July 15, 1924
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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 9

Contents for

JULY 15, 1924

Does your neutrodyne work perfectly? You know the advantage of a neutrodyne is that it can be neutralized to prevent all distortion. If yours is not or cannot be adjusted to this point, see "BUILDING THE RICE NEUTRODYNE," by Charles R. Wexler and Arthur Slepian, in our next issue.

Why are some sets such bad squealers while others cannot be made to oscillate? This is discussed by H. V. S. Taylor in "SOME SETS SQUEAL—SOME DON'T," in our issue of August 1.

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RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. I, No. 9 JULY 15, 1924 15c. PER COPY, $3 PER YEAR

Explaining Static Level

Why You Can't Get Across the Continent Now With Best Set

By HORACE V. S. TAYLOR

WHY can't you hear from New York to San Francisco in the summertime? It certainly is a fact that it can not be done, at least with any regularity, even when you use a four or five hundred dollar set. Some nights it seems difficult to get a powerful station one hundred miles away. Many folks are wishing that they had better sets so that they could reach out thousands of miles even in summertime, but they would be disappointed if they made a change.

There is not much doubt about receiving being much poorer in summer than in winter; at least most broadcast listeners are painfully aware of the fact, although to read the advertisements of some of the manufacturers, you would think that summer is the best time of the year to listen-in. We do not blame radio makers for trying to overcome the summer slump, which has always existed in the sales of radio parts, but it would seem desirable to stick to the facts and admit that while summer radio has wonderful entertainment value, nevertheless *distance* should not be aimed at as a regular thing until the fall months.

Won't Better Sets Do It?

It may surprise our readers to hear that the most expensive sets won't reach out very much farther in the summertime than will the more moderate priced outfits. Don't think this is intended to mean that the expensive set isn't worth the money. It is, for it excels in clearness of tone and in selectivity. By this is meant that even though a loud local station may be running, still the fan can tune it out completely, and pick up any one of say one dozen distant stations, if they are not too far off. The cheaper set would have to listen to station LOCAL until they signed off, but after that they could also bring in the same dozen of moderately distant broadcasters. Another point is that a fairly good set will often re-radiate or squeal in your neighbor's ears, while the best radios are absolutely non-squealing.

All Advantages but Distance

From this you can see that the high priced instruments excel in every way, except their ability to pull in stations two and three thousand miles away

Sending Station Curve

To begin with let us see how the sending station affects the air at various distances. Refer to Figure 1. We see a broadcaster at work transmitting a piece of music. Right in the vicinity of the station, of course, the signal is very loud. A crystal set will pick it up with enough volume, even to work a loud speaker. This is shown in the diagram by the fact that the loudness curve is very high right over the station itself. The fact that it is *over* the station does not mean that we measure it up in the air; the picture of the station is shown just to indicate its location on the curve.

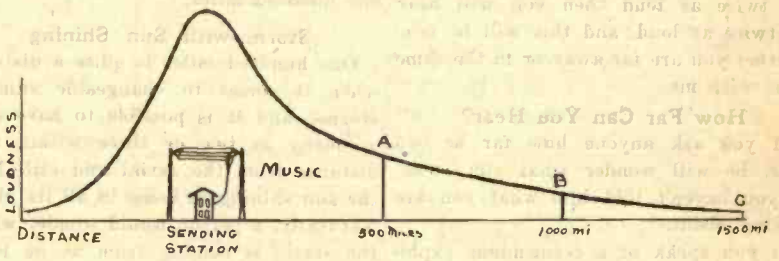

Fig. 1. How Loud is a Sending Station?

It must be understood that this discussion applies only to *summertime* radio. In the fall and winter these sets are able to pick up waves from across the Continent and even across the ocean, often times on a loop.

Let us see why it is that distance is a sealed book in the summertime. When you start looking into this subject, right away you run into the phrase, "Static level." When you have grasped this idea you will understand why summer and winter are so different in this respect.

The loudness of tone is apparent all around the station within a mile or so.

But notice that as we get farther and farther away the energy in the waves dropped off quite sharply at first, and then more slowly. When we reach a distance of 500 miles as shown in point A, the music is quite soft. Of course, it would not begin to work a crystal at this distance, but if for instance the wave were increased by two steps of radio amplification, so that the energy increased to its former value, then of course, it would work the crystal

again. As it is, even a pretty cheap single tube receiver, would be able to hear the music at 500 miles.

At B the waves have travelled 1000 miles. Notice that the line B is not nearly as long as that of A which shows that the music isn't nearly as loud. It is still loud enough though, to be picked up by any good radio set without much trouble. When we reach 1500 miles at C there is a corresponding reduction in the amount of music and it takes an unusually good single tube set to hear a station whose waves are no louder than the line C.

Distance Not Only Thing

Naturally, distance is not the only factor in determining how much volume the program will have at your receiving station. The curve shown represents a powerful transmitter, say 500 watts. The picture of a 1000-watt sender would look like this, except it would be about twice as high. This is the same thing as saying that if I suddenly start talking twice as loud then you will hear me twice as loud, and this will be true whether you are far away or in the same room with me.

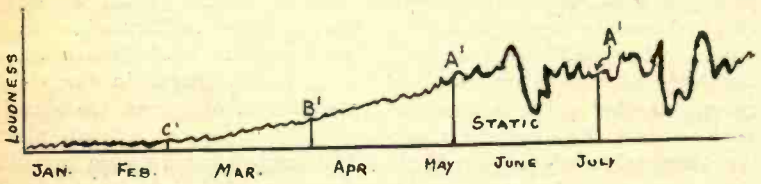

Fig. 2. How Static Varies

How Far Can You Hear?

If you ask anyone how far he can hear, he will wonder what you mean as you haven't told him what you are talking about.

If you speak of a tremendous explosion, the answer is 100 miles. But if it is a mosquito buzzing it is more like 100 inches, so it must be understood that the two important factors which influence the loudness of radio waves *in the air* are first, how loud they were at the source, and second, how far they are from the source. As yet, we have not mentioned the sensitiveness of the receiving set at all. Although this plays a very important part in changing the radio waves into music to reach your ear, still it will easily be understood that it has no part in affecting the size of the waves themselves at the time they strike your aerial.

Curve of Static

Now let us see how static varies from time to time. As used in this article, the word "static" is a broad term, which includes not only the sharp variety, sounding like the delivery of five tons of coal, but also the smaller noises which all blend together and make a continuous sound. Static is much more common in summertime than in winter. Although the exact cause is not completely understood, still it is known that the same conditions which make a thunderstorm also are responsible for this disturbance. As everyone has observed, thunderstorms are rare in winter, but common in summer. Oftentimes you see black clouds piling up fast in July and August, and yet no rain appears—in other words, the storm blows over. But even though the rain, thunder and lightning did not come to a head, still the gathering of static in the atmosphere progressed far enough so that it affected all radio sets within fifty or one hundred miles.

Storm with Sun Shining

One hundred miles is quite a distance when it comes to changeable summer storms, and it is possible to have even as many as two or three within that distance from the aerial and still have the sun shining at home in all its glory. Naturally, a person would wonder where the static is coming from as he looks out into the beautiful blue sky, but the weather man could have told him that the lightning was flashing fifty miles to the South, and again one hundred miles to the West at the same time.

If, instead of *listening* for static a meter is connected to the receiving set in such a way that it measures the amount of static, it is found that it varies considerably from day to day and also from month to month. If we plot a curve of the amount of disturbance received by our antenna, it will look something like Figure 2. In January and February static is very small,—oftentimes it is absent, but in March it begins to climb, and by the end of April receiving conditions are not nearly so good. Naturally, it is not always the same from day to day. Our curve shows that in June there was one day of particularly bad interference, and the next day following, conditions were very much better. Such a fluctuation is going on all the time.

Comparing Static and Signal

We are now ready to see how the music compares with the disturbance. Suppose we are 1500 miles away from sending station, Figure 1. Then the loudness of the program will be represented by the line C. Up to the latter part of February we shall not be bothered much by static but by C' in Figure 2, the static comes in just as loud as the signal and reception will be poor. From then on fans 1500 miles away will not have good results in picking up our broadcasting station.

But the signals are still coming in merrily to listeners only 1000 miles away as at that distance the music is as loud as line B. It is only by waiting until the early part of April that we find a line B' of equal loudness. After this date 1000 mile fans will have difficulty in hearing. Our friends at 500 miles get good results away up into the middle of May, at which time A' is as loud as A. Static keeps getting worse and so blots out this station until by our curve we see that after the first half of June the 500 mile listeners will be able to get this station again. By July the static A' is again equal to A and the signals disappear.

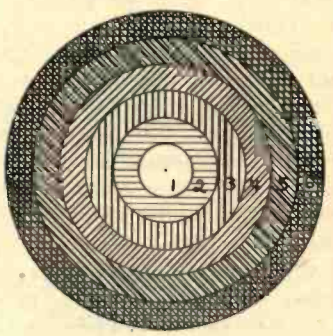

Fig. 3. Static Zoning

Only a Sample Curve

Figure 2, of course, is just a sample of what may be expected. It follows the general shape of static curves which have been taken by the Bureau of

Continued on Page 8

A Portable Regen-Reflex Circuit

This is an Easily Wired Set to Work on One Tube

A GOOD many reflex circuits have been designed, but most of them do not make any use of regeneration or feedback. Since this action is very powerful in increasing the volume of a set, it would seem worthwhile to use it in the reflex hook-up. An unusually simple reflex, which includes a tickler for feedback, is illustrated in the cut. It will be seen that only one tube is used. A second one might be added if desirable, using the same general scheme.

The list of parts necessary for building this outfit are as follows:

1 tap switch and points. This may be omitted, but sharper tuning results from its use.

1 variocoupler. Primary should have 50 to 70 turns with six or eight taps.

1 23 plate adjustable condenser.

2 .001 mfd. fixed condensers. Paper ones will do, but those with mica insulation are better.

1 .0005 ditto.

1 UV-199 tube. The UV-201-A can be used instead, but will require a storage battery, and so the set could hardly be called portable.

1 socket to fit the tube.

1 rheostat. A 20-ohm value is good for UV-199 tube.

1 radio frequency transformer.

1 audio frequency transformer. If only one tube is used, a high ratio of 6 to 1 or even 10 to 1 may be employed.

1 crystal detector. Either a fixed or adustable type is satisfactory.

3 dry cells for "A" battery.

1 22-volt "B" battery. Two will give slightly more volume.

Making the Connections

As seen in the diagram, this radio is unusually easy to connect. The tap switch handle runs to the aerial. Only a few taps are necessary, spaced about 10 turns apart. If a short aerial is to be used, taps taken at 40, 50, 60 and 70 turns will be right, but with a long one, 125 to 150 feet, the first tap should be taken at 20 turns. Of course, these figures may be varied a few turns up or down to suit the particular variocoupler which you have. Some builders prefer to omit the tap switch entirely. This can be done quite well by using a small clip to make connections with the loops on the variocoupler. This clip should be connected to the aerial. You will find that some one tap works best with the aerial and ground that you have. Although this clip should be varied up or down, depending on the wave length of the station coming in, still very good results will be obtained by leaving it in the one place. It is something like a fixed focus camera. Pictures made by such an instrument are very good, indeed, but if the focus had been adjusted for each picture, slightly better operation would have occurred.

The secondary of the audio transformer is shown in the diagram as being connected with lead to the grounded side of the stator and the other to the plus of the "A" battery. When the set is operating, this latter connection should be shifted to the minus of the "A" battery to see if better results would obtain. If it is found to be an improvement, the connection should be left in that way.

Here is the way the set works: The primary oscillates from the aerial to the tap switch and part of the stator to ground. The secondary vibrates from the grid, through the entire winding of the stator and back to the filament, passing the condenser "C2" on the way, as the radio frequency cannot pass through the audio amplifying transformer. The output leaves the plate and runs along the rotor, which is adjusted to feedback to the stator, and then through the primary of the radio amplifying transformer to the point "X." The high frequency cannot use the telephones for a path and so instead passes condenser C3 to the filament.

The secondary of the radio transformer has its output rectified by the crysal. This reduces it into audio frequency and goes through the primary of the audio amplifying transformer. The secondary of the audio reaches the filament, and the grid through the winding

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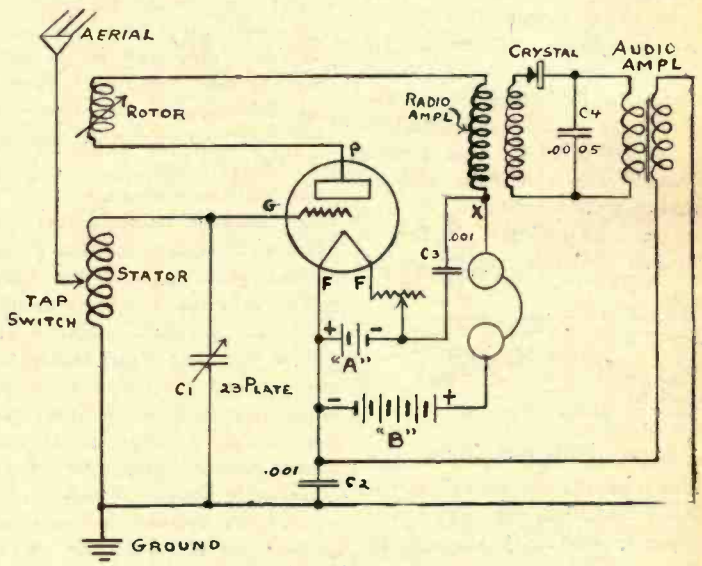


Reflex Combined with Regeneration

EXPLAINING STATIC

Continued from Page 6

Standards at a good many different cities. Besides this it must be understood that there is no sharp cut off of the signal when the static level as shown in Figure 2, is just equal to the music strength shown in Figure 1. Indeed the interference is bothersome when it is only one-half as loud as the program and on the other hand, the broadcasting can be understood, although not enjoyed through a disturbance twice as loud as itself. But the general principle can be understood from these two figures.

