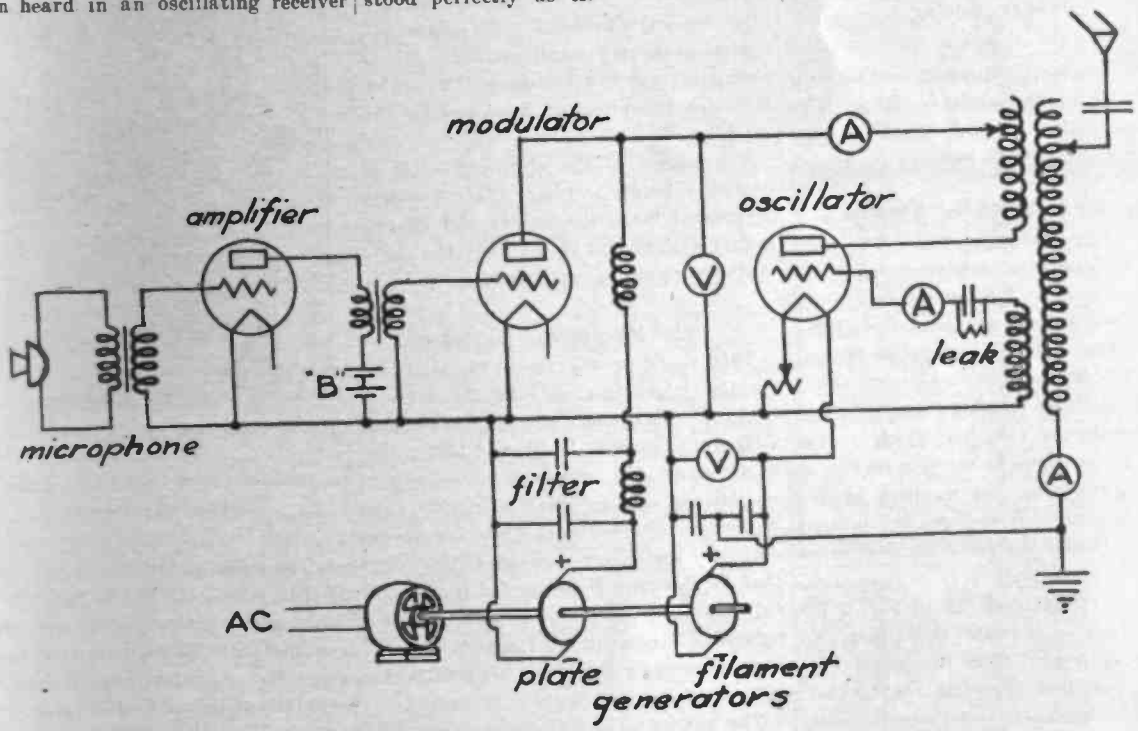


Fig. 6. Complete System. This Combines the Oscillator of Fig. 2 with the Modulator of Fig. 4

to pass, the action of the choke coil is to prevent such a sudden rise with the result that the pressure across these terminals drops down nearly to zero. What we have then might be called a variable "B" battery and the variations of its voltage correspond exactly with the audio waves, which the performer is singing in to the microphone.

You will now see that we can combine the modulator of Fig. 4 with the oscillator of Fig. 2. The latter shows a con-

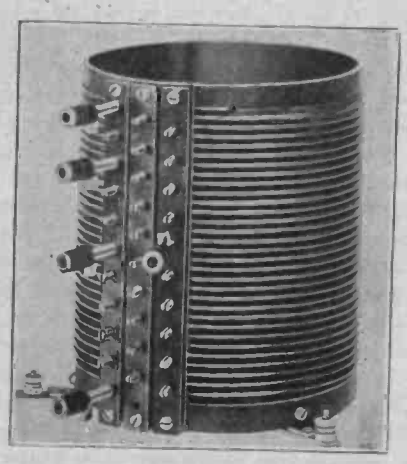


Fig. 7. The Antenna Coil. The Taps Are Used for Tuning

stant "B" battery. Instead of this unit let us hook-up the variable "B" such as we have just described. Such a complete wiring diagram appears in Fig. 6.

