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The Radio Man Explains Aerials
Special Article by H. V. S. Taylor

Closed Circuit Batteries for Radio

How Far Should a Set Hear?

A Professional Touch on Your Set

How Electrons Can be Heard

A Spider Web Neutrodyne

HOOK-UP NUMBER OUT JANUARY 15

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Published Twice A Month
SPECIAL HOOK-UP NUMBER OUT JAN. 15th

ADVERTISING FORMS
CLOSE JANUARY 10th

This is a carefully selected list of sets which WILL WORK. They include the best hook-ups of Crystal Sets, Single Tubes, Regenerative and Non-Regenerative, Two and Three-tube Radios, Reflexes, Neutrodynes and Superheterodynes.

This issue is bound to create a demand for parts and sets. You should get some of this business.

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Radio Progress
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Undoubtedly you have tried following various wiring diagrams and found that they were not what they pretended to be. This will be a carefully selected list of sets which do work. They include the best hook-ups of crystal sets, single tubes, regenerative and non-regenerative, two and three tube radios, reflexes and also the more ambitious styles, like neutrodyne and superheterodyne.

Among them you will find several, anyway, which you will wish to try out.

15 Worthwhile Hook-ups
# RADIO PROGRESS

**HORACE V. S. TAYLOR, EDITOR**

**Volume 1**  
**Number 20**

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**JANUARY 1, 1925**

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STAND BY FOR

Special Hook-up Number

JANUARY 15th

Out of the hundreds of possible hook-ups there are only a few which are really worth trying. After considerable investigating of circuits the following fifteen have been selected as the best in their class. Complete diagrams will be given together with winding data for coils and condenser sizes so that any one who is at all familiar with the use of ordinary tools can construct a set.

1—Simple Crystal Detector
2—Double Circuit Crystal
3—Single Regenerator with Coupler
4—Single Tuner, Variometer Regeneration
5—Two-Circuit Tuner
6—Three-Circuit Tuner
7—Four-Circuit Tuner
8—Spider Web Regenerative

9—Audio Frequency Amplifier (1 or 2 steps)
10—Complete Three-Tube Regenerative
11—Radio Frequency Amplifier
12—Four-Tube RF and AF Regenerative
13—Three-Tube Reflex with Coupler
14—Three-Tube Reflex Regenerative
15—Five-Tube Neutrodyne

You all have heard the air full of noises when you are trying to pick up distance. A fine discussion of this problem appears in Goldsmith’s “Silencing the Ether Squeals.”

Criminals find the newest development in radio against them. Their portraits can now be flashed across the ocean. See “Waving Photographs Three Thousand Miles,” by Vance.

The Stethoscope in the hands of a good physician can tell a lot about your health. But even a recent medical graduate can tell what’s going on in your heart when he sees a picture of its beats. This is explained in “Taking Portrait of Heart Beats,” by Arnold.

Sometimes hook-ups are so complicated that it is difficult to follow them. The best way of tracing them out is explained by Taylor in “Understanding a Hook-up.”
Using Christmas Money

There are lots of ways you can spend money upon improving your radio. One of the surest and most satisfactory is to use good transformers. The units designed a year or more ago are not to be compared to the good ones now on the market.

Our transformer stands in the front rank of up-to-date design. If you are thinking of adding one or two steps of audio to your present hook-up you will get much better results if you select a noiseless transformer like the Radiclear. The results are heard in two ways. In the first place, the music comes in as loud on the 3 1/2 to 1 ratio Radiclear as it does on 6 to 1 ordinary transformers. But the distortion is absent. That is why the low notes of the piano and the high tones of the violin both come through the amplification and still sound the same as before.

A PECULIAR THING ABOUT THIS TRANSFORMER

Strange to say when you are listening to a distant station talking, you can understand the words. That is because the Radiclear transformer does not distort and also because it makes no noise itself. That is why it is often known, as “The Noiseless Transformer.”

In spite of the fact that this device is the result of a great deal of engineering skill and laboratory work it sells for $3.95 postpaid by check or money order. Or if you prefer, we will ship it to you C. O. D. for $3.95 plus postage. In either case we will refund your money if you are not satisfied at the end of two weeks' trial.

Send in your order today

FOR THAT CRYSTAL HOOK-UP

When you put together a crystal set as a first step in radio building you will find that the most necessary thing of all is the crystal. But there is no need of spending a lot of money. The best crystal which we have ever tested in radio is the AUDION, and the price is only 25 cents. You take no risk in ordering one, for if when you test it out you do not find that it is equal to any other on the market selling up to $1.25 apiece, just return it to us and we will refund your 25c.

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Providence, R. I.

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Gold Plated Cat Whisker @ 15c.

I enclose $... to pay for these.

(These above prices include the postage for sending.)

Send them to me C. O. D. I will pay the above price plus postage.

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The above prices include the postage for sending.

Name.............................
Address............................
The Radio Man Explains Aerials

Here are Some Pointers About Putting Up that New Antenna

By HORACE V. S. TAYLOR

The radio man had a tired expression on his face. He had just finished explaining to the lady customer that those soft rubber sponges were used to kill jars and shocks before they reached the tubes and not to sop up the grid leak, so he was glad to greet his friend Bill when the latter entered the store.

"Well, how is the new set going Bill?" he said.

"I haven't hooked it up yet. That's why I came over here to ask you about putting up the aerial. How long a wire do I need?" "If you have plenty of room on your lot," replied Ralph, the radio man, "I advise you to get a 150 foot roll of aerial wire. Then use this for aerial, lead-in, and also for ground."

Why Tape is Good

Different Ground Wire

"Why, I'm surprised," said Bill. "Everybody uses a different kind of wire for the ground lead. Why should I use the same kind for both antenna and ground?" "Yes, lots of people do it," was the answer, "but it is quite unnecessary. The same radio oscillations flow through both wires and if a certain size is right to use in one place, it is foolish to use any smaller and unnecessary to use any larger anywhere in the same series circuit. It is just the same as if you had part of the pipe between the water main and the street and your water meter of one-inch pipe and the rest of half-inch size."

"But we do use two or three different sizes of water pipe in our house," exclaimed Bill. "To be sure, but that is because you have a branch line, which divides the water into several sections. The big pipe must carry all the water to supply the entire building, while the small pipe runs only to a few faucets and so will not need to conduct very much water. The same thing is true of electric wires. If a conductor carries a heavy current, it must be big throughout its entire length. When it divides into several branches, then each one will naturally be smaller."

"Yes, I get the idea," said Bill. "Since the aerial and ground carry the same amount of current without having any of it divided off into a branch, it is best to use the same kind of wire."