Zoning System for Static

These are the days when many big cities are divided into zones for building purposes. A zoning map might be drawn of interference in the same way. Look at Figure 3. On a bright, clear day it may easily happen that there is no disturbance within 100 miles. This shows clear in Zone 1. In the 200-mile range there is a little atmospheric electricity developed, so Zone 2 shows a little shading. At 300 miles the area is so big that it covers some cloudiness with the result that reception from this distance is not so good as indicated in Zone 3. The 400 and 500-mile ranges include

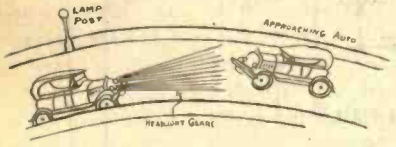


Fig. 4. Static-like Glare

some storms, and at 600 miles reception is completely blocked by the large amount of atmospheric electricity through this wide area.

The next day conditions may improve a lot and each zone instead of representing 100 miles may be the equivalent of 200 or 300, but the same idea holds. On a very bad night each ring would be the equivalent of perhaps only ten miles.

Working in Boiler Factory

Another illustration of this idea might be found in a big factory. As you stand in the middle of the aisle within ten feet no noise is being made. Beyond that a man is hammering. In the thirty foot zone, several men are banging on a boiler and as we go out farther and farther we get to big machinery making all sorts of hideous racket. If your friend speaks to you when he is nearby, you hear him easily. If he is in Zone 3 say, he has to yell at you to be heard, and if he walks across the room you can not get what he says no matter how loudly he shouts at you.

Sharpening Your Ears

Now we get to the point about improving your radio. Why won't the best radio hear farther in summer? Well, go back to the boiler factory. You hear your friend easily at ten feet. If your ears were a lot sharper you would hear him plainer, no doubt, but he is now only a local station. When he retires to thirty feet, the racket nearly drowns out his voice. If your ears were a lot better ,you would not only hear him louder, but you would also hear the hammering a great deal plainer, and it would still almost drown out his voice. When he goes across the room to Zone 6, the riveting machines completely overwhelm his voice. No matter how good your ears may be, the *better* they hear the *more* machines drown him out and there is no chance of improving your hearing to the point where you can get what he says.

Or take the case of a concert in a large hall. Between numbers there is a constant buzz of conversation going on all around you. "I bake my beans in a bowl," says the woman in front of you. You hear that quite plainly. Five rows behind you hear a girl telling the latest scandal and you have to strain your ears to get it because the intervening noise almost swamps it. If you should attach an ear trumpet to your ears the intervening noise would still almost swamp it because it also would be brought in a lot louder. Way across the hall you see a friend, but there is no chance of hearing what he says because the noise (static) is ten times as loud as his voice and no amount of amplification will increase what he says without building up the noise in the same proportion.

You may understand all this perfectly and still be surprised at one thing. Suppose a distant station has been coming in loud all winter. On an average summer night static does not seem to be so bad, and yet you do not hear your old friend. Why? Refer to Figure 4 and this will be evident. As we drive up over the hill in our machine, shown at the right, we notice a lamp post and lamp at the right hand side of the road. It is quite plain. But an instant later another automobile comes over the brow of the hill and its head lights glare in our eyes. The head lights are not so very powerful—they are only twenty-one candle power—and the lamp post may have a very bright light, but in spite of that we find it difficult to see the lamp any more. Now instead of one automobile glaring in our faces, we have in the summertime a great many sources of interference, and while each one is quite small, nevertheless, they all add up to cause the effect of glare so that we find difficulty in seeing our lamp post. But by next winter all these small sources of disturbance will die off and the sending station will again emerge as loud as before.

THE NEW LANGUAGES

Radio has brought the various nations so close together that an international language seems to be very much needed. In this country and abroad there have been several associations formed to look into this matter. The one in the United States and also in England is called the Radio Auxiliary International Language Society. As this is too much of a mouthful to say in one breath, it is abbreviated to RAILS.

The RAILS has considered a good many different systems, but its choice has been narrowed down to only two: Ilo and Esperanto. The former is new and the latter old. They have the virtues and defects of youth and age. Esperanto is fairly well established, especially on the continent, where the people are better linguists than they are in America. Ilo, on the other hand, is of recent origin and has not nearly so many adherents. However, it has the advantage of appearing much easier to a person who has some knowledge of the commoner foreign languages, but who knows nothing of either of these new ones.

Either one is much easier to learn than any natural tongue. One of the reasons for this is that there are few rules of grammar and absolutely no exceptions whatever. If you remember studying French and German in school you will recall that the rules were not so bad. The trouble was to know when *not* to apply them.

Good-By, Radio Batteries

Thermoformer Replaces "A", "B" and "C" Units

By G. E. BURGHARD

WHAT does it cost to run your radio set? It depends somewhat on whether you use your set to listen or to play with. If the latter, then the cost of upkeep includes such items as burned out tubes, (when you made a wrong connection) as well as new condensers, coils, and the like. But if you use your set to make music, then about the only parts that have to be renewed are the batteries.

The "A" batteries are used in lighting the filament. They will last for 30 to 80 hours operation for the average set. Of course, it depends on the number of tubes, the amount of current they take, and the size and kind of battery, but these figures represent usual values. Besides the filament battery, a "B" battery is required to operate the phones or loud speaker. Four months might be called an average life for the common size "B" battery, but here again the kind of set, of course, plays an important part. Most of the older sets stop right here, but the new ones often employ a "C" battery. This is used to put a voltage on the grid, to give it a grid bias, as it is called. This battery gives out no measurable current, and it dies from old age rather than from exhaustion. At the end of three to six months it should be renewed, the time depending on how good a battery it was to start with.

Three Batteries Used

Figure 1 shows the hook-up of a simple, non-regenerative set, using "A," "B" and "C" batteries. As is usual in such a circuit, the radio waves coming down the aerial run through the primary of the coil to the ground. The secondary, which uses the same wire as the primary, is connected to the grid through the "C" battery, which puts the right voltage on this terminal. The negative always runs to the grid. The filament is heated by the "A" battery through the adjustable rheostat. The output of the tubes comes from the plate, through the phones to the plus of the "B" battery. No regeneration or feedback is shown, but the hook-up of the batteries is the same in all such sets.

Junking Your Batteries

It has been the dream of the fan to dispense with his batteries and instead use the energy from the electric light circuit. To plug into the nearest electric light socket—that is what is wanted.

A new invention, the "Thermoformer," has been designed to bring this about. Indeed, it does begin to look now as though the many of us will soon be discarding our batteries, thus eliminating the greatest source of trouble and expense in the operation of the home radio set.

There is nothing new to this idea of plugging into the nearest electric light socket for the operation of radio tubes. So many other tasks are done in the same manner—sweeping, ironing, fanning, heating, massaging, haircutting, soldering, driving various machines and what not—that the electric light socket is naturally looked upon as the ideal source of current for our vacuum tubes. However, when it comes to harnessing the usual lighting current for the operation of sets, we find numerous and serious obstacles. There is considerably more to the problem than cutting the voltage down from 110 to the 6 or 3 volts required by the usual vacuum tube—a transformer would take care of that with little or no trouble. There is also more to be done than converting alternating into direct current—a simple rectifier would attend to that. Indeed, the real trouble is in eliminating the hum found on all commercial lighting circuits, whether they are alternating or direct current.

Iron Out the Ripples

Radio men and electrical engineers alike have been busy on this problem of utilizing standard electric lighting current to vacuum tube operation. The irregularities or "ripples" in such current must be ironed out smooth, so to speak. The vacuum tubes for receiving sets must be supplied with currents of absolutely constant voltage for noiseless and proper operation; and heretofore the smooth, "noiseless" current of the storage battery or dry cell has had to be used for both filament and plate circuit of the usual receiving tubes.

To be sure, progress has been made in operating sending tubes and even power amplifiers on lighting current. The methods followed out have called for

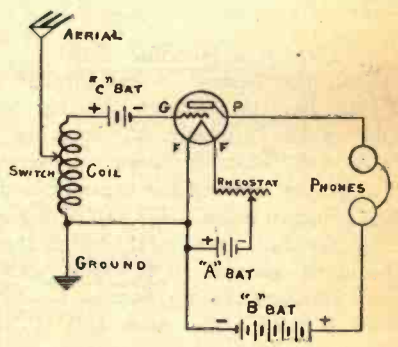


Fig. 1. Showing "A," "B" and "C" Batteries

special transformers, the output of which is smoothed out by high value coils and capacities, chemical rectifiers, and other miscellaneous apparatus. These methods have been fairly successful in connection with sending tubes for radio telegraph. However, it is also true that such ironing-out schemes have called for an expensive and fussy array of apparatus which in many instances has cost far more than the batteries replaced. And these attempts, when directed towards receiving tubes, have proved impractical for many reasons.

Expense Against Transformer

First of all, the electric light current transformer has been quite expensive, and many of them have a high upkeep, and in the second place a transformer and rectifier gives a pulsating current.

Look at Figure 2. The upper diagram shows the current wave of an ordinary 60-cycle lighting circuit. You will notice that first the current rises from zero and increases to a maximum of perhaps one ampere (depending on how many lights are burning) and then it drops to zero again. Next it increases, but flowing in the opposite direction in the circuit until it again reaches the same maximum and again drops to zero.

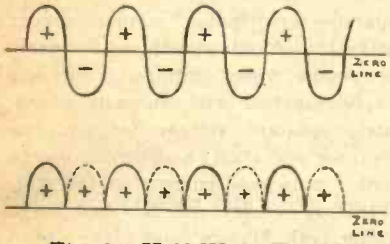


Fig. 2. Half Wave Rectifier

This action is repeated over and over again indefinitely sixty times every second. That is why it is called sixty cycles. This figure is standard for most of the United States.

Here is a Horrible Howl

When this current is run through a rectifier like the ordinary vibrating rectifier or like a tungar, it works like a valve and lets the positive current through, but cuts off the negative loops. This is shown in the lower half of Figure 2 by the full lines. The dotted lines should be omitted. It is called a half wave rectifier, because only half of the wave is used. The other half is not thrown away in the sense that it is wasted. It just is not allowed to flow, and so does not register on your electric light meter. Such a form of rectified current is quite satisfactory for charging a battery. Sixty times every second current is fed into it and then sixty

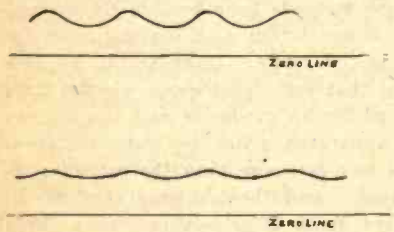


Fig. 3. Effect of Filter

times the battery rests for an instant, but such service would cause a horrible howl in a radio set. So radio rectifiers use two such units connected together with the leads reversed, so that one passes positive waves and the other negative, but adds them up in the same direction. The action of the second rectifier is shown by the dotted line in Figure 2 and the net result is the continuous curve of full and dotted lines.

Better Than Half Wave

While such a current is an improvement on the half-wave rectifier, still it is not yet suitable for radio work, but by connecting a large coil in series with the rectifier and a large condenser across the terminals besides, the curve is smoothed out as shown in the upper line of Figure 3. Such a result will be good enough for sending code as the amount of hum which it would cause would not be bad. It would not do for receiving music. To smooth it out still more it is only necessary to increase the size of the coil and condenser mentioned above with the result that its curves would look like the lower half of Figure 3. This will perhaps be all right for broadcasting.

From this the principle becomes quite clear. We can never get a line which is absolutely smooth, but we can reduce the ripples down to as low a value as we like merely by using big enough coils and condensers, but it is found on trial that this is a rather expensive solution.

Ripples Will Not be Acceptable

All the devices until now have been magnetically or directly coupled to the electric lighting current, and with the sensitive radios now in use there is certain to be a marked hum or buzz in the phones used with such sets. Furthermore, since the tendency is towards more and more sensitive receiving sets, these schemes which already hum under present conditions are certain to be useless in a year or two, when even the slightest ripples in vacuum-tube current supply will be objectionable.

Although the alternating current is the more difficult to transform for vacuum tube operation, there are certain dangers in the handling of direct current. Most of the devices so far have used a high resistance which means a direct electrical connection with the line. In view of the danger of the full potential being impressed on radio set, through faulty wiring or accidental short-circuits, such arrangements are not looked upon with favor.

Tubes and Still More Tubes

Recent progress has been in the direction of more and more tubes for the receiving set. Back in the early days of broadcasting, not so long ago, the average listener-in was quite content with a single detector tube with regeneration, operating one or two head sets. Then came along the one and two-tube audio-frequency amplifier for the operation of head-sets or small loud-speakers. As the months went by, radio enthusiasts sought more and more loudness. All this brought radio-frequency amplification to the front, and it was soon developed into a practical thing. Also, the

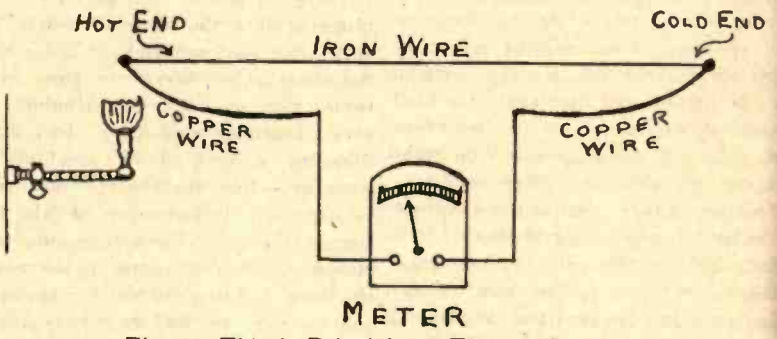


Fig. 4. This is Principle of Thermo-Couple

radiation situation — your neighbors' squeals—has of late resulted in giving regeneration a black eye. So radio-amplification has been used to take the place of the tickler feed back. Radio amplification calls for more tubes, so that from the simple three-tube sets of two years ago—a detector and two audio tubes—we have gone to five tubes—two steps of radio, a detector, and two steps of audio amplification—for example the well-known "neutrodyne" receiver.