Modulator Tubes Not Counted

In a large station two 250 watt tubes are used for oscillators, and two 250 watt tubes for modulators. The power of a station is found by adding together the wattage ratings of the oscillator bulbs only.

The first tube labelled "Amplifier" in this drawing is the one which is explained in reference to the line in Fig. 4. Such an amplifier has no part in the modulator-oscillator system, but is used merely to make the voice currents large enough to work well.

Only one tube is shown in Fig. 6 for each part so as to make it simpler. To run two such oscillators in parallel, for instance, connect their plates together, their grids together, and their filaments together. Other simplifications were resorted to also. However, it can be seen that when the voice is impressed upon the microphone, it is passed through the step up amplifier which is here shown as a single tube although it is usually a three-tube affair. This amplified voice is then put upon the grid of the modulator tube (one or two 250 watt bulbs), by passing through a modulation transformer.

The Motor-Generator

The modulator is connected to the plate and filament of the 250 watt oscillator tube or tubes. Across this connection as just explained is a large, heavy choke coil which consists of thousands of turns of wire on an iron core; it has an inductance of many henries. The plate and grid coils of the oscillator are heavy copper strips or wire coupled to the antenna coil. Meters are placed in all of these circuits to indicate currents and voltages. The plate and filament power is supplied by a motor generator set. The motor runs on the city alternating current and drives the direct current generators. One generator supplies the low voltage, heavy current for the filaments of the several tubes. The other generator supplies several thousand volts plate potential at a very small current. Across each generator is a volt-meter (V) which indicates the pressure developed by the machine.

The output of the plate generator is passed through a filter. This consists of several large condensers and chokes and is designed to smooth out the commutator ripple of the machine.

Why Ripples Are So Bad

This ripple is the small variation in voltage, which is caused by the various bars of the commutator as they pass under the carbon brushes which conducts away the current. These slight oscillations are so small that for any ordinary electrical work they are never noticed. You must remember, however, that in this case they are fed to powerful amplifiers and so they must be surpressed if the music sent out on the air is to be entirely free from a slight humming noise.

The antenna circuit consists as usual of several wires high above the ground, well insulated and brought down to the inductance; sometimes a series condenser is used to increase the frequency (k.c.). The antenna coil used in one of the very popular broadcasting stations is shown in Fig. 7. Another photo (Fig. 8) shows a picture of a condenser used in a foreign radio telephone station, not for broadcasting, however, but for commercial business. This particular station has a rating of twenty thousand watts output. The condenser stands about ten feet tall and is oil insulated and cooled.

Wire Telephone in Broadcasting

Much of the broadcasting now done originates in a place far away from the station. It may occur in a city several

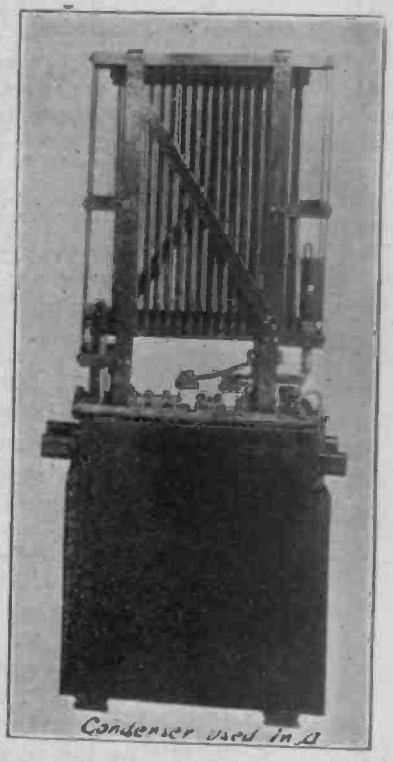


Fig. 8. Combined Coil and Condenser to Feed the Aerial

hundred miles away. Broadly speaking, all that is done is to stretch the wires, which connect the microphone to the transmitter, to as many miles as necessary. But electrical conditions are not favorable to a couple of lonely wires many miles long. The telephone com-

Continued on Page 30

R 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 objection to liquid soldering flux?