"That's right—the reason people used to have two different kinds of conductors was that they did not understand this point and the radio dealers were able to sell them high priced insulated wire for the ground. That was doubly foolish, since of all places in the entire equipment the ground is the only one which has no need at all of insulation."

Why Use Insulated Wire?

"Speaking further of insulation," said Bill, "the aerial is supported on porcelain insulators and so can not leak even though it is bare; what is the advantage of using enameled copper for the antenna?" "That is a very good point," was the reply. "It does not seem as if insulation would be of much use and as a matter of fact, a rubber covering over the outside of the aerial is of no value at all unless it be to prevent its swaying against a conductor. However, there is considerable advantage in using stranded wire, which is insulated by enamel. This enamel must be applied before the wire is braided into a cable. The reason is this. If you use a solid wire the radio vibrations travel entirely on the surface. They do not penetrate into the mass of the metal at all."

Fig. 1. Why Tape is Good

Fig. 2. Measuring Aerial Length

"Well, what harm does that do?" was the next question. "It increases the resistance of the wire several fold. That is because the copper in the center is not helping at all. The same thing applies with an ordinary braided wire. The electricity will not follow any one strand in and out of the braiding, but jumps from one strand to the next whenever necessary to keep on the outside. The high frequency resistance of such a cable is oftentimes even higher than that of a solid wire of the same..."
outside diameter since the current path keeps jumping from one wire to another as I just explained."

"Well, how does the enamel prevent that?" "That is easy," said Ralph. "The braiding of such an enamel cable makes each separate wire just the same as its neighbors as to the amount that it is on the surface compared with the interior. Since each strand weaves in and out, the current cannot pick out any particular wire as being on the surface. Therefore, it divides equally among all the strands. Owing to the enamel insulation it can not jump from one to another, but must follow each one through until they are all joined at the radio set itself."

Any Advantage in Tape?

"How about the tape for aerial use that I have seen advertised by several manufacturers, is it really any better than round wire?" "Yes," explained Ralph, "compared with a solid round wire of the same area or weight, it has quite an advantage. This can be seen in Fig. 1. Remember that each little element or thread of electric current wants to get as far as possible away from all its neighbors. In the round wire the distribution of current will be something as shown by the heavy black line. Each part can get only half an inch away from the furthest of its neighbors. In the flat tape, which has the same area, each of the waves as before tries to keep its distance with the result that a separation of over an inch results between the distant parts. It follows that the penetration of the current at the edges is very much deeper than it was in the round wire, and so the total amount of copper used is greater. This results in a lower high frequency resistance of the tape."

"How does the tape compare with the enamel stranded copper?" was Bill's next question. "The whole idea is to try to make the electricity use as much of the copper as possible. By going from a solid round wire to a flat tape we persuade the current to use perhaps 50% more. But by enameling the strands we increase the total used to nearly 100% and so the round enameled wire is the best yet. Notice I say nearly 100%. The reason it is not absolutely all used is because the center of each of the little strands is not much of a current carrier. By sub-dividing the area of copper into more and more strands the efficiency is raised. However, it is found by experience that 15 or 20 different wires will accomplish such good results that the further gain by increasing this number is not worth the bother."

"Would it not be better to have this enameled stranded wire spread out in the form of a tape, rather than round?"

"No, since each of the wires in the round tape carries its full share no better division could possibly be made. If the wire were in the form of a tape, the change might upset the distribution to some extent, and if it did it would make it unequal through various parts and so not as good as before."

About the Lead-in

"How long should the lead-in be?" asked Bill. "The lead-in is really part of the aerial itself. It is an advantage to have the major part as high as possible and so if the horizontal part (CD in Fig. 2), is made as long as possible—that means that the lead-in BC should be made as direct as is convenient. As a matter of fact the length of the aerial is the total AB plus BC plus CD. And furthermore, the entire length of this wire plus the ground should not be more than 150 feet, if you wish to be able to get the low wave lengths."

"Unfortunately my lot is rather short in the back and I can't get a flat top of more than 40 feet. Had I better put in three parallel wires for the aerial?"

"With a 40 foot length it will be better to use two wires," Ralph replied. "These should be spaced at least three feet or more apart. The wider they are separated the more energy they will collect."

Why Not Four Wires?

"But," objected Bill, "the broadcasting station down town uses four wires. Why do you advise me not to employ more than two?" "Each wire collects most of the energy from the air for a distance of several feet around it. Of course, it is not an exact distance, as shown in Fig. 3, but the idea can easily be seen from that. Wire No. 1 sweeps practically all the waves from a radius around it as shown. Wire No. 2 has another circle from which it gathers the energy. Of course, part of another wire half way between, observe that its circle of influence is entirely taken up already except for the two triangular shaded areas lying between the other two circles. The gain is so small as not to be worth while. With the sending station it is different. They are using five to ten amperes and they need a large number of wires to carry the heavy current."

High Post Needed

"How high a post do I need in the backyard to carry the far end of the aerial?" queried Bill. "The higher the better," was the reply. "The distant end is the most important in radio and that is why you should have as high a support as you can manage for it. If the post is too low it reduces the effective height of the aerial as a whole and so..."
cuts down the volume on distant reception. If the only available post is as low as eight or ten feet, while the other end is say thirty feet high, it is often times an advantage to put an insulator in the middle of the aerial, so as to raise the effective height. Thus in Fig. 4, insulator A will make the average height of an aerial considerable greater than it would be if the insulator were placed at B. Of course, this shortens the length at the same time, but it is better to sacrifice a little on length in such a case in order to get the height.

"Perhaps it will be an advantage for me to use an inside aerial, as I have no good means of getting a high post in the yard. "That is quite possible," said Ralph. "An inside aerial is just as good as one outside of the same dimensions, except for shielding. If you have a lot of water and steam pipes and electric wires running above your inside aerial, they will all act to steal the energy out of the air before it reaches the antenna. If, however, you can put up your wire above all these metal conductors, you will get very good results."

**Spacing Inside Aerial**

"How should the aerial be run in my attic?" asked Bill. "To answer that remember that both height and spacing is wanted. If your house is only thirty or forty feet long, it is best to use two wires spaced far apart, as we just were talking about. That would mean two wires run in the eaves, as shown in Fig. 5. This gives the greatest separation. However, since they are in the eaves, (D and E), they will not be nearly as high as a single wire would be in the peak at C. Neither of these locations is the best. Just split the difference and use positions A and B, which are quite a distance apart and yet are considerably higher than D and E."

"How should these two be connected?" asked Bill. "Tie the two together at one end only. Then connect the lead-in to this tie wire at a place which will make the distance from it to the end of each of the long wires just the same. The idea is that two wires of equal length will vibrate at the same frequency (wave length) but if they are unequal the shorter will try to oscillate at a higher speed and this will reduce the sharpness of the tuning, which you can obtain from your set."