Radio engineers have been face to face with this problem of increasing number of tubes. Knowing the disadvantages of storage "A" batteries, these engineers

have endeavored to find a substitute. And getting little help in using lighting current, their work has been to find a new kind of filament which would use only a little current. They have done

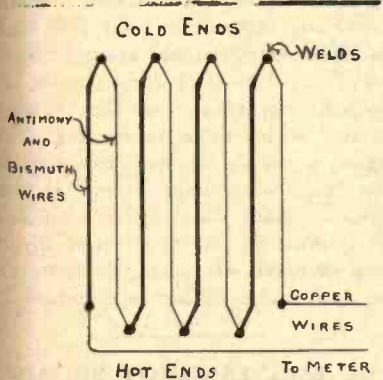


Fig. 5. Assembling the Units

a splendid job. The oxide-coated filaments in the WD-11 and WD-12 and the treated filaments of UV-201A and UV-199 operate on so little current that they may be used with ordinary dry cells. In fact, most of the new radio sets are intended for dry-battery operation.

The Miles-Per-Gallon Idea in Radio

Now dry battery operation, convenient as it may be, costs money. Both "A" and "B" batteries must be renewed. Anyone who has been operating on dry cells knows that when the cost of batteries and the hours of use are considered, the operating expenses mount up. Indeed, if we had to pay for our lighting current on the same basis as we pay for our vacuum-tube energy, we might be going to kerosene lamps without delay.

With the multiplying of tubes this dry-battery expense begins to count. Standard dry cells cost about 40 cents each. So the cost per hour of radio entertainment has become an appreciable item, especially when dealing with a five- or six-tube set. The radio fan soon regards his enjoyment just as the motorist does, with his miles-per-gallon idea. It becomes a question of: "How much does it cost per hour?"

Objections to Battery

The storage battery, while cheaper to operate than the dry battery, is handicapped in several ways. Its first cost is high, and a recharger must also be bought, unless one wishes to go to the trouble and expense of sending it to a charging station every so often. The storage battery requires constant attention and its life is none too long, and the distilled water which must be added regularly is in itself a bother. It is messy and, as ill luck would have it, often runs down when there is an exceptionally good program on the air and a houseful of company to be entertained. For that matter, battery operation of any kind leaves much to be desired. The voltage cannot be kept constant, and so conditions vary as compared with the steady voltage which could be obtained with some method of using the electric light current for this task.

It has remained for R. E. Sabin, a chemical engineer of Somerville, N. J., and L. G. Pacent, a radio manufacturer and engineer of New York City, to work out the practical solution of utilizing commercial electric light current for operating a radio. They have worked out an indirect method, in which the current is merely used as a source of heat, rather than as electrical energy.

Thermo-Couple is Used

The principle on which this invention rests is illustrated in Figure 4. If a piece of iron wire of any ordinary size is welded to each end of a piece of copper wire, then such a pair of unlike metals is called a "thermo-couple." "Thermo" means heat (thermometer) and "couple" means the two different kinds of metal. Now connect a sensitive volt meter between the copper wires as shown. Of course, there is no source of electricity in the system, and so the meter will read zero.

But if we heat one end of the welded iron-copper couple (either end will do) then immediately the meter will start to show current passing. The hotter we make the heated end the more the meter will reflect. This is a rather extraordinary phenomena and the explanation of it is not known. However, it is no more mysterious than the action of an ordinary dry cell, which gives out voltage. The amount of electricity measured by the meter depends on the *difference* in temperature between the hot and cold ends. That is, if we put both in the flame, the meter will still read zero.

Like a Thermometer

This principle is made use of in the big steel mills for measuring the heat of the steel tempering ovens. Naturally a thermometer could not be used, as the glass would be melted, so a thermocouple, like the one just described, is built into the oven with its hot end near where the steel will be placed. The meter instead of reading volts is calibrated to read directly in degrees of temperature. Of course, the meter itself can be located 25 or 100 feet away from the furnace in any convenient place.

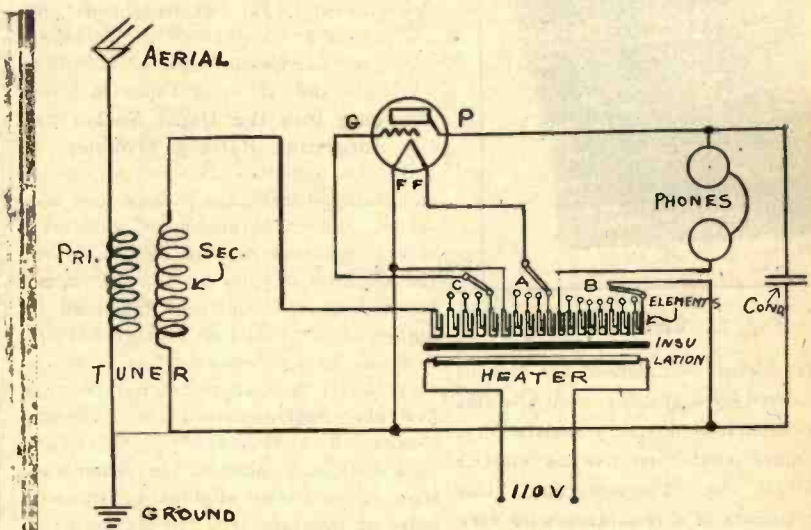


Fig. 6. Hook-up of Thermoformer

For such use it would not do to employ iron and copper, as they would be corroded or burned out too easily. Some of the metals with higher melting point are used instead, but the idea is just the same.

How Thermoformer Works

In the perfected device worked out by Mr. Sabin and Mr. Pacent, and known

as the "Thermoformer"—a name which suggests the idea of the use of heat (thermometer), and transformer to produce the desired current—the idea of Figure 4 is used. But one single couple does not give enough voltage to operate the radio. However, by joining several pairs together as shown in Figure 5, the pressure of each set is added to that of its neighbor's. It happens when the hot end is heated by an electric heater and the cold end is left at ordinary room temperature, each couple gives off about one-eighth of a volt. If we want 4 volts to work a UV-199 tube, we can get it by using 4 x 8, which equals 32 pairs.

Fig. 7. View of Unit

In our picture we showed the couples being heated by a gas flame. While this can be done, it is not very satisfactory. It is much neater to use an electric heater. In the "Thermoformer" this heater consists of a resistance wire very much like what you find on the inside of an electric flat iron. The chief difference is that it is made of much finer wire and so takes only a very small current. This electric heater is connected directly to your electric light socket, with an ordinary plug. It can be used on either direct or alternating current as both have the same heating effect. This heater is well insulated from the thermo-couples. This means that there is no danger of getting the light current into your radio through a short circuit; but although the electricity cannot run through insulation, the *heat* does and the ends of the couples reach a high temperature just as though they were heated by gas. The hook-up is illustrated in Figure 6.

Used with Super-Het

The entire assembly of thermo-couple units and heater strips is mounted in a metal case with perforated top and bottom plates, so as to provide the proper circulation of air, as shown in Figure 7. The "Thermoformer" for six UV-199 tube filaments, which is the number for the present-day super-heterodyne sets, occupies less room than the standard 6-volt storage battery.

The "Thermoformer" can be made up for any desired voltage output, so that it becomes available for the filament or "A" battery, and the plate or "B" battery. The inventors have intentionally concentrated their first efforts on supplying current for the filaments, or the replacement of the "A" batteries, since this is in greatest demand. After succeeding in this particular, they developed the universal "Thermoformer" operating on A. C. or D. C. anywhere, for supplying current in place of the usual "A," "B," and "C" or grid-bias batteries.

Plugging into the Usual Socket and Forgetting Battery Troubles

By this ingenious, indirect application of lighting current, the problem has been solved. The "Thermoformer" delivers a steady, noiseless current, devoid of even the slightest ripples so that it cannot be told apart from that delivered by high-grade dry cells or storage battery. One convincing demonstration is to operate a six-tube super-heterodyne or a five-tube neutrodyne on a "Thermoformer," first with a loud-speaker, and then with head-phones. In either case there is not the slightest extraneous noise or hum; in fact the set seems to be operating on its usual dry cells.

The cost of operating the "Thermoformer" is negligible, for the resistor units are quite small and draw only little current. The cost is only a fraction of that of battery operation, aside from the obvious convenience of this method of operation.

Installed in Cabinet

Radio experts who have seen the "Thermoformer" and listened to the results obtained with it are agreed that it is a valuable invention, especially at this time when more and more tubes are required by the latest receiving circuits. It now becomes possible to place the "Thermoformer" unit in the receiver cabinet, if desired, with plug and attachment cord for connecting with the nearest socket.

When it is remembered that there are some three million vacuum tube receiving sets in use in these United States alone, and that in the year 1923 alone about $35,000,000.00 was spent for radio storage batteries and dry batteries, the economic importance of the "Thermoformer" begins to be appreciated. This device is certain to find wide application, replacing batteries now in use. However, many receiving sets will still be operated by batteries, especially in rural districts where electric light current is not at hand, and in portable sets.

DO EAGLES ENJOY BROADCASTING?

Considerable excitement was caused at radio station WTAM of the Willard Storage Battery Co., Cleveland, Ohio, one afternoon recently, when a large American eagle picked the station's antenna towers as a feeding place.

The bird had caught or stolen a large fish which was still alive as the eagle fed, and could be plainly seen from the ground as it flopped under its captor's talons.

A group of interested spectators watched the bird at its repast through the telescope of a surveyor's transit. The bird's visit lasted over half an hour. The station is located about five miles from the heart of the city and it is believed that this is the nearest an eagle has come to Cleveland for several years.

POWERFUL COLLEGE STATION

One notable example of college radio service, entertaining as well as instructive, and incidentally the first in the field of 500-watt stations, is the Rensselaer Polytechnic Institute at Troy, N. Y., whose broadcasts from station WHAZ have spanned the country and frequently far beyond, for two years without any expectation of financial return. Its very complete radio equipment was the gift of the Roeblings, the famous bridge builders. Its operation for the benefit of the public, beside its very necessary uses in connection with the electrical engineering course, is maintained by this pioneer college of engineering. Rensselaer will celebrate its centennial in October.

Train Type Radio For All Purposes

To Be Used in the Home, the Camp, and the Railroad Train

By ALBERT TURENNE

IN close contact with the great strides being made in the radio field comes the newest lay-out of the De Forest ultra-audion circuit. This receiver completely answers the needs of the vast army of sports and out-door enthusiasts who are crying for a cheap, practical set that is well adapted to the various uses of present-day radio.

Last summer proved a real boom as well as the beginning of general year-round employment of radio apparatus. But it also provided the "out-door" radio fans with many a heartache, as well as with the new thrill of tapping the great intelligence "far from the babbles of the cities," for the apparatus then used was comparatively clumsy and rather unsatisfactory. The sets were built to stay at home, and they should have been kept there.

Designed for Vacationists

The results of these troubles, and they were plainly proved by the many lamentations of the tourists, reached the radio manufacturers, who forthwith consulted their research engineers and proceeded to create and improve upon past experiences. Thus was born the new line of fine portable receivers that will make a great hit with vacationists.

Among the several hook-ups of this type, the latest ultra-audion circuit stands out conspicuously because it embodies most of the potential requisites that are now demanded in these small receivers. Let us describe briefly the new one-tube set of this circuit, which is being nationally advertised:

This Baby Weighs One Pound

This baby set is but eight inches long by six wide, and weighs only one pound. As it is base-mounted, it occupies a space about three inches high when packed in a box. Thus, you may see, it can be easily slipped in an ordinary hand-bag, without taking up much of the space that might be required for other articles. The lay-out includes a straight-line condenser, an inductance coil, grid leak, and a filament control rheostat. To complete the summary, add a tube socket, a rubber or composition panel, binding posts, several feet of "spaghetti" and No. 18 wire. The wiring, which is very simple, runs underneath the panel and requires no soldering; the effect of the mounting being clean-cut and good-looking.

The whole radio described here is cheap to construct; and what is more, it gets the best of results. The one-tube set will tune in with satisfaction as much as 1500 miles, while with the two stages of amplification it will bring in on the loud-speaker stations that are at that distance. A 6-ohm rheostat should be employed with the WD-12 tube; while the UV-199 and UV-201A types demand a 20 or 30-ohm rheostat. The latter tube should give a slightly larger volume of reception than the others.

Figure 1 shows the hook-up of this

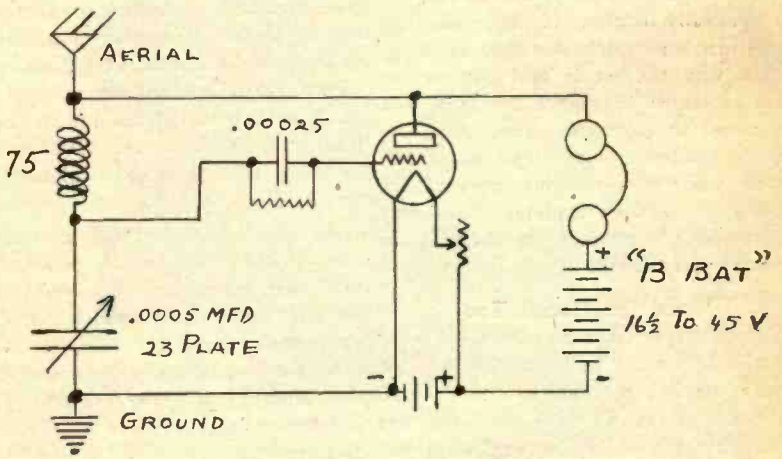


Fig. 1. Hook-up of Ultra-Audion

Most of the present built-in-the-case portable sets are chiefly of a rugged construction that meets well the demands of the traveler; but they are hardly the thing to grace the table during our stay at home. If a portable case is desired to enclose the ultra-audion set, it should be built separately, with a few spring hooks to hold the accessories firmly in their places. It would then be a simple matter to discard the case at home, and, by coupling the set to two stages of amplification and a loud-speaker, advertise to the neighbors your return from the So-and-So Mountains.

set. The operation is very simple. The incoming signal runs down the aerial through the 75-turn honeycomb coil and then through the adjustable condenser to ground. The grid connection is made to the stator of the adjustable condenser and the filament goes to the rotor. In this way the voltage across the condenser is impressed on the grid. The usual .00025 grid condenser and grid leak are inserted in series to give detector action. The output of the tube from the plate divides; radio frequency runs to the left to the coil and condenser, where it acts as a non-adjustable tickler,

thus giving regeneration to the set. Low or audio frequency leaves the plate to the right. After flowing through the telephones it reaches the "B" battery and from there to the filament.