Answer. In the first place it is difficult to get a flux which is non-corrosive. In soldering fairly large wire, this makes no difference, since even a flux which is quite acid will eat off only the surface of the copper to a depth of say 1/100 of an inch. If you are soldering small wire, on the other hand, this becomes a serious factor, as such a wire may not be much more than a few hundredths of an inch in diameter and such an amount is pretty nearly the entire volume of the wire. Besides this, there is another objection. When you apply the hot iron to the joint, the flux is apt to run, and if it is a liquid it will often times spatter a little bit. Since an acid solution is a good conductor of electricity, the effect which it has on insulation is to make it slightly conducting, and this introduces large losses into the circuit.

Question. Why do some loud speakers have an adjustment for the diaphragm and how often must it be used?

Answer. The adjustment is to control the length of the air gap between the magnets and the armature or diaphragm which they attract. By turning the handle back and forth, this distance can be varied from a few hundredths of an inch down to nothing at all. The reason it is sometimes desirable to change this is because different "B" battery voltages may be employed on the set. When a large amount of "B" pressure is used, then a large current flows through the loud speaker windings and this naturally has considerably more of a pull on the diaphragm than would be the case if the "B" battery were only 45 volts.

If the air gap happens to be set at a small figure, then this extra pull might easily bend it over so that it hits the pole pieces. This would cause a very bad rattling. The remedy is to increase the gap so that there will be no danger of striking. On the other hand, if the larger gap which has now been arranged should be used on a loud speaker, connected in a circuit with only 45 volts of "B", then the diaphragm would spring away from the magnets quite a distance because of the low magnetic pull. Such a large air gap would prevent the speaker from being as sensitive as it otherwise would be.

Question. Which is better, round or square busbar for wiring a set?

Answer. It is largely a matter of preference. The square wire used to be employed almost exclusively, but recently the round is becoming more popular. The square wire has a nice finished appearance, but it is more bother in making the bends or else it is likely that it will become twisted or a bend will not always come right opposite one of the flat sides. Of course either of these defects can be seen immediately. Round wire, however, can be twisted and bent in any direction, and will not show. Electrically they are so nearly alike in resistance that no ordinary meter or test will be able to tell which is which. When measured by the most precise instruments, the square wire has a very slight advantage over the round of the same cross sectional area.

Question. What is the advantage of the cabinet loud speaker over the ordinary horn type?

Answer. It is entirely a question of looks. Many people think that the customary horn is rather unsightly and they prefer something which will harmonize better with the cabinet of their radio set. Such people prefer the cabinet speaker. When properly made such an instrument is probably as satisfactory from the electrical and musical standpoint as an ordinary horn, but it is certain that to design such a speaker of equal merit requires more engineering skill than is needed for the conventional type.

New Products of Unusual Interest

A NON-SKID DIAL

Most dials that have been made so far have been fastened to the shaft of the condenser or coupler by a set screw going through the side. This has some objections, as it is likely to slip if the condenser sticks in any point. Of course, the only way you notice it, is that you have lost the list you made of stations logged, since what used to be 25 is now perhaps 37.

Another disadvantage of the ordinary style is that so often the hole in the dial does not exactly fit the dial. When it is rather small there is considerable difficulty in slipping it on. On the other hand, when the hole is large the set screw pushes the shaft over to one side, and as a result the dial does not run true.