**The Direction Effect**

"Which end of the long wires should be used for the lead-in?" was the next question. "It does not make much difference," answered Ralph. "The stations at which the open or distant end of the aerial points will be heard slightly louder than those in the opposite direction, but this difference is very slight. If the aerial were laid flat on the ground, instead of up in the air, it would be quite noticeable, but any aerial which is over fifteen or twenty feet high will receive nearly as well in the poorest direction, as it does in the best."

"Suppose I wanted to make sure that it was equally good in all directions, how could I fix it?" "One of the sharpest tuned aerials I ever saw," said Ralph, "was an installation constructed so that it had no directional effect at all. It was mounted on the ceiling of the second story of a two-story house. The second floor had four bedrooms, one in each corner. The lead-in was brought up the stairway to the middle of the entire story, as shown in Fig. 6. From this four separate wires branched into each of the bedrooms. Care was taken that each of the four branches was the same length. Looked down at from the top, the wires would have made the shape of a swastika. The diagram shows the the wire as a wavy line so as to distinguish it easily from the line representing the walls, of course, actually the wires were straight. They rested behind the picture moulding without any insulation at all, since the wall paper and plaster will not conduct electricity. This aerial was unusually sharp in its tuning.

**Improvement From Good Aerial**

"How much better results could I get if I have a good aerial?" asked Bill. "That depends somewhat on your set. If your radio itself is poorly constructed, then slight additional losses in the aerial will not be noticed, and the improvement by substituting a first-class aerial will be lost in the shuffle. But if your set is a very good one and uses all the energy fed to it in the most efficient way, then you will find that it pays to use the greatest pains with the aerial. It is like pouring a liquid out of a bottle. It is the neck of a bottle that counts."

"Well, most aerials around here could certainly be improved," remarked Bill. "There are only a few of them that answer all the requirements you have mentioned. "Yes," said Ralph, "and considering how much better radios are being built now than those of a year or two ago, it would pay the average fan to go over his installation and make sure that he had everything right up to date."

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**Fig. 4.** Lead-in to Aerial at Middle Point

**Fig. 5.** Stringing Aerial in Your Attic

**Fig. 6.** Good Aerial for Small House
Radio and the Public

What Trends Are Shown by the Records of the Department?

By HERBERT HOOVER, Secretary of Commerce

The greatest development in broadcasting during the past year has not been in the application of new methods of transmission or reception, important as improvements in these lines have been. It is rather in the change in public attitude. Listeners are becoming more and more appreciative of the real service of radio and increasingly critical both as to the character of the matter furnished them and as to the efficiency with which it reaches them. The whole broadcasting structure is built up on service to the listeners. They are beginning to realize the importance, to assert their interests and to voice their wishes. Broadcasting must be conducted to meet their demands and this necessarily means a higher character in what is transmitted.

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Closed Circuit Batteries for Radio

How to Build One That Runs 24 Hours a Day

By W. S. STANDIFORD

DURING the last two years, radio broadcasting has developed from an infant into a giant and reached a stage of marvelous efficiency, considering this short time that it has been in existence. While radio is to-day not yet a perfected art, improvements in the designs of radiophones have been so rapid that everybody is positively amazed at the phenomenal growth of the industry.

It is naturally true that the less bother any person has during the working of a machine, the more enjoyment can be obtained from it. This applies with double force to radio appliances as they are more or less subject to trouble, and not perfected to the extent they will be in the course of time. However, very satisfactory progress is being attained in radio receiver designs.

Why a Rheostat is Needed

The two styles of batteries used in radio reception are storage, and dry cells, each having its advantages and disadvantages. The main drawback in the use of dry batteries for lighting the vacuum tubes of receivers exists in the fact that, due to their construction, the voltage obtainable from them fluctuates to a certain extent when being operated for lighting detectors and amplifiers, thus making it necessary to adjust the filament rheostat from time to time. A glance at Fig. 1 makes this clear. The values up and down represent the pressure of a dry cell in volts. Horizontal distances show the hours of burning a single WD-11 tube. At the start the pressure of the cell reads 1.5 volts. This potential drops off fairly rapidly at the start, and then a little slower until at the end of forty hours it is down to 1.3. Seventy-five hours operation has reduced the pressure to 1.1 volts, which is the rated value of this vacuum tube. Since the rheostat can reduce the voltage at the tube, but can not raise it you must discard the battery at this point, if you wish to get best operation from your set. Of course, it will continue giving out current at still lower pressures, and will ordinarily bring in the programs fairly well, since there is some factor of safety in the rating of the tube voltage.

Fig. 1. How Dry Cell Lasts with WD Tube

Dry cells vary somewhat in capacity and so you will not find that this figure of seventy-five hour operation will apply in every case. It is, however, a fair average. If you are using three tubes from the same cell, you would naturally expect that it would last one-third as long, or twenty-five hours. That is not true, however. The efficiency of the battery is not so great when it is giving out the heavier current and so the life would probably in that case drop to about twenty hours.

Internal Short Circuits

Some other faults of this type of electricity generator are as follows: They lose their voltage and amperage through internal causes such as partial short-circuits, and also the gradual drying out of their chemicals; the longer they are kept, the worse they get until a time comes when their voltage gets so low that these cells have to be thrown away. Additional expense is caused in this way. As the use of loud-speakers among radio fans is continually increasing, the time of "listening-in" has gone up from two to some four hours. This throws an additional strain on the energy obtainable and tends still further to shorten a cell's life. Storage batteries when freshly charged are practically free from current fluctuations until their voltage drops, and recharging is necessary, but they need careful attention in other ways so as to make them give efficient service.

A Cell That Won't Deteriorate

There is another kind of electric battery on the market called the "closed-circuit," the cheapest one to operate being the sulphate of copper battery, which is used largely in railroad telegraph work. What the amateur radio fan desires is a battery which will give either a constant current when it is wanted, or one that can be laid away until the next day or when it is desired to use it without any deterioration taking place while it is in action. The writer has found out after some experimenting, that by making a few changes in the original designs of the Danielli...
sulphate of copper cells they can be made to give a steady, continuous current and also can be laid away without deterioration, thus always being ready for service when wanted. With the improvement in construction of this closed-circuit battery as outlined in this article, it becomes feasible to use such closed-circuit cells to light the UV-199 vacuum tubes, or even the older ones which require more current. All that is necessary in the case of tubes requiring higher voltage is to use more batteries, connecting them in series (that is, copper to zines).