It will be noticed that there is only one control; that of the variable air condenser. This is what makes the set so easy to operate. Of course, it also has with it the disadvantage that the regeneration is non-adjustable, but this can be taken care of in the design, and by turning the filament rheostat so that the brightness of the tube will be just

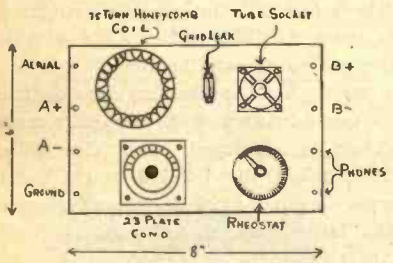


Fig. 2. Layout of Set

right. The coil shown of 75 turns is correct for an ordinary size aerial. If an unusually long one is employed, then a 50-turn honeycomb would be better.

The way the set is laid out on the base is shown in Figure 2. This is a very neat arrangement. The signal control or condenser is mounted at the left front, while the rheostat goes at the right. As already explained, this may be used if necessary to adjust the amount of feedback.

Good for Home, Too

Now that we have an idea as to what this little wonder is, let us find out the uses it can be put to and how this should be done. First, we have the home use with which we are well enough acquainted to require no explanation. The same may be said as regards the settled camper.

Then comes the adaptation of the small receiver to the automobile, the railroad train and the ship. In each of these instances we may use an efficient curtain aerial that takes but little space when rolled up. This aerial should be constructed like this: Between two pieces of cloth twenty-six inches square, sew in 14 turns of No. 22 or No. 24 single silk insulated wire, spacing it one-half inch apart. The curtain can be pinned or hooked up wherever it is convenient. Whether in an automobile, train or boat, the ground should be connected to a metal conductor that is directly in line with the steel frame of the vehicle. This can easily be done in each case, and needs no further explanation.

The storage battery of the automobile can be advantageously used to furnish the six-volt filament current required for the UV-201A tube. But the battery could also be tapped for four volts, should we want to use a UV-199. The WD-12 tube, however, is to be preferred where the set is used in more than one situation; it operates on one dry cell.

Uses the Curtain Aerial

Some fine day, this summer, you may see a comely maid enter your train, and deftly proceed to trap a little bit of entertainment. She will first pin a curtain-aerial to the back of the seat in front of her, and then tap the radiator which will afford a good ground. Next, she will pull out of her hand-bag a little chit of a set which she will lay on her knees. The minimum size "A" and "B" batteries will be placed on the seat beside her, and connected to the proper binding-posts. When she claps the earphones on her head and gives a few slight twists to an easy-gliding dial, don't be surprised if the damsel then begins to shake a wicked shoulder. She probably will be using the latest hook-up.

All in all, the ultra-audion receiver is one of the best tuning sets now in existence, and, since radio is fast losing its seasonable aspects and is becoming a year-round necessity, this circuit will probably be nationally known as one of the dependable long distance-getters adapted to all purposes of present-day broadcasting.

ALL WANT RADIO PICTURES

Of the hundreds of visitors who come to see the main works of the Westinghouse Electric & Manufacturing Co., at East Pittsburgh, Pa., nearly everyone wants to visit the radio studio and station of KDKA or wants to meet the announcers.

In a report issued by the man in charge of the visitors' bureau it is stated that visitors from 38 countries located in all parts of the world have requested photographs of KDKA's studio, station and radio announcers. Many of these foreign visitors had heard KDKA transmitting and wanted to take home with them some souvenirs of their visit.

The following countries have been represented by visitors requesting radio pictures: Austria, Argentina, Brazil, British Columbia, Belgium, Chile, Colon, Canada, China, Czecho-Slovakia, Cuba, Denmark, England, Egypt, France, Germany, Hawaiian Islands, Holland, Hungary, Ireland, Italy, Japan, Jarva, Mexico, New Zealand, Norway, Panama, Philippine Islands, Porto Rico, Roumania, Russia, Switzerland, Scotland, Sardinia, San Salvador, and Sweden.

It is believed these requests for radio souvenirs coming from such a world-wide audience sets a record for this sort of thing. It is also a good indication of the many different nationalities who yearly visit the Westinghouse Works.

SITE SELECTING BY RADIO

That the value of a home site is affected by its efficiency as a radio receiving point is evidenced by references in real estate advertising, such as one noted recently in a metropolitan newspaper as follows: "Farm for sale; nine-room house; fruit trees; 2 hours by rail from New York; excellent radio reception, KGO (Oakland, Cal.) being heard consistently on one-tube set. Price——, Box——." More space was devoted to radio than to description of the property.

New Yorkers building homes in the suburbs frequently inquire how their favorite stations come in before purchasing home sites, according to real estate men.

But one prominent attorney was not satisfied with the realtor's assurance. His present home is located in a fashionable Westchester suburb, but he suffers from interference from a mysterious source of induction. Before building his new home, he secured an elaborate loop receiver, mounted it in his car, and spent an evening listening in, so as to be certain that the new location would be a first-class receiving point for WEAF's programs without interference. Perhaps some day travellers will be mystified by groups of abandoned homes, until it is explained that residents found it necessary to move elsewhere because radio reception at these points is unsatisfactory.

Every Auto Its Own Aerial

Portable Outfits Are Good; Here's a Portable Antenna

IN the summer time you read a lot about the portable radio set, and to be sure it is a great boon to travelers. But you do not hear so much about the aerial to be used with the set. Of course, if it is one of the new designs that has a built-in loop antenna, then nothing further is needed, but such a set is quite bulky, and is very expensive, so it is necessary to use at least two stages of radio amplification to work a set on the loop.

If you are going a long distance from civilization, (which means broadcasting stations in these days), then the scheme which is mentioned here cannot be used, but if your vacation will be spent inside a radius of 100 miles of a good broadcaster, then it is worth giving it a trial.

Rubber Covered Wire

The idea here presented is not claimed to be new, but it is only recently that sets are good enough to give complete satisfaction. The idea is to use the whole frame of the automobile for a counterpoise (like a ground) and a special wire built into the top of the machine as an aerial. The way to go about it is this. Get 150 feet of rubber covered No. 18 wire. The rubber covering is not necessary in dry weather, but it is desirable to insure good insulation after a rain. Leave an end about six feet long to give plenty of room to reach the set at the front seat. Run the wire up the side of the windshield, but leaving it loose so that when listening it can be swung several inches away from the metal windshield support. Some people tape the wire around this piece of iron, but it is poor practice since it brings the aerial and counterpoise so very close together.

The side supports of the top of an open car are usually made of wood. Small screw eyes can be fastened in this wood on the inside, screwing them in horizontally. The wire should now be zig-zagged back and forth, from one side to the other, being supported by a screw eye, first on the left and then on the right. Since the average top is about six feet wide, it will require about twenty-two or three stretches back and forth to use up the 150 feet of wire. The end of the wire should be as far towards the back of the car as possible. No special precautions are necessary with this end except to tape it up so that no moisture will enter.

Auto Uses Itself for Aerial

This lead constitutes the aerial for your portable set. The ground is made by attaching a wire under any convenient screw on the motor. The rubber tires insulate the automobile from the ground and so the whole frame acts as a counterpoise. The aerial lead should be kept as far away from any metal on the machine as possible as mentioned previously.

The filaments are lighted from the six-volt storage battery. If UV-200 or 201A tubes are used, then the regular six-ohm rheostat is all that is needed. But if WD-11, WD-12, or UV-199 tubes are employed, then an additional resistance should be used. A special form of resistance, which consists of a flat piece of fibre, is obtainable for about 20c. which attaches right on the "A" minus binding post of the set, and the slider is attached to the wire from the storage

Continued on Page 18

The Piedmont Trio

GRAHAM McNAMEE IN PUBLIC EAR

Through his colorful descriptions of the Republican and Democratic Conventions, Graham McNamee's resonant voice has become familiar to millions of radio listeners in all parts of the country—not that all his laurels have been earned during the Conventions for McNamee has figured prominently in many important broadcasts involving the connection of numerous stations by telephone lines. His two most recent assignments, however, have sent his voice over a very wide area. No less than eighteen stations, a record number, were linked together for the Democratic Convention.

McNamee's abilities, however, are not limited to handling political events. He is a baritone of no little distinction. In spite of the demands of WEAF's microphone, he still appears as soloist in some of New York's most famous churches.

On the occasion of the broadcasting of the President's Annual Message to Congress, Mr. McNamee performed a feat which won the praise of hundreds of newspaper men. He listened to the President's long address through a loud speaker and immediately upon its conclusion delivered a clear and well balanced summary of the address for the benefit of his listeners, who ranged from Virginia to Massachusetts and from Missouri to Texas. No copies of the speech were available in advance; he delivered his summary—a ten-minute speech—without opportunity to edit or revise, or to consult the text of the address, in a manner which would do credit to a trained reporter and an experienced political speaker.

MUSIC THROUGH COAL

In a test recently conducted by officials of a Scranton, Pa., coal mine signals from WGY were received at the lowest level of the mine, 480 feet beneath the surface, and a half-mile from the foot of the shaft. The experiment with radio in the mine was carried on chiefly to test the extent to which radio may be utilized for the preservation of miners' lives.

PICTURES OF POPULAR PERFORMERS

Some people like a solo and some prefer an entire orchestra. But most everybody likes to hear a good instrumental trio. Our photograph is of the Piedmont trio, who have appeared before the WJZ microphone a great many times. Now, since WGY in Schenectady is connecting up with WJZ in New York, it is very probable that these musicians will be heard from the former station also.

NOW POLITICIANS TOE THE MARK

Microphones now face politicians wherever they go and they are learning to obey its rules. One of the most exciting periods of the Republican Convention in Cleveland was during the speech of John Adams Cooper, a delegate from Wisconsin, who offered a minority report to substitute for the majority report of the Resolutions Committee. The radical changes in the platform which he proposed aroused considerable interest on the part of the delegates. After speaking for five or ten minutes, the radio audience heard a great many hisses and boos and shouts which seemed to be in derision of the speaker. But the delegates, though unsympathetic, were quite anxious to hear Mr. Cooper, who offered the first real thrill of the Convention. What they were hissing was the Sergeant-at-arms, who was stepping forward to the end of the platform as if to lead the speaker away because the time allotted to him expired. But all that the Sergeant-at-arms was trying to do was to push Mr. Cooper a little nearer the microphone so that the radio audience could have the full benefit of the political drama he was enacting.

WJZ LINES UP WITH WGY

WGY is broadcasting a series of eleven concerts by the New York Philharmonic Orchestra every Thursday evening. These concerts will be radiocast in co-operation with WJZ of New York from the Lewisohn Stadium, College of the City of New York. The conductor of the opening concert was Willem Von Hoogstraten. The program starts at 7:30 p. m., Eastern Standard Time.

American Radio Relay League

POINTING THE ETHER WAVES

"Direct ray" radio transmission tests being conducted by the Marconi station at Poldhu, England, have aroused a great deal of interest among amateurs of the American Radio Relay League. Many members in the eastern part of the country have heard these signals on 94 meters. The call 2YT identifies the messages as coming from the test station.

This method of transmission which provides for sending the radio signals in just one direction is done by a system of reflection like that used for pointing a beam of light. The radio waves are sent out from the station toward a definite point with the help of a network of wires near the antenna, placed in such fashion that they act as a reflector.

The idea can be grasped by comparing the antenna system of the sending station with an automobile headlight with lamp and reflector. The aerial is like the light and the network of wires like the polished reflector.

By this novel means of transmitting radio waves, greater distances can be covered with the same power, as well as being concentrated definitely toward the receiving station. There is a rumor that work on the construction of the high power link in the British Empire wireless chain in Australia has been stopped until the definite outcome of these experiments.

It has just been reported here that Leo Deloy, prominent Dutch amateur, was heard in Brazil during the Pan-American radio tests of the American Radio Relay League. This probably gives Deloy the honor of being the first European amateur to be heard by an amateur operator in South America.

Deloy wishes to inform amateurs in the United States that his station will be "off the air" for the rest of the summer, but he confidently expects to have it ready for DX (distance) this fall.

Mr. Keith McLeod

A WELL-KNOWN DIRECTOR

Everyone these days seems to be interested in knowing how the directors of a station look. WJY and WJZ in New York are regarded as two of the highest class broadcasters in the East. The musical director of these twin stations is shown in our picture. Mr. Keith McLeod is a virtuoso on the piano. He has gained an enormous following from the broadcast listeners who hear him evenings from one or the other of these two stations.

AUSTRALIA AND BACK

Having communicated in both directions with amateur radio telegraph operators in South America, amateurs of the United States and Canada are now turning their attention to the Pacific ocean for the purpose of engaging in a two-way radio contest with the experimenters in Australia and New Zealand. Two ten-day periods, one in August and the other in September, have been set aside.

This test is being arranged by the American Radio Relay League at the request of C. D. Maclurcan, president of the Australian Radio Relay League, in a determined effort to establish two-way radio contact with North American operators before the end of the year. All of the transmission will be carried on with very short waves.

While sending on wave lengths of about 100 meters is somewhat restricted from the standpoint of U. S. amateurs, it is expected that there will be a suffi-

cient number of special licensed operators on the air to make the test successful. Many American amateurs are being heard in Australia on the short waves.