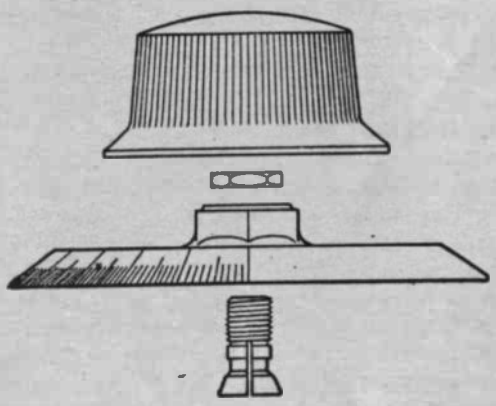


Fig. 1a. Dial Without Set Screw.

Omitting the Set Screw

A dial which is just coming on the market is illustrated in Fig. 1 at A. Notice that there is a brass chuck split into four jaws with a wedge shaped end. This fits into a taper hole in the dial. A brass nut, which is moulded into the bakelite knob, fits the thread of the chuck. When this knob is screwed down on the chuck, the wedge shape jaws are pulled into the paper hole and so contract and squeeze the shaft. Quite a lot of latitude is allowed in the diameter of the shaft, and no matter how loose it is, if it fits at all the dial will run true.

To put this on your set you slip the chuck over the shaft and then slide on the dial. The zero mark on the latter is turned until it is right opposite the edge of the condenser plate. Now screw on the knob, and you will find that the dial does not change its position compared with the shaft, but the jaws fit tighter and tighter as the knob is turned.

A Convenient Battery Tap

There are various chargers on the market for filling up storage "B" batteries. Some of these use a vibrating rectifier or a Tungar bulb. Others employ a chemical cell, which is called an electrolytic rectifier. Such a cell is made of two electrodes, which dip into a solution of a liquid. The action is to prevent the current running backwards while it is allowed to flow in the "charge" direction.

1b A "B" Battery Tap

Such a cell works very well indeed in preventing the return flow, but it will let too much current go into the "B" battery in the charge direction, unless it is used with a resistance. This resistance is most conveniently made up as an electric light bulb. On 110 volts, a 50-watt lamp will pass about a half an ampere, while the 25 watt allows a little less than one-quarter ampere to flow.

Connecting in the Lamp

Some fans have had a little trouble with this hook-up, even though it is simple, because they did not get the lamp in the right place. It is also a little bit awkward to make such a connection and have a good looking job. The Re-Vi-Vo Company has recently put a unit on the market, which appears in Fig 1B. The connection plug, series resistance socket, and leads for attaching to the charger are all made up.

To use such a device, it is only necessary to connect the charger to the "B" battery with a short length of wire and then fasten the two leads on this tap, one to the charger and the other to the "B" battery. Plugging in the connection to a 110-volt alternating current socket starts the "B" battery on charge. The current rate is adjusted as just explained by using the proper size of lamp bulb. The 50-watt for 48 volt, and the 25-watt for 22½ volt units are the ones which are most popular.

THE SENDING END OF MUSIC

Continued from Page 28

pany takes care of these lines and before a program is to be transmitted they check over the line very carefully. A man is at each end and an extra pair of wires used for the time being puts them into communication with one another. Thus four wires are held up from regular telephone traffic.

At each end is a set of instruments comprising an oscillator and a galvanometer. The oscillator is connected to the line and all the frequencies from 50 cycles up to 5000 cycles are sent over the two wires to the man at the other end. These frequencies are the upper and lower limits of speech and music vibrations.

All Waves Treated Alike

By using the meter it can be told if all the frequencies are coming over with the same intensity. In order that a speech, a violin selection, or organ recital will be heard very well it is necessary to connect an equalizer across the line. The equalizer is an instrument consisting of an inductance, capacity, and resistance which are varied until both the men report good results. This whole process usually takes several hours work by a couple of trained men.

The result is then that when the artist performs before the microphone, his voice travels over many miles of carefully tuned lines to the station. From there on it is similar to local studio work.

UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

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

	K.C.	W.L.	W.P.
KDKA—Westinghouse Elec. & Mfg. Co., E. Pittsburg, Pa.	970-	309-	1000
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O.	1200-	250-	500
KDYM—Savoy Theater, San Diego, Cal.	1070-	280-	100
KDZB—Frank E. Siefert, Bakersfield, Cal.	1250-	240-	100
KDZE—Rhodes Dept. Store, Seattle, Wash.	1110-	270-	100
KFAB—Nebraska Buick Auto Co., Lincoln, Neb.	1250-	240-	200
KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz.	833-	360-	100
KFAE—State College of Washington	900-	333-	500
KFAF—Western Radio Corp., Denver, Colo.	1080-	278-	500
KFAJ—University of Colorado, Boulder, Colo.	1150-	261-	100
KFAU—Boise High School, Boise, Idaho	1090-	275-	500
KFBK—Kimball Upson Co., Sacramento, Cal.	1060-	283-	100
KFCF—Frank A. Moore, Walla Walla, Wash.	1170-	256-	100
KFCL—Leslie E. Rice, Los Angeles, Cal.	1270-	236-	500
KFDM—Magnolia Petroleum Co., Beaumont, Tex.	950-	316-	500
KFDX—First Baptist Church, Shreveport, La.	1200-	250-	100
KFDY—S. Dak. Ste. Col. Ag. & Mech. Arts, Br'kngs., S. Dak.	1100-	273-	100
KFEQ—Scroggin & Co. Bank, Oak, Nebr.	1120-	268-	100
KFEX—Augsburg Seminary, Minneapolis, Minn.	1150-	261-	100
KFFV—Graceland College, Lamoni, Iowa	1200-	250-	100
KFGC—Louisiana State Univ., Baton Rouge, La.	1120-	268-	100
KFGD—Oklahoma College for Women, Chickasha, Okla.	1190-	252-	100
KFGH—Leland Stanford Junior Univ., Stanford Univ., Cal.	1100-	273-	500
KFGX—First Presbyterian Church, Orange, Tex.	1200-	250-	500
KFHJ—Fallon & Co., Santa Barbara, Cal.	833-	360-	100
KFHR—Star Elec. & Radio Co., Seattle, Wash.	1140-	263-	100
KFI—Earl C. Anthony, Los Angeles, Cal.	642-	467-	1500
KFIF—Benson Polytechnic Institute, Portland, Ore.	1210-	248-	100
KFIZ—Daily Com'lth & Seifert Rad. Corp., Fondulac, Wis.	1100-	273-	100
KFJF—National Radio Mfg. Co., Oklahoma, Okla.	1150-	261-	225
KFJM—University of No. Dak., Grand Forks, No. Dak.	1080-	278-	100
KFKB—Brinkley-Jones Hosp. Assoc., Milford, Kans.	1100-	273-	500
KFKQ—Conway Radio Laboratories, Conway, Ark.	1200-	250-	100
KFKU—University of Kansas, Lawrence, Kas.	1090-	275-	100
KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb.	1040-	288-	1000
KFLR—University of New Mexico, Albuquerque, N. Mex.	1180-	254-	100
KFLV—Swedish Evangalical Mission Church, Rockford, Ill.	1310-	229-	100
KFLZ—Atlantic Automobile Co., Atlantic, Iowa	1100-	273-	100
KFMQ—University of Arkansas, Fayetteville, Ark.	1090-	275-	500
KFMT—George W. Young, Minneapolis, Minn	1140-	263-	100
KFMX—Carleton College, Northfield, Minn.	890-	337-	750
KFNF—Henry Field Seed Co., Shenandoah, Iowa	1130-	266-	500
KFOA—Rhodes Dept. Store	666-	450-	500
KFOC—First Christian Church, Whittier, Cal.	1270-	236-	100
KFON—Echophone Radio Shop, Long Beach, Cal.	1280-	234-	100
KFOU—Hommel Manufacturing Co.—Richmond, Cal.	1180-	254-	100
KFOX—Technical High School, Omaha, Nebr.	1210-	248-	100
KFPR—Los Angeles County Forestry, Los Angeles, Cal.	1300-	231-	500
KFPT—Radio Service Corp. of Utah, Salt Lake City, Utah.	1150-	261-	500
KFPX—First Presbyterian Church, Pine Bluff, Ark.	1240-	242-	100
KFPY—Symons Investment Co., Spokane, Wash.	1130-	266-	100
KFQB—Searchlight Publishing Co., Fort Worth, Tex.	1180-	254-	100
KFQC—Kidd Brothers Radio Shop, Taft, Cal.	1300-	231-	100
KFQD—Chovin Supply Co., Anchorage, Alaska	1070-	280-	100
KFQM—Texas Highway Bulletin, Austin, Tex.	1120-	268-	100
KFQU—W. E. Riker, Holy City, Calif.	1280-	234-	100
KFQX—Alfred H. Hubbard, Seattle, Wash.	1290-	233-	500
KFQZ—Taft Radio Co., Hollywood, Calif.	1250-	240-	250
KFRB—Hall Bros., Beeville, Texas	1210-	248-	250
KFRU—Etherical Studios, Bristow, Okla.	1010-	297-	500
KFRW—United Churches of Olympia, Olympia, Wash.	1360-	220-	100
KFSG—Echo Park Evangelistic Asso., Los Angeles, Calif.	1080-	278-	500
KFUM—W. D. Corley, Colorado Springs, Colo.	1240-	242-	100
KFUO—Concordia College, St. Louis, Mo.	550-	545-	500
KFUT—University of Utah, Salt Lake City, Utah.	1150-	261-	100
KFUU—Colburn Radio Laboratories, San Leandro, Calif.	1340-	224-	100
KFWA—Browning Bros. Co., Ogden, Utah	1400-	214-	500