It will be found that owing to the continuous voltage (pressure) and amperage (current), generated, that an improvement in operation will often result, as sulphate-of-copper batteries give a practically constant current until their chemicals become exhausted. A steady current without any flickering enables the vacuum tubes to keep their brilliancy at the required temperature after one adjustment is made to secure their proper lighting, thus doing without the necessity of constantly looking after them.

What Causes Polarization

A few words describing the electrical action that keeps this cell producing a steady current and voltage until its chemicals are used up, will be of interest to the fan.

When an electric current is passed through a liquid conductor or electrolyte, it always makes some chemical change. In this respect it is very different from passing through a solid. For instance, you can run a current through an electric wire for 100 years, and at the end the wire will be exactly the same copper in weight and material as it was at the start. But when current flows through a liquid, the action may occur in the poles or electrodes (as in the case of charging storage battery plates or depositing a coating of nickel plating), or it may occur in the liquid itself. A case of this is when current is passed through water. It breaks the water up into its two component gases, oxygen and hydrogen. In an electric battery the same thing happens but the oxygen is used in the cell itself.

The hydrogen is left over with nowhere to go, and as a result it clings to the positive pole, which is the copper or carbon, as shown in Fig. 2. Unfortunately, this layer of hydrogen is an insulator, and so when enough of it has collected on the pole it chokes off the flow of current. The battery is then said to be "polarized." This bad condition may be remedied by pulling the carbon out of the battery and heating it to drive off the bubbles (which is not very practical in ordinary use), or some sort of chemical can be combined with the pole which will itself absorb hydrogen. This is the usual solution of the problem.

Construction of Daniel's Cell

The battery which will be described is a modification of the well-known Daniel's cell, which is used somewhat in railroad telegraph lines. Briefly, it consists of a copper plate which rests on the bottom of a glass jar and a zinc plate, made in the form of a star, which is supported near the top of the jar. A water solution of copper sulphate or blue stone is poured around the copper terminal so that it fills the jar about two-thirds full. Then a water solution of zinc sulphate is carefully poured on top of the copper sulphate. Since the former is lighter in weight it will float on top of the latter without mixing very much.

The sulphate of copper in the solution surrounding the lower electrode is deposited on the latter in the form of copper electro-plating by the current through the battery; the sulphate from the sulphate of copper deposited and released in the solution reacts with the zinc of the upper electrode to form zinc sulphate. Thus the cell keeps using up blue stone and zinc which must be renewed, and makes out of them copper (deposited in the bottom of the cell) and zinc sulphate which accumulates in the upper solution and has to be thrown away occasionally. In this way no hydrogen bubbles are deposited on the poles and so the cell does not polarize.

Keep Copper Off Zinc

Although, as mentioned, the zinc sulphate solution is lighter than that of the copper and so floats on top of it, still, over a period of days the two tend to mix or diffuse. When any of the copper solution strikes the piece of zinc it is deposited on the upper pole where it causes considerable loss of efficiency.

In the ordinary style of sulphate of copper cell it is essential, when left for any length of time out of use, that its terminals be connected together by a wire of fairly high resistance (10 ohms per cell), which allows a very small current to flow. This prevents the solutions from mixing, as any copper sulphate which wanders up toward the zinc is converted by the current into zinc sulphate (as just described), before it has a chance to reach the upper electrode. In this way the action of the cell is maintained by the small current flowing all the time. That is why it is called a "closed circuit" cell. Of course, such treatment would quickly ruin a dry cell without any advantage at all.

By my method of surrounding the zinc electrode with a layer of carbon, as will be described, it enables this battery to be left alone on open-circuit until it is wanted for use. Dry and wet cells for open-circuit work, which means intermittent use such as door-bells, etc., also contain a depolarizer, which absorbs the hydrogen gas, but as this action occurs very slowly these cells need long periods of rest, as otherwise, their current drops very rapidly and fluctuates.

List of Parts Needed

If you want to construct a modified Daniel's cell, which will have the advantages just mentioned, get from an electrical supply house the following:

1 glass jar of the desired size. (A 6x8 in. one is good).
1 porous cup to fit.
1 nickel-plated binding post.
1 zinc rod, such as is used in ordinary wet batteries.

6 feet rubber insulated No. 12 copper wire.

2 lbs. paraffine wax.

1 lb. coke.

3 lbs. copper sulphate (blue stone).

1 wooden cover to fit jar.

Melt the wax slowly in a saucepan, taking care that it doesn't catch fire; then dip the bottom of the porous cup into the hot wax, letting it extend one-half inch up the side. Do the same with the open end of the cup, as shown in Fig. 3. Also dip or paint the top of glass jar for a distance of two inches. The object of this coating is to prevent the chemicals from creeping up the sides and over the top of jar and porous cup. Paraffin wax also insulates the bottom of the cup, which is necessary.

**Insulating the Cover**

Make a cover out of a ¾-inch board. This cover is to have a rabbet (circular groove) or some cleats nailed on its bottom surface to prevent its sliding sideways. A round hole for the zinc rod should be bored in the center of its top. Screw binding post on cover; bore a hole alongside of it to fit the copper wire. After completion, boil cover in the hot wax for 15 minutes, drain and let cool. When it is cold, take your brush and put an extra amount of wax on the inside of the hole for insulation, or if desired, a porcelain tube having a hole of sufficient diameter to hold the zinc rod can be used as an insulator.

Stand cup in the center of jar, break coke into pieces the size of coffee grains and put a layer on the bottom of the jar surrounding the porous cup. Then scrape insulation off end of wire and twist the latter around tang of binding post, screwing the base of binding post down on it tightly. Enough insulation is to remain on the wire after it passes through cover so as to extend two inches below the top of porous cup. Remove the rest of insulation from the wire and brighten up its metal surface with sandpaper.

Coil wire around porous cup but keep it closely touching the inside surface of glass jar, and as far away as possible from the side of the porous cup.

If you prefer, bare copper wire can be used instead of the insulated (which will save the bother of scraping most of it off) and a piece of rubber spaghetti can be slipped over the upper end of the wire to serve for insulation.

**Assembling the Elements**

Mix up together a sufficient amount of sulphate of copper crystals and coke pieces, putting them into the jar, taking care to cover the wire. Don't put any of the copper crystals against the sides of porous cup, but keep an inch wide layer of coke against it. Continue the process of filling the jar until the mass is within one inch of the top of porous cup. Also fill the space around zinc in cup with coke, the latter pieces to be the same height as those in the outer jar. Put no copper crystals inside of the cup.