Announcement was recently made at the A. R. R. L. Headquarters that the first transmitting period will be from August 10th through the 20th, and the second from September 7th through the 16th. Australian and New Zealand amateurs will listen from 3:00 to 3:30 a. m., E. S. T., and they will transmit from 3:30 to 4:00 a. m., E. S. T. Two-way work will be attempted daily starting at 4:00 a. m., E. S. T.

While the amateurs in the United States and Canada will be losing sleep in the early morning hours, Australian and New Zealand operators will be working their stations about 6 p. m. The transmitting hours will be the same each day. It is suggested that all operators use a code word for identification.

SENDING WITH 201-A TUBES

The ban on amateur radio telegraph tranemission in Sweden has just been lifted by the government, and thirty licenses for transmitting stations have been issued, says Bruno Rolf of that country, in a letter to the American Radio Relay League. Mr. Rolf is secretary of the Svenska Radio-Klubben (Swedish Radio Club).

The number of listeners has grown rapidly the last few months, as this organization now has a total of 1,600 members. All receiving sets are licensed by the government; 30,000 of these licenses have been issued since the new regulations were passed.

There is still a great deal of confusion "in the air" and the Swedish club is cooperating with the transmitting amateurs in order to provide for a fair division of wavelengths. It appears that the regulations affecting sending sets are of general nature and many conflicting questions have yet to be decided upon.

Regulations of this kind of traffic comes under the direction of the Swedish Telegraph Department, which branch has just decided that in the future amateur stations must use SM as the first two letters in their call. This is necessary to identify the amateur who is transmitting as a Swedish operator.

As yet few amateur stations have succeeded in getting out very great distances; the best record so far is that of Dr. G. Alb. Nilsson, Skolgaten 5, Lund, Sweden. His station was heard in England when transmitting with ¼-ampere in his antenna. The power was obtained from four *receiving* tubes with 250 volts D. C. on the plate. He does not use sending tubes at all. Dr. Nilsson's call is SMZV.

SOUTH SEA SENDING

Having penetrated the polar regions with MacMillan, amateur radio is now about to take the opposite extreme and set forth on an adventure in the South Seas.

The auxiliary ketch, "Big Bill," is preparing to sail from Chicago in the interests of the Deep Waterways Commission on a two-year trip that will ultimately take it around the world. It will have as its radio operator, Mr. E. C. Page of Evanston, Ill., a young amateur and member of the American Radio Relay League.

The selection of Page has been approved by Captain A. J. Dukan, who will be in command of the vessel, following his recommendation by local representatives of the A. R. R. L. For his equipment he will have Zenith radio apparatus capable of working on both commercial and amateur wave lengths, including the shorter waves. Page expects to communicate regularly with amateurs. The official radio call assigned to the vessel is WHU.

From a radio standpoint much interest is being taken in the expedition which is being organized and outfitted under the supervision of William H. Thompson, former Mayor of Chicago. It will offer an opportunity to study the efficiency of the shorter wave lengths in the climate peculiar to southern waters.

The vessel, with its crew of seven men, will proceed down the Mississippi River, through the Panama Canal, and then around the world. It is expected that in addition to operators in the United States consistent radio communication will be maintained with amateurs in South America, Europe and Australia.

WGI TALKS TO HAMS

Immediately following the usual code practice broadcast from WGI, Medford Hillside, at about 6:40 p. m., twice a week, there will be an amateur radio period, during which announcements of special interest to transmitting amateurs will be made. C. R. Emery, Director of Broadcasting at Amrad, is being assisted in promoting this phase of the evening program by local members of the A. R. R. L. and the Commonwealth Radio Association.

It is expected that these short talks for the benefit of amateur listeners will help to bring about a better understanding between the amateurs and the broadcast listeners, giving to both classes a better appreciation of citizen radio.

EVERY AUTO ITS AERIAL

Continued from Page 15

battery. The slider is set by experiment to the best place, and then all further adjustment in control is taken care of by the regular rheostat.

The picture shows such an installation as has just been described.

Motion picture news reels are as keen for stories as newspapers. A newspaper has a staff of many reporters, mostly all working under one head, the city editor. With the reporters or cameramen working for news reels it is necessary for them to find their own stories and it has been a habit for them to read newspapers or wait for their good friends to call them—but—today for those that believe in being on the job at all times during business and pleasure hours it is necessary to keep the World News with you at all times penned into a little box that you can carry with you. This photograph shows Harry Birch of Chicago, one of the oldest news reel cameramen in the business with a Westinghouse senior set in his car. He can tune in every half hour no matter where he is so that he can listen to the "World Crier," Station KYW, which broadcasts world news every half hour throughout the day. This keeps him advised as to everything that is happening and gives him a chance to get stories for his news reel, when they are still news.

It might be mentioned that many radios are unable to get KYW. This is because their long wave length (536 meters) is above the range of many sets which were sold a year or more ago.

BUYING CHEAP PARTS

WHEN starting to build a set the first question is one of finances. How much money do you want to put into its construction? On the market at the present time there are radio products of all prices.

As a guide in the purchase of such parts, we offer the following suggestions: In the first place, we may divide the apparatus into two general groups. The first consists of parts which act only mechanically or for making a good appearance. In this class are included binding posts, knobs, dials, switch points, spaghetti, screws and nuts. The second class takes in everything else which has some electrical part to play in the set.

Have You a Good Eye?

When it comes to picking out material in the first group, it is perfectly safe to let your eye be your guide. If you get a 6-32 screw and a nut to fit, then they will mate well together, so that the nut can be turned without any great effort. In such a case you have a combination which is perfect, and no matter how small a price you may have paid, you have got something which is just as serviceable as the most expensive which can be obtained. Take the matter of a dial. If it *looks* like a good dial it *is* a good one. The only work a dial has to do is to twist the shaft when you turn it, and any style, even the cheapest, will accomplish this. So again in this case it is safe to let your eye be your guide. Naturally the more expensive dials are the better looking, and it does not mean that you should buy cheap material necessarily, but that you are paying only for looks and you can go as far as you like.

When, however, it comes to selecting your coils and condensers, and in fact anything which has an electrical part to play, then more skill is required. A good variable condenser is quite necessary if you want to obtain great selectivity or the ability to tune out unwanted stations. But here a little common sense should be used. The better the set which you are building the greater is the need for good parts. It is just as foolish to use the most expensive parts in a cheap hook-up as it would be to put a $150 paint job on an automobile of the vintage of 1915. Take the single circuit tuner as an example. This is a pretty good set for a small expenditure of money and quite long distances can often be reached with it, but it is not selective at all. Putting the best kind of condensers and coils in it will not make it selective. So here is a place where cheaper parts may be used without any sacrifice of efficiency.

Don't Pick for Show

On the other hand, if you are ambitious and are building a super-heterodyne, which is expected to reach out 3,000 miles on a good night, it would be foolish to use anything but the best equipment. If you do not know just what you want, the best way to do is to go to a reliable dealer and ask his advice. But here is a tip in selecting your variocouplers and variometers—do not pick out the instruments which have a large amount of unnecessary brass in their construction. Heavy metallic posts and supports make a very good looking job, but you must realize that in all such pieces of metal there are losses from eddy currents. Each such metallic piece is robbing some of your energy. This results in less selectivity and a shorter range. Instead, pick out those parts which have just as little metal in them as possible aside from the actual wire or condenser plates themselves.

WATCH YOUR GRID CONDENSER

What would you think of a man who carried a rifle very carefully so that nothing could interfere with the gun barrel, but who quite carelessly let the children play with the trigger? It would seem that any one familiar with the operation of a gun would look first of all to having a good trigger mechanism.

Watch tht Trigger

When you come to a vacuum tube, the grid is the trigger. It controls the output of the tube. If a small amount of vibration is fed to the grid, then the tube amplifies it or multiplies it some five or ten times in volume and sends this increased signal out through the plate. From this it is evident that care should be taken as to what is connected to the grid of your detector, whereas the plate is not nearly so important. Most sets contain a grid condenser and also a phone or stopping condenser. This latter is connected in the plate circuit as a by-pass to allow the high or radio frequency to get by without passing through the phones. For such a position a paper condenser costing 10 or 15 cents is very satisfactory. The losses in such a condenser are negligible and are supplied by the tickler or regeneration so they have no effect on the operation of the set.

But the grid condenser is a very different proposition. As we have just explained, it is the guardian of the trigger. If a paper condenser is used here, the losses will be subtracted directly from the music which you receive, and the effect of the losses will be multiplied in going through the tube. There is only one style of condenser which is satisfactory in this position, and that is one having mica insulation. The best condenser obtainable for this important place costs only 35 to 50 cents, and so it will pay you to remove your old paper condenser if you are using it and put a mica one in its stead.

IT'S AN ILL WIND, ETC.

The two National Conventions give a good illustration of this old proverb. No one seems to be satisfied with the big gatherings themselves. It is common talk that the Republican Convention hurt the Party because it was too cut and dried; too much controlled by the bosses; too short. It is also common talk that the Democratic Convention hurt the Party because it was not enough cut and dried; not controlled by the bosses enough; too long.

Nobody so far has hinted that they have hurt radio. As a matter of fact they seemed to have waked fans up to the fact that radio is a year round proposition. We know of staid Republicans who sat up until after midnight with the phones glued on their ears listening to the Democratic Convention to hear whether McSmith was going to beat out Underglass, and all the time he would tell you that the Democrats had not a chance of electing their candidate even when they got him.

Perhaps one thing that helped the situation was the fact that a great many of the most powerful stations in Central and Eastern United States all sent out the same message. Practically every fan would tune to some station and stay there. Consequently there was almost complete absence of the squealing, which usually results when a listener fishes for distance stations with his tickler turned up too high.

If every set operator would take this lesson to heart and realize that conditions *might be* just as good every night, as they were during the Conventions it would be a big help. So many fans delight in hunting for stations and usually don't seem to realize that by turning on their feedback to nearly full strength they are just spoiling their neighbor's enjoyment. Of course, this point has been mentioned again and again, not only in this magazine, but in all others, but we do not recall of ever seeing such a fine demonstration of what would happen if everyone were considerate of his neighbor's feelings.

The next time you feel tempted to squeal around for distant stations, think to yourselves—Remember the Conventions.

THE FAMOUS CRYSTAL MYTH

It has long been the custom to talk about something being "as clear as crystal." This phrase started many years ago before radio was thought of. Of course, it referred to a glass crystal.

The idea has been brought over bodily to refer to the crystal set. Many a person speaks of a program coming in, "as clear as on a crystal set." This has been said so often that many think a crystal is clear, but that a tube set must be distorted. Let us see how this works out.

There are two general classes of messages to be received. The first is from a local station, the other from distant points. In general the nearby music comes in more than one hundred times as powerfully as the distant one and this ratio may even reach to ten thousand times. Of course, the crystal is not good for receiving over a distance much in excess of twenty miles as a general rule. But a good single tube set can get 1,000 miles or more with fair regularity. We compare cases of getting local and distant stations on a crystal, and local and distant stations on a tube.

Since the crystal will not pick up distance, as just mentioned, everybody must take the case of *local* reception on a crystal. To be fair, we should compare it with similar action with the tube. But this is where most people are unfair. It is the action of the tube on the distant station, 500 miles away, which is matched up with the crystal, receiving five miles. To get 500 miles the single-tube set must naturally be worked with feedback or regeneration. Even here good reception can be obtained provided the tickler is not turned up too high. But so many operators spin their dial way around in the effort to reach out as far as possible, and of course the result is that the music is distorted. Then they complain and say if they had been using a crystal, it would have been much clearer.

To be really fair in the matter, listen to a local station on a crystal and then try the *same* station with a tube set, worked without regeneration. That is, turn the feedback dial to zero. We have tried this a good many times and if the tube is a good one, we have found that the program sounds just as clear as it does on a good crystal set. We would like to hear from any of our readers who disagree in this matter, as it is realized that most people hold the opposite view. Apparently the reason is that they have not been fair to the tube set in making a trial.

It reminds us of the ease of riding in an automobile compared with that of an old style horse-drawn buggy. The horse and buggy would gallop along at five miles per hour and owing to this low speed the seat cushions gave pretty easy riding. But suppose you drive at 50 miles an hour in your auto. The high speed will bump you around a lot in spite of the fact that the springs and cushions are much softer than they used to be. Would it be fair to compare the comfort of the buggy at five miles with the discomfort of an automobile at 50, and so condemn the upholstery of the machine?

Some Sending Station Stories

"KEEP THEM GUESSING," SAYS KDKA

Why do some radio programs find a better response with the public than others? Miss Marjory Stuart, radio critic of station KDKA, Westinghouse Company at East Pittsburgh has found out.

She has found that those radio programs which permit the participation of the radio audience are the ones in which the radio fans find their greatest thrill.

This means that when a missing word contest is radicast, or when some problem is sent out into the ether for the listener to solve, then the average fan sits back and thinks radio is the greatest thing in the world.

Perhaps the same fan thinks similarly when he hears a magnificent opera broadcast, or when the concert singer entertains or during a good lecture, but if he does he doesn't make so many remarks about it.

There is a fascination about sitting at the radio with pencil and paper in hand and either drawing some animal partly described by the announcer, or writing down a problem to be solved that is felt by every radio listener.

That this feeling is universal can be easily proved by asking the fans themselves. Ask the football fan what he likes best about the broadcast of the play by play reports. He will say that he likes to lay out the football gridiron on paper and then as the progress of play is radicast to draw on the paper the progress of the teams. Ask the fight fan who sits with pencil in hand and writes out the rounds which his favorite boxer has won or lost. Even during the great national conventions just concluded, it was the ability to sit down and add up the votes as they were cast, thus showing the total being given to the various candidates, that kept the fans seated before their loud speakers or with head phones on their ears for long hours.

At KDKA when the animal guessing contests were broadcast, not only children took part. Many a grown-up also drew a picture and while not sending it in to the radio officials, kept it prominently displayed.

It is because of these personal touches which these contests or other radio parties engender between the station and the listeners that KDKA always has one or two such "stunts" every month or so. It is one of the "sure-fire" things of radio.

DO FOLKS LIKE GOOD MUSIC?