	K.C.	W.L.	W.P.
KGO—General Electric Co., Oakland, Cal.	1000-	300-	2000
KGU—Marion A. Mulrony, Honolulu, Hawaii	833-	360-	500
KGW—Portland Morning Oregonian, Portland, Ore.	610-	485-	500
KHJ—Times-Mirror Co., Los Angeles, Cal.	742-	404-	500
KHQ—Excelsior Motorcycle & Bicycle Co., Seattle, Wash.	1100-	273-	100
KJS—Bible Institute of Los Angeles, Los Angeles, Cal.	1020-	294-	500
KLDS—Reorg. Church of Jesus Christ of Latter Day Sts., Ind., Mo.	1120-	268-	250
KLS—Warner Bros. Radio Supplies Co., Oakland, Calif.	833-	360-	250
KLX—Tribune Publishing Co., Oakland, Calif.	588-	510-	500
KLZ—Reynolds Radio Co., Denver Colo.	1060-	283-	250
KNT—Walter Hemrich, Kukak Bay, Alaska	1140-	263-	100
KNX—Los Angeles Express, Los Angeles, Cal.	890-	337-	500
KOA—General Electric Co., Denver, Colo.	930-	322-	1000
KOB—New Mexico Col. of Agriculture, State Col., N. Mex.	860-	349-	500
KOP—Detroit Police Dept., Detroit, Mich.	1090-	278-	500
KPO—Hale Bros., San Francisco, Cal.	698-	430-	500
KQV—Doubleday-Hill Electric Co., Pittsburg, Pa.	1090-	275-	500
KSAC—Kansas State Agric. College	880-	341-	500
KSD—Post-Dispatch, St. Louis, Mo.	550-	545-	500
KTHS—New Arlington Hotel Co., Hot Springs, Ark.	800-	375-	500
KTW—First Presbyterian Church, Seattle, Wash.	833-	360-	750
KUO—Examiner Printing Co., San Francisco, Cal.	1220-	246-	150
KUOM—State Univ. of Montana, Missoula, Mont.	1230-	245-	250
KWH—Los Angeles Examiner, Los Angeles, Cal.	833-	360-	250
KYQ—The Electric Shop, Honolulu, Hawaii	1110-	270-	100
KYW—Westinghouse Elec. & Mfg. Co., Chicago, Ill.	560-	535-	1500
KZKZ—Electrical Supply Co., Manila, P. I.	1110-	270-	100
KZM—Preston D. Allen, Oakland, Cal.	833-	360-	100
KZRQ—Far Eastern Radio, Manila, P. I.	1350-	222-	500
WAAB—Valdemar Jensen, New Orleans, La.	1120-	268-	100
WAAC—Tulane University, New Orleans, La.	1090-	275-	100
WAAF—Chicago Daily Drovers Journal, Chicago, Ill.	1080-	278-	200
WAAM—I. R. Nelson Co., Newark, N. J.	1140-	263-	250
WAAW—Omaha Grain Exchange, Omaha, Neb.	1080-	278-	500
WABA—Lake Forest University, Lake Forest, Ill.	1320-	227-	100
WABI—Bangor Railway & Electric Co., Bangor, Me.	1250-	240-	100