Pour water into both cup and outer jar until it is on a level with the coke, and one inch below the top of the cup. Connect both binding posts together by a fine wire, leaving it connected for an hour, until current flows: then disconnect this wire and your battery is ready for use. It will be found, unlike the regular patterns of Daniell sulphate of copper cells, that the zinc in this battery will keep free from copper when it is left on open-circuit; and when used on a closed-circuit the zinc also keeps very clean. The pieces of coke in the outer container soon become coated with copper and owing to the large surface exposed, the resistance is lowered, which allows a larger current to flow.

The voltage of this cell is a little over one volt. This will be just about right to operate WD-11 or WD-12 tubes without needing any rheostat. Three of such cells connected in series (zinc to copper) will run the UV-199 vacuum tube very nicely. However, since each has a pressure slightly over one volt, the three together will have a potential of between three and four volts. The 199 tube runs best on 3.0 volts so it is well to use a low resistance rheostat in the tube circuit. If, however, you install the batteries in your cellar and run wires up to the set upstairs you will very likely find that the resistance of the wires is enough to give you just the right pressure at the tubes without needing any filament control at all.

**Fig. 4. Details of New Cell**

**How to Get More Capacity**

Another form of cell giving greater ampere-hours capacity is made by modifying the construction of the above battery. Instead of using a copper wire surrounded by pieces of carbon, copper netting such as is used upon screen doors is employed. This netting should be bent into V-shaped corrugations and then coiled into circular form to fit closely to the inside of the glass jar. A large zinc cylinder having more surface than the zinc rod, is placed in a larger porous cup. The broken pieces of carbon and sulphate of copper crystals being put into the outer glass jar with carbon pieces surrounding the zinc as previously described in the other battery. This arrangement gives a heavier current. The voltage remains the same, whether a battery is as small as a thimble or as large as a barrel.

Continued on Page 21
American Radio Relay League

THEY NEVER USE THE MAIL.

Practical use of the radio telephone for private conversation between individuals has been demonstrated by Donald H. Johnson of Euclid Beach Park for Cleveland, O. For two years he has employed the radiophone for a daily chat with his father, Dr. William H. Johnson of Collins, Ohio, about 70 miles distant.

These conversations were carried on in broad daylight with the same reliability as a private telephone, and of course required no toll charges. Both father and son are licensed amateurs using respectively the calls 8BEI and 8DG. The younger Johnson declared that the daily chats had never been missed so far. Other members of the family use the microphone and letter writing is a thing of the past. Report and station cards show that the range of these stations is from the Rocky Mountains to the Atlantic ocean.

Rain Does Not Interfere

A log of atmospheric conditions and resulting radio audibility is kept. This indicates that reception is best during rain storms, or when the antenna and counterpoise are wet. Both stations are well known to broadcast listeners and to the amateur members of the American Radio Relay League. They have given effective service in emergencies when wire communication was interrupted.

The receiving equipment at 8DG consists of three separate sets. One is home-made and was built by Mr. Johnson around a low-loss coupler. The transmitter was also constructed by the operator and uses two 50 watt tubes. A voice amplifier is provided with a 216A tube employing about 45 volts on the plate. Dr. Johnson's station is located in a place where there is no alternating current available so a DC plant furnishes the power.

DO NOT MIND THE SOUTH POLE

Six months ago F. D. Boll of Waihemo, New Zealand, wrote the American Radio Relay League that the favorite sport of local radio men was "logging Yankee amateur stations." For several weeks afterward there came lists of "calls heard," each accompanied by an enthusiastic letter describing receiving conditions.

The climax as regards the reception of American stations came when Bell reported that in one night he had heard all districts.

As usual with the amateur radio man, regardless of what part of the world he is located, that fact reduced the business of receiving American stations to a mere pastime. Bell immediately set out to accomplish something better even than that. He succeeded finally, according to his last letter, in hearing stations in England and France. Meanwhile, several New Zealanders conversed both ways with European amateurs.

This was the start of a steady flow in the reception of European signals until it has become a nightly event. "We continue to get Europe almost every night," states Bell, "between 6:00 and 7:30 p.m., New Zealand Time (6:30-8:00 a.m., Greenwich Meridian Time) and, of course, it is bright sunlight at both ends. I seem to get them better here than they do in northern New Zealand, which indicates the signals go by way of the South Pole."

The reception of these signals was accomplished during a period of unfavorable radio weather, which Bell described as being the "worst for static" that he had ever experienced. There were times, he said, when the British stations came in more clearly and with greater reliability than those of U. S. A. The lowest European stations were F8AB, F8BF, G2NM and G3OD.

"Nearly all of the British amateur stations," he says "have fine clear notes and it is a great pleasure to read them."

BEATS THRILL OF HEARING PARIS

Five years ago amateur radio telegraph operators were sending messages to all parts of the United States and Canada through the American Radio Relay League. There was no distance on this continent that they could not span. The idea of communicating with Europe was regarded as improbable. Today hardly a week goes by but some amateur makes a record pointing the way to world-wide amateur communication by radio telegraphy.

Receipt of two messages within a day or two of each other, one from Australia and the second from New Zealand, brought from Hiram P. Maxim, president of the A. R. R. L., the comment that the "big radio thrills today are in the two-way telegraphie game." Both of these messages came all the way by amateur radio with the same reliability that they could be sent by cable and wire.

"This appears to be another of the startling things that amateur radio is developing," Mr. Maxim declared. "Imagine what would have been said of me only five years ago if I had predicted that in 1924 private citizens in their homes in New Zealand and Australia would be communicating back and forth with others in the United States as well as in England and France!"

"The private citizens of the world have it in their power to communicate with one another without leaving their homes. Where is it leading to? May it not be toward broader political views, more international friendships and better understanding? There is a thrill in receiving music broadcast from France, but I believe it is even more awe inspiring to converse back and forth with an individual whom you have chanced to meet on the air."

756 PROGRAMS

During the past year, WEAF New York, has broadcast 1,348 programs of which 756 were rendered at WEAF's studios and 592 from points outside. The total time that WEAF has been on the air in the course of the year is approximately 2,128 hours.
How Far Should a Set Hear?

Broadcasting That Increases the Range of Your Radio

By ALFRED N. GOLDSMITH, B. S., Ph. D., Fellow I. R. E., Chief Broadcasting Engineer, R. C. A.

Two radio fans of limited experience are discussing the merits of their sets. One proudly remarks that last night he heard a station twelve hundred miles away. The other, with even greater pride, comes back with the triumphant statement that he has recently picked up two thousand miles away. The next question is what do their statements (assuming they are not liars) prove about the relative goodness of their receivers? And the answer is: absolutely nothing.

Two sets using different antennas on different nights, when handled by different persons, cannot be directly compared.