WGY, Schenectady, and WJZ, New York, are offering a series of eight concerts by the Goldman Band of New York on Saturday evenings during July and August. They start at 7:15 o'clock, Eastern standard time. The band of sixty musicians, conducted by Edwin F. Goldman, will play at The Mall, Central Park, New York. WGY will be connected by wire to the control room of WJZ in New York.

This is the seventh season of the Goldman band in New York. It began June 2 and will be continued for a period of twelve weeks. The concerts are the gift of Mr. and Mrs. Daniel Guggenheim and Mr. and Mrs. Murray Guggenheim for the benefit and enjoyment of the people. For five years, under the direction of Mr. Goldman, this band played a summer series of concerts at Columbia University and last year began their series at Central Park. During the summer of 1923 sixty concerts were given to audiences of from 15,000 to 25,000. At the final concert over 45,000 people were present.

RADIO VS. TORNADO

When disaster, in form of a waterspout and tornado, swept in from Lake Erie and demolished the city of Lorain, Ohio, radio was an important factor in rushing aid to the stricken city. Broadcasting station WTAM, of the Willard Storage Battery Company, Cleveland, was broadcasting the proceedings of the Democratic National Convention when vague reports of the damage filtered into Cleveland.

All lines of communication out of Lorain had been destroyed and radio was summoned to the task of mobolizing the national guard for protection and reconstruction. The convention proceedings were dropped from the air in order to release the long distance telephone lines to be used for emergency purposes if occasion should arise.

WTAM then set about broadcasting appeals for help for the suffering city. At the request of their officers, the 145th Infantry, the 135th Field Artillery and the 112th Engineers were notified by radio to mobilize at once for relief work.

Bulletin after bulletin on the destruction was broadcast until the entire city of Cleveland was on its toes waiting radio directions on what they could do

to help. The American Legion of Cleveland requested WTAM to broadcast an appeal for nurses and physicians, stating that transportation would be furnished. This was done and the response was immediate. Within an hour several hundred doctors and nurses were speeding to the ruined city.

Guardsmen who had seen service in the World War said that the wrecked city presented scenes worse than any they had seen in Flanders or France. Four years constant shelling, they stated, could not have accomplished the damage wrought by wind in 1 minute and 44 seconds, the estimated duration of the tornado in the city.

Officers acquainted with relief work in the Dayton flood and similar disasters stated that, never in their experience had they seen relief work so speedily organized and rushed to the devastated area as in this instance when radio filled the breech of destroyed communication.

SINGING "OLD MOTHER HUBBARD"

For two and one-half years Ralph Mayhew has been giving the radio children a Sunday Evening Bubble Story Hour from station WJZ, for he was among the first broadcasters in the days when that station was in Newark, New Jersey, and has continued to be a regular feature of the program since it moved to New York in May, 1923. During that period—which is to the best of our knowledge a record for continuous broadcast appearances—he has received personal letters from over forty thousand children throughout the country; and to most of the forty thousand he has said "hello" over the radio, mentioning each name so that his little correspondents could be sure that he received their letters.

Mr. Mayhew broadcasts at least three of his "Bubble Book Songs" every Sunday, asking the listening youngsters to sing with him; so that every week there are between twenty and forty thousand little voices singing simultaneously throughout the United States—the largest and the youngest choral organization ever known. The songs are the old familiar Mother Goose Rhymes, the ones which practically every kiddie who has ever grown up remembers, and no small number of grown-ups join in the choruses of "Old Mother Hubbard."

HE GETS THE LATEST CA-NEWS

Often Broadcast Bill, in summer,
Makes a trip upon the lake;
But to be content, his fish line
And his radio he'll take.

With his fish line round his ankle
And his head-set on his ear,
Though his "line" is often "busy,"
Still the music's loud and clear.

—*By Del.*

ARMSTRONG-DEFOREST REGENERATION

A great deal of interest has been shown recently in regard to the patent suit between Armstrong-DeForest as to who was the inventor of regeneration or feed-back, used so commonly on radio sets. The Radio Corporation of America has issued the following statement on this subject:

"The vacuum tube oscillator invention has been recently considered in an interference case in the Court of Appeals, District of Columbia. Armstrong, DeForest, Langmuir and Meissner each claimed to be the inventor of the method of causing a vacuum tube to oscillate, or produce alternating currents by means of regeneration. In the Patent Office, the first decision was in favor of Meissner and the last two decisions, including the final one by the Commissioner of Patents, were in favor of Armstrong. The most recent ruling is by the Court of Appeals and is in favor of DeForest.

"This decision is not necessarily final. The question whether a patent for the invention in dispute should be granted to Armstrong or DeForest may be litigated in a U. S. District Court, whose decision is subject to a review by a Circuit Court of Appeals.

"The Court of Appeals for the District of Columbia states that the issues of the interference are different from those which were involved in the suit of *Armstrong and Westinghouse vs. DeForest Radio Tel. & Tel. Co.* in the Southern District of New York where the Armstrong regenerative patent No. 1,113,149 was upheld as of primary importance and DeForest radio apparatus was adjudicated to infringe. This decision was affirmed by the United States Circuit Court of Appeals of the 2nd Circuit.

"Both Armstrong and DeForest have transferred rights under the invention in dispute to the Radio Corporation of America, so that the radio public will continue to be able to obtain Radio Corporation products using the regenerative invention in all its forms, regardless of whether Armstrong or DeForest should finally be granted a patent for the issue of the interference. In other words, the business of the Radio Corporation is not in any way affected by the decision of the Court of Appeals of the District of Columbia."

The Third General Electric Station

This Will be Even Better Than WGY or KGO

By W. T. MEENAM

WORK has been started on the Denver, Colorado, broadcasting station of the General Electric Company. In the early winter a new voice will be on the air. This will complete the General Electric's system of three stations, the first of which, WGY, opened at Schenectady, N. Y., early in 1922, and the second, KGO, at Oakland, California, in 1924.

In the construction of the Denver Station full advantage will be taken of the experience gained in the operation of both the Schenectady and Oakland broadcasting plants. Every improvement which has been tested by extended use will be included in the equipment. The entire plant, like the Oakland station, will be housed in its own building. The sending outfit will be designed to go to higher power than is now permitted should the regulations of the Department of Commerce be changed.

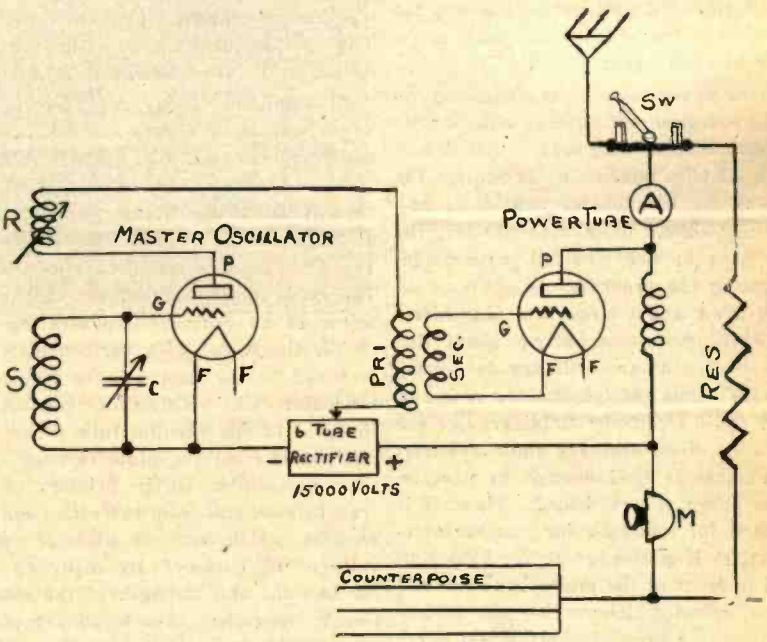
At present all the Department of Commerce will allow is one kilowatt, which equals 1,000 watts. This is the amount of energy consumed by twenty ordinary sized fifty-watt electric lights. This is considerably less than is used by some other countries. For instance, in Canada, the station of La Presse, Montreal, is completing a seven-kilowatt station, seven times as powerful as any in the United States. If, at any time, in the future, our government allows more sending power, most stations will not be prepared to take advantage of the permisison, since it will be too expensive to re-design their apparatus.

The station, a two-story building, will be located on 300 x 250 foot plot, four miles from the heart of Denver and on the main eastern motor highway. The studio building will be 58 x 47 feet and the first floor will be divided into reception room and offices for the executives, the correspondence and the program forces. On the second floor will be two studios, a waiting room and a control room for the station's amplifying equipment.

The first or main studio will be 45 x 22 feet in size, big enough to accommodate comfortably large bands and choruses. The deadening or echo period will be adjustable through the use of movable hangings and floor coverings. Complete deadening of the echo is nearly as bad as none at all. This was explained at length in our issue of May 15, on Page 9.

As the program varies from speaker to band, or soloist to orchestra, different degrees of deadening are required to secure perfect tone quality, and the Denver station will be equipped so that it may be easily changed to care for the different extremes of sound. The ceilings and parts of the side walls will be sound-deadened by a one-inch felt covering, over which decorative tapestry cloth will be hung.

Next to the main studio is the control room, and on the other side of that is a smaller studio. This arrangement has proved most successful at KGO, because one number may follow another with only the time taken for an announcement between them. This means that the listener is saved the annoyance of waits between numbers. The second studio also permits an artist to rehearse or tune his instrument before performing for "the air." Since the control room is *between* the two studios, the operators who work the amplifying and microphone equipment can watch what is going on in either room.



Sending with Master Oscillator

The power house will be a one-story building, 93 feet long by half as wide, and will be directly behind and connected to the studio building. This power house will be divided into two sections, one for the motor-generators, and the other a power room. In the first part will be eleven motor-generator sets. Such

a set includes a motor, which is driven by the city electric light current, and mounted on the same shaft is a direct current generator. The latter is required to furnish the current for filament lighting, (like an "A" battery), or plate current for the power amplifier tubes, ("B" battery), and grid bias potentials ("C" battery). This room will also contain the power transformers, (which are used to reduce the pressure from 2200 volts down to 110), the control panels and the starting compensators for the motors. These compensators are used in starting up the motors so that they will not take too much current and blow the fuses. They are built like transformers with several taps. When starting, the controller handle is moved to the right, and connects first 20 per cent. of full voltage to the motor, then 40 per cent. on the second step, etc., until full speed is attained. From then on the compensator is disconnected from the circuit until the machine is ready to start again.

In the power section, located along opposite sides of the room, will be two complete transmitting sets, either one of which may be placed in service by the operator at the control panel. If any difficulty should arise with one set, the other may be used instead, without interrupting the program.

When an artist sings into the microphone, it produces a current about like what flows in an ordinary telephone. This isn't loud enough, and so it is run to an audio frequency amplifier, like the first step in an ordinary radio receiver. This makes it loud enough to pass on to the power control board. There it is adjusted for loudness, for you must realize that if a speaker moves back and forth in front of the microphone the volume of sound which reaches the instrument varies a great deal. It would never do to let his voice fade on the air the way it does in the "mike," so one of the operators is constantly on duty and as the speaker approaches, and so increases the volume, it is *his* duty to insert enough resistance to drop the voice down to normal again.

After passing the control board, the waves are fed to the power tubes. These will be of the water cooled type, normally rated at 20 kw. They are used at an output of only 5 per cent. of their rating, in order to obtain the greatest reliability and freedom from distortion. The water cooling is used because so much heat is liberated from the filament and plate circuits that the tubes might get red hot if they were cooled only by the air which happened to strike them. The water cooling is the same idea as is used in your automobile. A jacket surrounds the tube and conducts the heated water to a radiator where it is cooled. Of course, for such an insulation, the radiator may be omitted and a new supply of cold city water fed continually to the water jacket.

A departure from the usual circuit arrangements will be made in the Denver station in that a master oscillator circuit will be used to obtain constant frequency for transmission, and freedom from harmonics. The output of both transmitters may be connected to an artificial antenna unit which will be located directly under the lead-out insulators. The purpose of this feature is to test the equipment without radiation. Through this unit either set may be connected to the antenna and counterpoise.

A simplified wiring diagram of this set is shown in Figure 1. To make it easily understood, the filament connections are omitted. These are supplied with current from one of the motor generators, which have just been mentioned. The first tube is the master oscillator. The hook-up is very similar to the detector of an ordinary regenerating set. "S" is the stator of a variocoupler. It is tuned to the proper wave length by condenser "C1." This tuner connects to the grid of the vacuum tube. The output comes from the plate through "R," the variocoupler, to the primary of the transformer, and from there through the rectifier, which serves in place of a high voltage "B" battery. By adjusting "R" the amount and strength of the oscillation is controlled. The secondary of the transformer is connected to the grid of the power tube. Its plate is hooked up to the antenna switch through ammeter "A"; then coil the back to the rectifier. In series with the ground lead from the coil is the microphone "M." Also connected to "M" is the counterpoise, which will be described shortly.

When the switch is thrown to the left the radiated energy goes out on the aerial. But when it is desired to test the set to see if it is operating correctly, the switch is thrown to the right. This substitutes the resistance "Res" in place of the aerial and so any troubles or squeals in the sending will not be broadcast to disturb the fans.

The advantage of using a master vibrator instead of hooking up the main oscillating tube, as a self-oscilator, is this: the power tube, it will be noticed, is connected to the aerial and so the capacity of the latter would influence the frequency or speed of oscillation, if it were a self oscillating tube. No matter how tight the aerial wire is stretched, there must, of course, be a *little* sag in it and on a windy day it is bound to sway. This swinging changes its capacity to ground. The result would be that on a windy day the frequency would shift slightly, and this would cause apparent fading in the sharper tuned radio receivers.

The master oscillator has no such variable capacity in its circuit. All it has to do is to feed the primary of the transformer. When once its frequency or wave length has been properly adjusted by condenser "C1" it will remain without any further change. The secondary of the transformer impresses this same frequency on the grid of the power tube, and so no matter how the capacity of the aerial is shifted, it will continue to vibrate at the wave length determined by "C1."