WABL—Connecticut Agric. College, Storrs, Conn.	1090-	275-	100
WABN—Ott Radio (Inc.) La Crosse, Wis.	1230-	244-	500
WABO—Lake Avenue Baptist Church, Rochester, N. Y.	1080-	278-	100
WABX—Henry B. Joy, Mount Clemens, Mich.	1180-	254-	250
WAFD—Albert B. Parfeet Co., Port Huron, Mich.	1290-	233-	250
WAHG—A. H. Grebe Co., Richmond Hill, N. Y.	950-	316-	500
WAMD—Hubbard & Co., Minneapolis, Minn.	1230-	244-	100
WBAA—Purdue University, West Lafayette, Ind.	1100-	273-	250
WBAN—Wireless Phone Corp., Paterson, N. J.	1230-	244-	100
WBAO—James Millikin University, Decatur, Ill.	1090-	275-	100
WBAP—Wortham-Carter Publishing Co., Fort Worth, Tex.	630-	476-	1000
WBAV—Erner & Hopkins Co., Columbus, Ohio.	1020-	293-	500
WBBP—Petoskey High School, Petoskey, Mich.	1400-	214-	100
WBBG—Irving Vermilya, Mattapoisett, Mass.	1210-	248-	500
WBBL—Grace Covenant Church, Richmond, Va.	1310-	229-	100
WBBM—H. Leslie Atlas, Chicago, Ill.	1330-	226-	200
WBBR—People's Pulpit Assoc., Rossville, N. Y.	1100-	273-	500
WBES—Bliss Electrical School, Takoma Park, Md.	1350-	222-	100
WBT—Southern Radio Corp., Charlotte, N. C.	1090-	275-	250
WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass.	900-	331-	1500
WCAD—St. Lawrence University, Canton, N. Y.	1140-	263-	250
WCAE—Kaufmann & Baer Co., Pittsburg, Pa.	650-	461-	500
WCAH—Entrekin Electric Co., Columbus, O.	1130-	266-	200
WCAI—Nebraska Wesleyan Uni., Uni. Place, Nebr.	1190-	275-	500
WCAL—St. Olaf College, Northfield, Minn.	890-	337-	500
WCAP—Cheaspeake & Potomac Tel. Co., Wash., D. C.	640-	469-	500
WCAR—Southern Radio Corp. of Texas, San Antonio, Tex.	1140-	263-	100
WCAU—Durham & Co., Philadelphia, Pa.	1080-	278-	500
WCAX—University of Vermont, Burlington, Vt.	1200-	250-	100
WCAY—Milwaukee Civic Br'dcstng Assoc., Milwaukee, Wis.	1130-	266-	250
WCBC—University of Michigan, Ann Arbor, Mich.	1310-	229-	200
WCBD—Wilbur G. Voliva, Zion, Ill.	870-	345-	500
WCBI—Nicoll, Duncan & Rush, Bemis, Tenn.	1250-	240-	150
WCBQ—First Baptist Church, Nashville, Tenn.	1270-	236-	100
WCBT—Clark University, Worcester, Mass.	1260-	238-	250
WCCO—Washburn Crosby Co., Minneapolis, Minn.	720-	416-	500