As long as a set is referred to as a "thousand-mile receiver," or a "fifty-mile receiver," or in similar terms, the purchaser will be to some extent confused as to the facts of the situation. There will be some very rare occasions on which reception of satisfactory music from a distance of twenty-five miles even from a good broadcasting station will be impossible on any receiver whatsoever (for example during a bad lightning storm directly overhead). There will also be a few times when a simple one-tube regenerative set will give good phone reception in some localities from stations thousands of miles away. Of course some radios are much more sensitive, selective, and give better tone quality than others. But there is no such thing as the guaranteed range of an outfit.

Will Be A Millionaire

It is about as sensible to ask for a specified range as to insist that a strong and intelligent boy is sure to have a financial "range" of a million dollars before he dies. Maybe he will achieve such a goal, and then again maybe not. It depends on a great many other factors than the boy himself. So that, although there are certainly big differences in the quality of various chaps, there are many other things which determine the results which the boy will obtain in life. Radio reception is similar, and so it is worthwhile to see what factors besides good-ness of the receiver determine range, and what sorts of service can be expected from good equipment.

In all following discussion, to make it simple, estimates are based on receiving conditions on the Atlantic coast about as far north as New York. Understand that in certain parts of the country, conditions will be somewhat worse than those described, particularly in southern regions where summer static is heavy and lasts longer. It is also well-known that in more northerly and central regions, as well as in parts of the West, reception is markedly superior to the standards described, partly due to less static and partly to better transmission of the radio waves.

What Can Be Expected From Your Receiver?

<table>
<thead>
<tr>
<th>TYPE OF SERVICE</th>
<th>DISTANCE OF STATIONS</th>
<th>SERVICE AVAILABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCAL SERVICE</td>
<td>LESS THAN 100 MILES</td>
<td>11.7 MONTHS PER YEAR</td>
</tr>
<tr>
<td>INTERMITTENT SERVICE</td>
<td>LESS THAN 500 MILES</td>
<td>9 MONTHS PER YEAR</td>
</tr>
<tr>
<td>OCCASIONAL SERVICE</td>
<td>LESS THAN 2000 MILES</td>
<td>4 MONTHS PER YEAR</td>
</tr>
<tr>
<td>&quot;FREAK&quot; SERVICE</td>
<td>OVER 3000 MILES</td>
<td>? MONTHS PER YEAR</td>
</tr>
</tbody>
</table>

Fig. 1. Table of Times for Good Programs

Your Local Station

The easiest reception, and of course the best service, is from your local station. By this is meant programs from stations of say one-half kilowatt (500 watts) output not more than twenty-five or fifty miles away. Unless you are so unfortunate as to be very near a spark station transmitting code working during broadcasting hours, or unless very heavy static or bad man-made disturbance interfere, reception over this distance should be good about all the time. There may be ten or fifteen days a year, generally in midsummer, when programs will not be entirely perfect; but in general, local service is continuous and very satisfactory. It is for this reason that it will become increasingly popular among those who desire to enjoy to the full the entertainment and educational value of radio rather than its experimental side. This will particu-
larly apply if they happen to be so lucky as to be near a broadcasting station which runs attractive programs, as is now usually the case.

When the distance to the sending station is less than about five hundred miles, what may be called "intermittent ser-

One Hundred Mile Stations Fade
Furthermore, the very sensitive receivers required to hear a couple of thousand miles, naturally pick up local interference more readily. Often local stations will drown out the more distant ones, particularly in radios which are not very selective. Fading consists in very big changes in the loudness of the signal, which may at one moment be very loud and then fade away to almost nothing in a time varying from a second or two to half an hour, depending largely on the distance of the station. Fading is particularly severe for stations around a hundred or a hundred and fifty miles away, and there is no remedy available for it commercially at present. For these reasons, the listener must not expect distant (intermittent) service to be as perfect as local.

About Static and Fading
The two chief obstacles to consistent reception of stations at distances of one hundred to five hundred miles are interference (including static), and fading. Interference may be either natural, such as static during the summer months, resulting in crackling noises which disturb music or speech, or it may be of human origin, such as professional or amateur code stations transmitting, especially spark stations, or sparking motors, telephone ringer, X-ray machines, and the like. So far the elimination of static to any extent has not proved to be practicable for ordinary radio sets, although it can be accomplished to a considerable degree for the more elaborate and expensive trans-oceanic and marine receiving stations.

Man-made interference can be avoided to a large extent by stopping it at the source by kindly persuasion or by suitable legal regulation. Great progress is being made along these directions. The reason interference is so much more serious in the case of distant than of local service is that the signals, being much weaker, cannot ride over and drown out interference to the same extent.

How to Compare Two Radios
It is not possible to compare two receivers except at the same location, at the same time, on suitable antennas, and on the same signals. These necessary conditions of comparison are often forgotten. Receiving conditions may change in the short space of an hour. Localities a few hundred feet apart may be quite different. Stations on particular wave lengths may come through much better than those on others at a certain time and place. It is for these reasons, that receiver comparisons can be made in precise and practical form only in well-equipped laboratories and by skilled observers using such receivers for a long time. This is also why you can not state the range of a receiver in definite miles.

Highly sensitive sets working with short antennas, and provided with selective circuits for cutting out interference, and designed to give excellent quality of reproduction will naturally enable much longer distance reception than less effective receivers, but it is not possible to give any general figure of the degree of improvement. Today, however, it can be stated, that service from stations twenty-five to possibly one hundred miles away is so reliable, in general, as to be truly a "public service" of tremendous value to the community and of continually increasing importance.

Kinds of Broadcasting
A few years ago there was but a single sort of broadcasting, and it was crude compared to present practice. Now broadcasting falls into a number of subdivisions based partly on regulation by the government and partly on scientific classification. The entire art of broadcasting is becoming more complex and specialized, and new developments occur with astonishing frequency.
Following the recommendations of the Second National Radio Conference, the Department of Commerce adopted regulations for radio broadcasting which included a classification of the various types of stations and their licenses. If you are interested, you can get the exact qualifications for each grade of station from the Supervisor of Radio for the radio district in which you live, or by directly addressing the Radio Service, Bureau of Navigation of the Department of Commerce at Washington. Broadly, however, the classification is as follows:

Class A the Smaller Stations
Class A stations are those having a power in the aerial wire system of less than 500 watts (or approximately two-thirds of a horse power). They are assigned the higher frequencies or shorter wave lengths (below 300 meters), and are generally not given exclusive assignments of these bands. They are permitted to send out music from the phonograph, which obviously lightens the task of their program managers to a considerable extent.