In our diagram we have shown the microphone direct in the ground or counterpoise circuit. As a matter of fact it is usually in a local circuit connected to the main one by a modulating transformer in the ordinary way. This is not shown, in the interest of clearness.

The fifteen thousand volt plate supply for the water-cooled tubes will be furnished through a vacuum tube rectifier consisting of a six-phase, 220 to 15,000-volt transformer, the output of which will be rectified through six UV-219 power tubes. Any ripple will be eliminated by means of smoothing reactors and a bank of condensers.

Unlike WGY, where the towers are located on top of a five-story building, a quarter of a mile from the control room, or KGO, where the supports are built on the ground also a quarter of a mile from control room and studio, the towers of the Denver station will be erected right on the ground, one on each side of the studio building. The antenna wires will be directly above the power house. The towers are of steel, 150 feet high and triangular in shape. They will support a three-wire antenna. Distance between

Continued on Page 29

A Hornless Extra-Loud Speaker

With One of These Instruments You Can Yell a Mile

By OLIVER D. ARNOLD

THERE have been many descriptions published recently of the new hornless loud speaker, which has been installed at Schenectady. But nothing much has been said describing the operation of this unit. It might be called an "extra-loud" speaker, as the volume of sound which it gives out is much greater than that coming from any ordinary instrument.

The general appearance of this new invention is shown in Figure 1. Dr. C. W. Hewlett of the Research Laboratory of the G. E. Company is responsible for its development. He is shown beside the instrument. By examining the picture, it is clear that nothing at all in the nature of a horn is used. As a matter of fact, the device looks exactly alike on both sides, and both sides give out music equally loud. This is quite an advantage, since it can be set up along the roadside or in the middle of a gathering of people and both halves will be able to hear without the need of two separate instruments facing opposite ways.

The first one to be displayed in public has been set up at the camping ground at Schenectady, right on the main thoroughfare for tourists. It is being operated by the city itself. It is certainly a great advertisement for the place, as no automobile can pass by without being struck with the novelty of the device.

A Three-foot Diaphragm

The diaphragm itself is three feet across. This compares with two to three inches for the ordinary loud speaker. Over all the apparatus measures 3½ feet. The peculiar thing about the diaphragm is that it vibrates as a whole. Other styles of speakers have a push-and-pull applied at the center, but the edges are firmly clamped by the cap, which is screwed down tight. In place of this action in the present instance, the diaphragm is an aluminum disk and instead of being *clamped* at the edges, is loosely supported by soft rubber gaskets. The difference in the form of vibration is pictured in Figure 2. At the top is shown the way the disk looks in other devices and below is the same thing in this one. It can easily be seen that the lower form of vibration will set a good deal more air in motion, and so give louder notes.

This same principle is used on all sizes of speaker. The smallest one yet built is about six inches in diameter and the

Fig. 1. This Speaker Can Yell

biggest, three feet, as just described. With the large one 500 feet is covered by the programs from WGY as received on a fifteen-inch loop aerial.

It Has No Insides

The principle on which this induction loud speaker works is rather novel. There is no inside to it at all. Everything can be seen at a glance. In the center is the thin disk of aluminum, supported at the edges by soft rubber rings. Just in front of the diaphragm is a coil of wire wound flat. In the large sizes there are a number of these coils of various diameters nesting one within the other, and all within one-half an inch from the disk. This set of coils is repeated on the other side of the diaphragm; in fact, there is no front or back to the instrument and the description of one side exactly fits the other.

Squirt Hose on Window

Direct current is run through these coils so as to make them magnetic. But the two sides are connected with reversed leads so the magnetism of one opposes or bucks that of the other. Since the aluminum disk is right in the center, no magnetism runs through it from one side to the other, but the two magnetic streams meet and flow off to the sides as shown in Figure 3. The action is very similar to the way a stream of water flows, if you squirt a hose straight against a window pane. Assume that some one else was playing a similar stream of water on the other side of the pane at the same time. The water does not go *through* the glass at all, but runs *along* it from the center out in all directions. The same thing occurs with the magnetism. The arrows shown in full lines point the direction of the magnetism, while the dotted arrows show which way the current flows through the wires. The flux, or lines of force, do not pass through the aluminum from side to side, but run out in all directions, as shown in Figure 4. This makes a south pole in the center of the disk and a series of north poles all around the edge. This action is continuous all the time as the direct current generator supplies thirty amperes to the winding as long as the speaker is in operation.

In order to get motion it is necessary to have two things,—magnetism in one

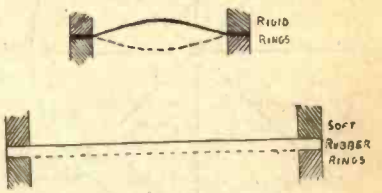


Fig. 2. Diaphragm Action

direction and a current flowing across it at right angles. In the telephone the magnetism is supplied by the permanent magnets in the case, and the current runs in the coils. In the power loudspeakers, such as the Magnovox, Thorophone, and the like, the magnetism is caused by di-

rect current from the battery through a large winding, and the current from the radio set is passed through a coil located in the magnetic field. In the present case we have the magnetism from the coils as shown. The next question is how to cause current to flow in the disk.

An Electrical Fence

This is solved by transformer action. The same thing happens in your first and second step of audio amplification. The same coil "C" that carries the direct current is also used to conduct alternating current from the power amplifier of the operating receiver. This is connected as shown in Figure 5. It represents the same coil as in Figure 3, but to save confusion, its mate and the generator circuit is omitted. The power amplifier which is the last tube of the radio set operating this speaker, has its output coupled through the transformer "T" to this coil. A five-mfd. condenser is connected in the line to prevent the direct current shown in Figure 3 from backing up through the transformer. Direct current, you will remember, cannot run through a condenser. The choke coil shown in both figures is used to prevent the alternating current passing over to the direct current generator. The combination of condenser and choke might be called an electrical fence. That is, it keeps the direct and alternating currents separated, except that they both use the same coil, "C."

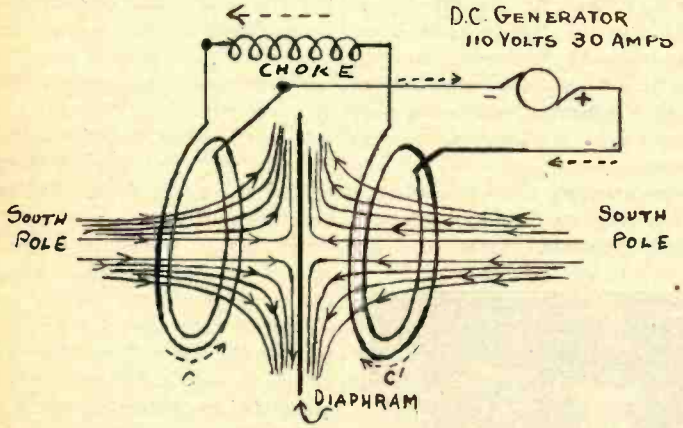


Fig. 3. How Coils Affect Diaphragm

Coil "C," you will remember, is very close to the aluminum disk. Aluminum is a good conductor of electricity and so it acts like a big piece of wire wound in a circle. We now have regular transformer action, which is called induction. Coil "C" is the primary and disk "D" is the secondary of an audio frequency transformer, so currents oscillate back and forth in "D" in just in time with those following in "C." This is shown in Figure 6.

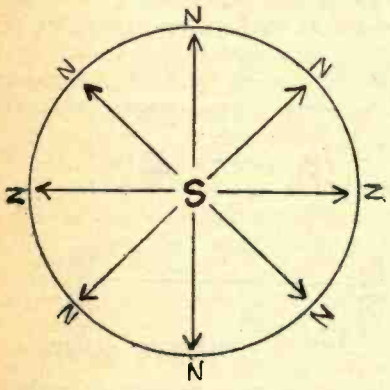


Fig. 4. The Magnetic Lines

The arrows are made double ended to show that the current is alternating and keeps reversing its direction. These currents spin around and around all through the disk.

Now, we have just what we want. Figure 4 shows the magnetism running out in all directions or "radial," as it is called (like a radius). The currents are flowing around and around the axis or "axially." As just explained, if a current flows at right angles to a magnetism, it makes the conductor move at right angles to both. That is, it makes the diaphragm vibrate back and forth in a direction at right angles to the paper. This action is not confined to the center of the disk, but takes place all over it, that is why it vibrates as a whole, as shown in Figure 2.

Good and Bad Points

Among some of the advantages which might be mentioned for this type of loud speaker are these:

It sends the sounds in both directions.

No horn is used with it.

It contains no iron, nor permanent magnets.

Since it vibrates as a whole it has very little distortion.

The heavy diaphragm responds much better than ordinarily to low pitched tones.

It can be heard nearly a mile.

There is no mechanism to get out of order.

The following disadvantages can be seen

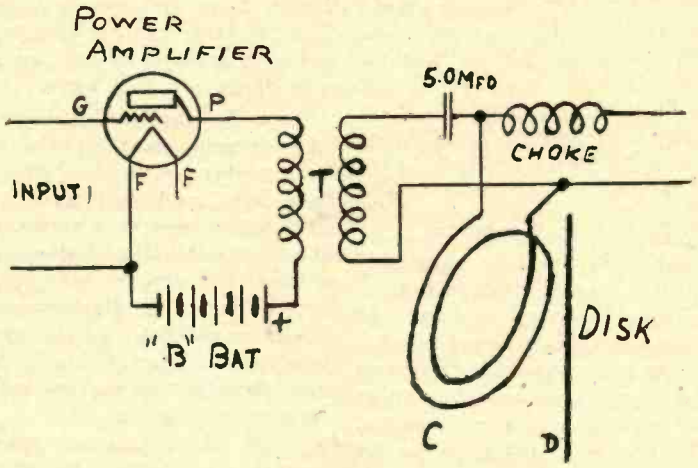


Fig. 5. Hook-up of Speaker

It is quite large and heavy.

It requires a power amplifier to feed its audio frequency.

Continued on Page 30

A Low-Cost Transmitter-Amplifier

Two Detectors Are Used in This Unusual Combination

By CLARENCE H. WEST

THE average amateur and radio experimenter spends many of his evenings constructing a one-bulb receiver that will bring in the distant stations. At last he hits upon a circuit by which he is able to cover a wide radius of reception with his phones, but it is not enough. His main desire is to hear those same D-X (distant) stations out of a loud speaker. So he then proceeds to build a two-stage audio frequency amplifier.

As a rule, he meets with a great disappointment. Local stations come in with terrific strength, and likewise squeals and squawks from re-radiating receivers. But the tuning, that was always sharp on the "one-bulber," becomes broad. Somehow or other, those D-X stations will not come through the local traffic when amplification is used.

The writer has had this same trouble, so he proceeded to work on amplification along different lines. The apparatus which resulted has been called a "transmitter amplifier."

Use Phone Transmitter

In explanation, your one-tube receiver phone is clamped to a telephone transmitter of a sending apparatus radiating a very short wave length. A detector and ordinary two-stage amplifier is then used to pick up the signals from the transmitter—the amplifier, of course, being always left in tune with the transmitter; and all adjustments in station hunting are made on the one-bulb receiver.

According to law the station becomes a transmitter and should be licensed, but we believe that the law does not apply here, owing to the fact that the emitted wave of the transmitter is very low, and will not carry beyond a very short range. The amplifier will not pick up the signals of the transmitter at a distance of over 25 feet, and as this is within the limit of one's dwelling, with the transmitting current not powerful enough to reach beyond it, we believe the experimenter is safe on that point.

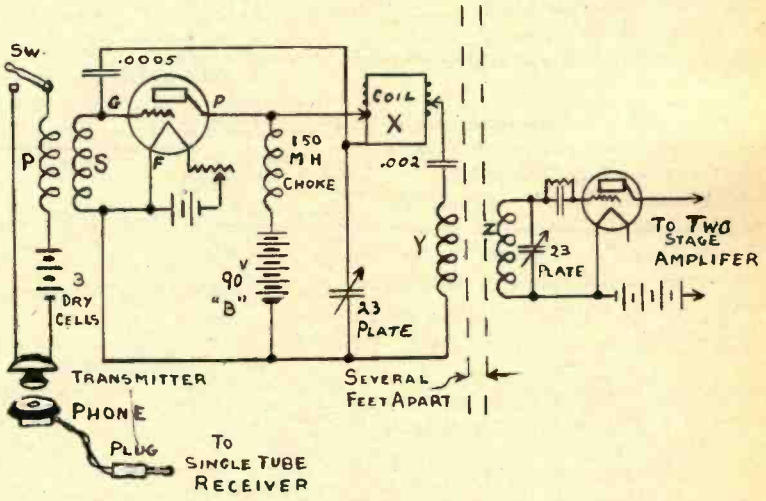
The transmitter uses no ground, while the antenna coil "Y" consists of six turns No. 18 annunciator wire around a 4-inch tube or formed in a spiral. This transmitter is the Colpitt's Circuit with Heising Modulation in conjunction with a 110-Volt A. C. step-down bell-ringing transformer used for modulation.

These bell-ringing transformers are rated at 110 volts for one side, and 12 or 16 on the other. They may be obtained at most electrical supply houses at a cost of about $1.50; the 16-volt side is connected to the transmitter and the 110-volt to the grid. This gives a step-up ratio of about 7 to 1.

A UV-201A, or C-301A tube, or any hard tube may be used, the plate power being furnished by "B" batteries of about 90 volts. The transmitter is tuned to the lowest wave that it will oscillate on. This is determined by the reading on the dial of the variable condenser in the amplifier, which should read as close to the zero point as possible.

How It Operates

The way the system operates is this: A station is first tuned in on the single-tube receiver (not shown in our drawing). Assuming that it is a good set, we get satisfactory music in the phones, which being right up against the transmitter, causes the current through it to fluctuate, as in any telephone. When switch "S" is closed, transmitter is served by three dry cells and the local current flows through the low voltage side of the bell-ringing transformer. The secondary puts the audio oscillations directly on the grid. The plate is furnished with "B" battery voltage, through the 150 millihenry choke coil. The output from the plate goes to coil "X," which consists of 70 turns of No. 18 SCC (single cotton covered) wire, tapped every ten turns. The return of coil "X" is through the adjustable 23-plate condenser, back to the filament. A tap is taken off the bottom of coil "X" and runs over to the grid through a .0005 condenser to prevent "B" battery pressure from reaching the grid. It is this connection between plate and grid which makes the tube oscillate.