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

Announcing the

"WIZARD ARISTOCRAT"

(All that the name infers)

THE "B" BATTERY SUPREME

Fashioned by experts—from the best materials the market affords—and built in Pawtucket, R. I., assuring fresh stock, longer life and greater efficiency, undisturbed by long hauls and deterioration en route.

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COMPARE, DISCUSS and then **DECIDE** to use **''WIZARD ARISTOCRAT.''** "Lends TONE to any Radio Assembly."

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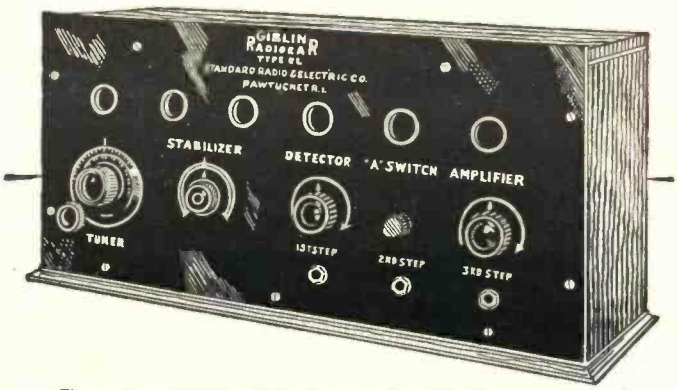
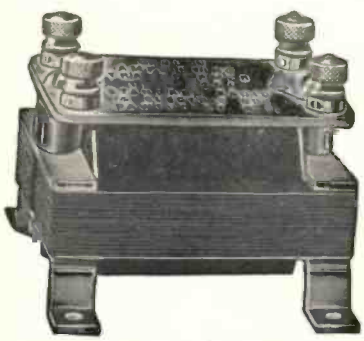
The Giblin Broadcast Receiver

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



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



The Giblin Audio-Frequency Amplifying Transformer
Price $4.50

The Giblin Radio-Frequency Amplifying Transformer
Price $5.00

Buy Giblin Products from your dealer

Write for descriptive circulars

STANDARD RADIO & ELECTRIC CO.
PAWTUCKET, RHODE ISLAND

She Was Afraid of Ghosts

Mrs. J. C. Blackwell had been scared as a child and as the result she dreaded weird noises. That is why her radio set got on her nerves as the whistles and squeals which the audio transformers gave out reminded her of ghostly voices.

Sometime ago she had seen an advertisement of the RADICLEAR transformer, so she knew that it did not make any such noises itself. She finally decided to change her old style transformers and in their places put two RADICLEARS. Right away the noises stopped and, better yet, piano music sounded real and not like a harp. That is how we added her name to our list of satisfied customers.

This transformer has 3½ to 1 ratio, which gives greatest increase of loudness possible without introducing distortion. One reason for its clear music is the generous amount of iron in the circuit. Such special transformer iron is expensive, but results justify its use. The large number of turns of wire is what makes the program so loud.

Such a transformer can be used with a crystal set to work a loud speaker on one tube. And, speaking of crystals, don't forget that the AUDION CRYSTAL is selling in large quantities because it is so good. The price 25c, seems low for a crystal which will perform as well as those costing $1.00. If you do not find this statement true, send it back, and we will refund your money.

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

Please send me the following by parcel post. (Mark which one you want.)

Radiclear Audio Transformer @ $3.95
Amplifier set complete @.....$6.00
(Socket to fit.....tube)
Audion Crystal @ 25c.
Gold Plated Cat Whisker @ 15c.

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

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

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Address.....

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1206 Broad Street

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