Class B stations are required to use power in the antenna system of between 500 and 1,000 watts. They are assigned the lower frequencies or longer wave lengths (generally between 300 and 550 meters), and they have, during their operating time, either an exclusive assignment of their frequency or else one which is repeated only for a station at a distance of thousands of miles. Thus interference between Class B stations working on their rated wave lengths is extremely unlikely. Class B stations are required to send out regularly programs not involving the use of mechanically reproduced music, the modulation (tone quality) must be correct and adequate; the studio must be acoustically designed to minimize echo, and they must generally maintain high standards.

No New Class C Stations
Class C stations are the same as Class A stations except that they operate on a frequency of 833 kilocycles (wave length of 360 meters). They are really Class A stations which operated on the 833 kilocycle frequency prior to the issuance of the new regulations, and which have been permitted to retain their original frequency unchanged. New Class A stations are not given the 833 kilocycle assignment; that is, there will be no further Class C stations assigned.

Class D stations are a special partly experimental broadcasting class of stations, situated at factories which manufacture all the necessary parts for broadcasting transmitters and which desire to carry on extensive experiments for the development of the art. They have rather broad privileges and are found on the Class B frequencies. There can naturally be few such stations. KDKA and WGY are examples of this type.

The above classification is based on power of the station and kind of program and service rendered. An engineering catalog of broadcasting takes somewhat different lines.

Twenty-seven Countries Heard It.
The simplest variety of broadcasting is wireless telegraphic or code transmitting. This is of less general public interest than radio broadcasting because a knowledge of the Continental telegraph code is required to read the messages. Nevertheless it has a real sphere of usefulness. Striking instances of this class of broadcasting are the sending out of press messages or daily news from the high power marine station of the Radio Corporation of America at Cape Cod for ships at sea, and the transmitting of Edward M. House's messages to the world from the high power transoceanic station, Radio Central at Port Jefferson, Long Island. This latter message was received in twenty-seven countries, scattered to the very antipodes, and is the widest application of any form of broadcasting so far achieved.

Radio phone broadcasting is well-known to the vast army of broadcast listeners. It has not yet been attempted on high powers or lower frequencies, since the present system seems to be adequate for most needs at present. The development of radio telephony to individuals on board ships or to persons on the other side of the ocean has led to a consideration of secret systems by which only those having the key can receive the messages.

Sending Out Secrets
This leads at once to what may be termed code selective broadcasting. In this system, the transmitting station teleographs or telephones words which are not understood except by those having a key to the code which is being used. It is really ordinary transmission since anyone could copy down the telegraph or telephone messages thus sent out, although it would not be possible to understand the message carried by the words unless one had the code or could in some way decipher the messages. This system has been used in Germany to some extent for sending out business information to persons subscribing to such service. Since entertainment and most educational material cannot be thus sent out, it is not at present of wide public interest.

In order to avoid the limitations of code selective broadcasting, as just mentioned, attempts have been made to produce secret broadcasting. These systems use engineering means to jumble, or "scramble" the material which is being sent out, so that while it may be picked up by any receiving set, it will not be understood or enjoyed except by those possessing a special sort of receiving set which is capable of "unscrambling" the numbers and thus restoring it to its original enjoyable form. This process is something like "denaturing" the broadcast concert so as to make it musically unpalatable to the consumers, and then providing a group of paying consumers with a means for eliminating the "denaturing" of the concert, thus rendering it again satisfactory for musical consumption.

Pay or Don't Listen
There are a number of methods of carrying out secret selective broadcasting. Some of them are fairly simple and...
You Can Listen at 3:00 A. M.

KYW, the Westinghouse station at Chicago, is the only broadcasting unit in the world on duty twenty-four hours each day. Over this daily period the station is actually in operation eight hours and thirty-six minutes, but its mighty transmitter is in readiness at all hours of the day and night to go on the air.

From a station requiring a personnel of five, KYW has expanded to its present proportions, with a force numbering about 30 people. KYW today has four studios as follows: the Edison Building, Hearst Square, the Congress Hotel, and the Garrick Theater Building, and also has private wires to many other places.

With the varied class of entertainment, radio fans can meet almost all their desires by tuning in this station. The programs from the Edison studio are classical in nature and only the most select talent is accepted. The Congress Hotel Saturday evening concerts include only the foremost and highest class entertainment obtainable. From the Hearst studio, KYW broadcasts popular music selections and such chosen parts from the stage as will reproduce well by radio. From the Duncan Sisters' studio in the Garrick Theater building are broadcast special programs that have become very popular with radio fans. The Orchestra Hall program helps the radio world to enjoy the "end of a perfect week," by offering the morning church services of Central church, the Chapel service in the afternoon and the Sunday Evening Club programs in the evening. The popularity of the Sunday Evening Club programs have increased continuously in a surprising manner.

Last but not least, comes the World Crier service. The World Crier broadcasts its material in the form of world news, stock reports and sporting news, every hour and half hour, consuming an average time of five minutes on each occasion. The World Crier has also served on several occasions by request, when heavy snow storms crippled telephone and telegraph wires. On these occasions the World Crier added laurels to the value of radio, in broadcasting train dispatches and seeking information of lost trains.

All of the tit-bits of KYW's broadcasting activity, added to its regular daily schedules, would place its daily actual time on the ether, somewhat in advance of 8 hours and 36 minutes.

What Kind of Program?

Broadcasting could also be classified in great detail on the basis of the nature of the program sent out. Today we have vocal and instrumental music, orchestral music, comic operas, radio dramas, grand opera, political speeches, educational talks covering a very wide range of subjects, athletic training material, time signals, daily news, sporting reports, and a great number of other interesting subjects, including even foreign language and dancing instruction.

With broadcasting developing so rapidly it is not of much use to attempt program classification. It is clear, however, that practically no musical or educational aspect of human effort will be neglected by the broadcasting of the future.

HOW FAR SHOULD A SET HEAR?

Continued from Page 15

Radio has fairly easily overcome by the determined listener. Others are more complicated and would oppose big obstacles to listening by unauthorized persons. It has been said, in connection with cipher codes and burglar-proof safes, that "what the mind of man can devise, the mind of man can undo." While this is probably true of secret selective broadcasting as well, yet it may safely be said that secret systems could be invented which would make the task of "Stealing a hear" less agreeable than paying for the service rendered. The usefulness of such methods and their adaptability to public service must be investigated still further, but their scientific possibility and general engineering soundness cannot be questioned.

There is another variety of somewhat "HERCULES" Aerial Mast

All steel construction. Complete with galvanized steel guy wires and pulley. Simple diagram shows how to erect quick. 20 feet $10, 40 feet $25, 60 feet $45. We pay freight. Install this mast for greater range and better results. Write for literature and FREE BLUEPRINT.