Hook-up of Sending-Receiving Set

Another connection is taken off coil

Continued on Page 28

Fone Fun For Fans

An Ecstatic Lover

When the sunlight is kissing the softness
Of your dear lips tender curve—
When the wind and the waves are petting you
With such familiar nerve,
Then I'm jealous of the elements,
And wishing I could be
Your elemental sweetheart
For you're that, Delight, to me.

When the radio phone is caressing
The pink of your lovely ear,
And when the loud speaker is holding
Your breathless attention, dear,
Then I'm jealous of your listening,
And wishing I could be
Your favorite radio sweetheart
And you'd tune in with me.—Norton Stutson in Crosley Radio Weekly.

An old colored man was arraigned before a justice on a charge of assault. During the proceedings the judge asked him if he wanted a lawyer appointed to defend him.

"No, no, Judge," he replied; "I don't wan' no lawyer, but I sutinly would like a couple of good witnesses, if you got 'em."—Borrowed.

Teacher (conducting first-year spelling class)—Can any little boy or girl spell a new word for us?

Son of radio enthusiast (raising hand)—I can spell Pittsburgh.

Teacher—How do you spell Pittsburgh?

Little boy—KDKA. — Radio Times (England).

Business Condition as We Find It

Our statistician, after viewing various business people, gives the following reports on business conditions in general.

The first person interviewed was an artist's model, who admitted that she was just making a bare living.

"Business is dull," remarked the scissors grinder.

"Looking up," declared the astronomer.

"Dead," said the undertaker.

"Fine," said the judge.

"Fair," said the street car conductor.

"Pretty soft," said the mattress maker.

"I have seen the wurst," said the butcher.

"Just sew, sew," said the seamstress.

The preacher, who was the last one seen, admitted that he was working to beat the devil.—Nettleton Association News.

Up-to-Date

"How did you like my sermon Sunday" asks the modern clergyman.

"I couldn't get you," replies the radio churchgoer.

"Too much theology?" asks the minister.

"No," replies the radio lost sheep; "too much interference."—Exchange.

Shredded Statistics

Snookie: "Why so pale and nervous, precious?"

Oookums: "I've been digesting accident figures, and darned if I can figure out why they call it wreckless driving."—American Legion Weekly.

Dead, Anyway

Here lies the body of one John Gray,
Who died disputing the right of way;
He was right, dead right, as he sped along,
But he's just as dead as if he'd been wrong.—Radio Merchandising.

TRANSMITTER-AMPLIFIER

Continued from Page 27

"X" through stopping condenser .002 to coil "K," the sending antenna, which is built of six turns of No. 18 SCC, wound on a four-inch tube. The two adjustments on coil "X" and the setting of the variable 23-plate condenser govern what wave length will be transmitted. When these have been suitably adjusted, they are *never* touched again. As the received wave length varies from station to station, the adjustments must be made on the single-tube reeciver, but this *sending* set is held fixed at the one wave length, which may be anywhere from 150 to 300 meters, as you wish.

So far the transmitter has taken the music handed to it by the 'phone, (you could speak in it just as well yourself, as far as that is concerned), and has radiated it from coil "Y" at say, 200 meters. Now the final receiving set picks up these waves from coil "Y" on tuner "Z," which is twenty-five turns of No. 18 SCC, wound on a three-inch tube. This is tuned by a .0005 variable condenser to the wave sent by the transmitter. Since this frequency has been fixed once for all, the condenser, after once being in adjustment, can be nailed in that spot. A regular detector tube and two-stage amplifier completes the equipment. The detector is made non-regenerating (no tickler coil) since it is spaced close enough to the sending station "Y" so that feed-back is not needed.

Two Parts Independent

Each unit of the two composing this system is independent of the other. Your special one-bulb receiver picks up the DX signal. This is passed to the microphone of the transmitter, which sends it back out again on a very short wave, while the detector and two-stage amplifier pick it up again at a great strength and you have it out of the loud speaker.

The transmitter should be located as far as possible from the one-bulb receiver, but should be near the receiver-amplifier. In adjusting the apparatus, if the amplifier becomes choked this denotes that too much power is causing the detector bulb to become inoperative. Adjustment of the grid leak or increasing the distance between the transmitter and the amplifier will overcome this. The above does not apply to the one-bulb receiver, which is not adjusted in conjunction with the rest of the apparatus.

The writer believes that this type of amplification will win favor in a short space of time owing to the great developments that can be made along these lines.

Small Power Loss

It can be seen that one is actually a broadcaster himself, and owing to the short distance between the transmitter and the amplifier, there is not much loss of power. When a station is many hundreds of miles away it is a difficult matter to amplify without distorting the signals.

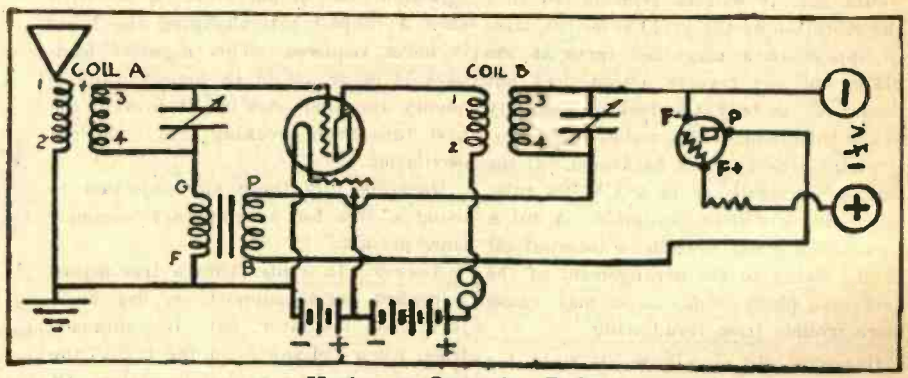
In transmitter amplification one has a volume of sound that will make his neighbors sit up and take notice. He has very little interference and only, in fact, what his one-bulb receiver gives; none from any other source.

Rx DR RADIO PRESCRIBES.

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

Question. I find that more regeneration must be used in an ordinary feed-back circuit when tuning in the higher wave lengths. Please explain why this is so.

Answer. The amount of transformer action which occurs between two coils depends on the frequency. The higher the speed of vibration, the greater will be such action. The short wave lengths correspond to the high frequency of oscillation, as is seen from looking up the table of wave lengths and kilocycles. When a short wave length station is being received, KDKA, for instance, at 327 meters, the tickler coil needs to be swung only part way into line with the stator, because the transformer action is powerful. But if we tune to KYW in Chicago, at 536 meters, then the low frequency which corresponds requires that the tickler be turned over a lot farther to give increased action at the less efficient speed. Perhaps we should not use the word efficient, as there is no thought of energy wasted in either case. Effective would convey the idea better. As a result of the relationship just described, it is usually necessary to turn both tickler and tuner together, adding to the first as you increase the second.



Harkness One-tube Reflex

Question. Please show hook-up of the Harkness single tube reflex.

Answer. The connections are shown in the diagram on this page. A diode, or two terminal tube, is used as the detector instead of a crystal, although the latter is satisfactory. It might be interesting to compare this hook-up with that of the regen-reflex shown on page 7 of this issue.

Question. How may the wave length of a variometer be changed?

Answer. It is much easier to reduce the wave length than it is to increase it. To diminish the length, it is only necessary to remove some turns from both rotor and stator. A good variometer has the same number of turns on both, and so care should be used to unwrap equal numbers in each case. It is also better to take half the rotor turns off the left-hand turns and half off the right, and the same with the stator. Most variometers have somewhere around 100 turns in all, which means 25 in each of the four sections. If stations come in with a wave length only slightly longer than the one you want to get, then removing five wraps from each of the four sections will be about right.

When it is desired to increase the wave length of a variometer, it is not nearly so easy. Ordinarily the clearance between the outside of the rotor and the inside of the stator is quite small, so that it is difficult to wind any more turns on it without causing danger of rubbing. Also, unless the coils are bank wound, the leakage capacity between turns will be high, and this will prevent sharp tuning. About the only way which works out well is to remove all the wire and rewind with wire of a smaller outside diameter. This reduction in the thickness of the wire may be had by going to three sizes smaller of the conductor itself, or, in case the original winding used double cotton covered, then by substituting single cotton or single silk covering, an increase in the number of turns may be made.

Question. Will a set using one stage of radio frequency amplification radiate from the aerial?

Answer. By putting on one or more stages of radio amplification the amount

THIRD G. E. STATION

Continued from Page 24

towers is 260 feet and the spreaders will be 120 feet apart. The counterpoise, consisting of a network of wires insulated from the ground and supported 15 feet above it by steel poles, will be used as a part of the antenna system replacing the usual ground connection.

of radiation in your set will be considerably reduced. It may even be cut down to zero if conditions are favorable. The reason why some radiation *may* get back is this: Assume that the detector is oscillating. Of course, if it is not, then there is no danger of radiating even without the extra tube. This oscillation occurs in both grid and plate of the detector. The grid is connected through the radio frequency transformer to the plate of the radio stage of amplification. Of course, this puts a vibration on the plate of the first tube. Now, if there were no capacity between the plate and the grid, that is as far as the vibration would go. It will be remembered that the vibration on the grid causes the same to appear in a magnified form at the plate, but the reverse action does not occur. It is only the leakage capacity of the tube itself which makes this transferring of energy work backward. If the leakage is small, as in a UV-199 tube, the feedback will be negligible. A 201-A tube has a great deal more internal capacity owing to the arrangement of the grid and plate leads, so it may cause more trouble from reradiating.

Question. Is aluminum all right for shielding a panel?

Answer. Aluminum is just as good as copper or tin foil from an electrical point of view. The objections to it are, first that it is more expensive than tin foil, and, second, it is difficult to solder the ground wire to it. Aluminum will not take ordinary solder at all, and special aluminum solder is hard to work, as the iron must be heated red hot. Rather than trying to solder on the ground wire, we recommend fastening it with a screw and nut to the aluminum sheet.

Question. Please explain what is meant by *negative* feedback.

Answer. Ordinary feedback is obtained from the rotor of a variocoupler when it is adjusted so that the output from the plate reacts back on the input to the grid and strengthens it. If the polarity of the rotor is reversed, then the output will *weaken* the grid input instead of increasing it. This is called negative feedback. It is never used intentionally on a detector circuit, as it would be a detriment rather than a help. It sometimes occurs unintentionally with a 180 degree variocoupler. Such a coupler has to be turned from zero to 100 degrees on the dial (equivalent to 180 degrees of a semi-circle) to vary the tickler action from nothing to maximum. For this reason the tickler cannot be reversed in direction except by interchanging the two rotor leads. In building, if these two connections to the rotor are accidentally put on backwards, the tube cannot be made to oscillate and no distant stations will be heard. Of course, the remedy is to reverse the leads.

A 90 degree variocoupler gets the action from nothing to a maximum when turned only *one* right angle. When turned one right angle in the opposite direction, the action reverses, so with such a coupler interchanging the leads is never required. This negative feedback is made use of in some radio frequency amplifier hook-ups to prevent the first tube from breaking into undesired oscillation.

Question. Is there any objection to using a tree for a temporary summertime aerial?

Answer. In winter time a tree makes a perfect aerial support, as dry wood is a good insulator, but in summertime, when the sap is in the trunk, the tree ceases to be a perfect insulator. Of course, it is by no means a good conductor, but some losses will occur through the ether waves being partially short circuited to the ground. However, this is not a serious matter, and no real trouble will be experienced by hooking the aerial to a tree.

Question. How small a crystal set can be made?

Answer. The size of the set depends upon how far you want to hear. The dimensions of any crystal set can be reduced by winding with finer wire. Of course, the smaller the wire is the higher the resistance and so the poorer the music. The smallest practical set that we have seen uses about 100 turns of No. 28 single silk, wound on a tube 1½ inches in diameter. However, if you are willing to be content with poor reception, these dimensions can be reduced as far as you like.

A HORNLESS LOUD SPEAKER

Continued from Page 26

A large generator is needed to supply direct current.

As set up in the Schenectady camping ground the speaker is installed in a shed, which is open on both sides. Nearby is a building which houses the motor generator needed to produce the direct current for operating. The amplifier connected to the receiving radio set is made up of a regular two-stage unit, which feeds a power amplifier. The latter uses a one-kilowatt Pliotron for a tube. Two thousand volts of "B" battery are used, but instead of a regular battery the pressure is supplied from a tube rectifier.

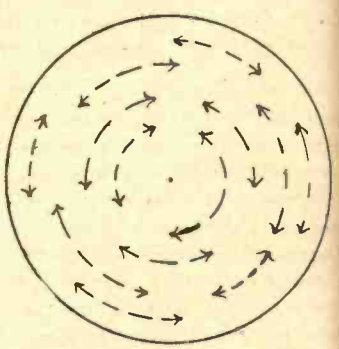


Fig. 6. Shows Current Flow

So far this equipment has been receiving WGY, four miles away, but the loud speaker can be used with any receiving set which gives enough volume to operate an ordinary horn and so distances of one or two thousand miles could be covered easily.

A PORTABLE REGEN-REFLEX

Continued from Page 7

of the stator. Condenser "C2" does not short circuit this transformer, since its capacity, .001 mfd., is too small to affect the low speed of oscillation. The output from the plate then goes through the phones and "B" battery to the filament without being affected by the rotor or primary of the radio transformer.

Operating this set is simple. The primary is tuned (if desired) by the tap switch. Secondary tuning is accomplished by condenser "C1." The rotor governs the amount of feedback. The rheostat controlling the filament current is adjusted to make the tube burn at normal brightness, and then needs no further attention until the dry cells run down quite a bit.