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2048 E. 79th ST. CLEVELAND, O.
A Professional Touch on Your Set

How to Make Them Think It Is Factory Built

By HARRY A. NICKERSON

This radio game is making America into a nation of expert tinsmiths and cabinetworkers.

This is really a good thing for the country. The young chaps (and some girls for that matter) are kept busy fixing up their sets rather than roaming the streets at night. The knowledge which they gain in craftsmanship will undoubtedly be a help to them in later life.

Fig. 1. A Fillet of Solder

The best solderer generally has the best looking and frequently the best working radio set; so, first, we shall give a few suggestions for soldering.

The soldering iron should be kept "tinned." By this is meant that the point of the iron is to be kept covered with a coating of solder. This may be done by scraping or filing the point up about a half inch or more until it is smooth and clean, and dipping the end, while it is heated above the melting point of solder, in a mixture of soldering flux and solder.

Another easy way of keeping the iron clean is to have a piece of coarse sand paper or emery cloth tacked to a board. You can smear some soldering flux on this and rub the iron over it occasionally, as necessary. Of course, if the iron is too hot it will gradually carbonize the paper.

How to Tin the Parts

It usually aids in soldering to "tin" two surfaces which are to be soldered together, separately, before placing them in contact.

By "tinning" is meant putting a thin coating of solder over the piece. Two strips of metal, which have no solder on them, are rather difficult to unite with solder. However, if it is flowed on each piece separately, where it is easy to get at, then a hot iron applied to the two parts will make them adhere without any further solder being needed.

All surfaces which are to be tinned must be clean and bright and coated lightly with some form of flux, before one can hope to do a perfect job. Prepared "pastes," except possibly on tin, permit of readier soldering than rosin, but in spite of the best efforts of the user, the paste will run under binding posts, and along insulation of wires, with resultant later corrosion or leak-path to the detriment of the apparatus.

An electric soldering iron is a wonderful help to good and quick soldering. Half and half solder generally is suitable for radio soldering.

What Half and Half Is

By "half and half" is meant a mixture which is 50 per cent. lead and 50 per cent. tin. Since tin costs several times as much per pound as lead, the natural tendency in the manufacture of cheap solder is to cut down the proportion of tin and increase the lead.

Don't buy solder because you can buy it cheap but pay a good price to insure that the proportion of lead to tin is not too great. A dull grayish solder which quickly burns off the point of the iron, instead of keeping it "tinned" indicates the presence of lead which burns into "dross" in short order, or that the iron is kept too hot, or both. Dross is the name given to lead oxides which form when lead is heated too hot. The oxygen from the air attacks hot lead and corrodes it, just the way it does iron, except that iron rust is formed even at ordinary temperatures.

Be Saving on Solder

Don't leave "gobs" of solder sticking up, but try to emulate the tinsmith whose every effort, to judge from his work, is to see how little solder he can use to accomplish a given result. The solder should be melted until it flows freely with its edges sloping until they meet the parts to be joined together and its edges are flush with these parts.

This is shown in Fig. 1. Notice that the solder forms a little curve, or fillet, in the corners and makes a neat looking and strong job. Without practice it may be difficult to solder some parts, e.g., binding posts embedded in hard panels.

The trouble is that hard rubber softens at a temperature even below boiling water (212°), and for this reason melted solder (at about 600° or 600°) is
apt to melt a hole in the panel. But fortunately hard rubber is a very poor conductor of heat, and if the iron is quite hot the solder will melt and flow before giving time enough for the heat to penetrate very far into the rubber.

What Kind of a Panel
We now come to the discussion of the panels. In general there are two kinds. There used to be three, but fibre has long since dropped from consideration as it is apt to absorb moisture, and so lose part of its high insulating value. These two kinds are, first, hard rubber, and, second, those made from synthetic resins. These latter, like Bakelite and Condensite, are made out of phenol (the chemical name for carbolic acid) and formaldehyde, which is that penetrating gas often used in fumigating rooms in which there has been sickness.

Such panels are not affected by heat up to the temperature at which they begin to carbonize, which may be in the neighborhood of 900° F.

The Bloom on the Rubber
Cheap grades of hard rubber discolor or "bloom" on exposure to the sun for a considerable period of time. The better grades of hard rubber are fairly heat resistant and keep their color and shape well, besides being electrically of lower dielectric constant, less affected by moisture, and easier working than the phenolic products.

The lower dielectric constant means that there is less capacity action with them, but this is a point of no great importance, provided the set is so shielded that no hand or body capacity effect is noticed. That is, if the hand capacity is zero, it does not do much good to try to reduce it. Wood panels are all right for experimental sets but too great a gamble for radios intended to be permanent, or on which much money is to be spent for other parts.

How to Remove Holes
To get a good paste to fill in holes, which may have been drilled through the panel in the wrong place, dissolve an old talking machine record in denatured alcohol. Some styles of records, like the Edison, are made of condensite, and these will not be affected by alcohol. The ordinary hard wax ones will be dissolved if left soaking for several days.

The color of this paste, after the alcohol has evaporated, matches that of the panel very closely. Some of the so-called "mud" dials and sockets, which have a shellac base will also dissolve in alcohol into a paste, suitable for filling in such holes in panels.

Making a Rubber Bracket
Hard rubber is bent with ease, if first softened by immersion for several minutes in water near the boiling point. A flat strip of rubber properly softened can be bent at right angles to make a bracket for a shelf, or the side of the shelf bent at right angles to make its own bracket.

If cut when warm, the edges of hard rubber do not chip. If heated in water for about five minutes, it can be cut with scissors or a knife. A warped panel can often be flattened by warming in hot water and then pressing flat between two stiff boards.

Bakelite panels can not be straightened, but it is very rare indeed to find one which is warped. If you are careful to buy good bakelite in the first place, you will not have any trouble with its getting out of shape. To cut it, you must use an ordinary hack saw, such as employed in cutting metal. Allow a very slight extra length so that edges can be filed smooth to remove the marks of the hack saw.

Don’t Let Screw Heads Show
Most instruments, which have to be mounted on the panel, now come through so that the mounting screws do not show. The newest designs of condensers are mounted in a single hole drilled in the panel. Screws supporting variocouplers and variometers are normally concealed by the dial which operates them. There are a few places, however, particularly with older designs, in which the mounting screws can not be concealed. In such cases, to hide the screw heads, flat headed screws are countersunk until they are flush with the surface of the panel, and then the heads are painted with black paint or black lacquer.

Cut for Insulation
A very convenient wire connector may be made from flexible "fixture wire" at the end of which is soldered a copper lug of fairly good size. See Fig. 3. About ¼ inch at end of wire is scraped bare and this is bent back on the insulated part of the wire. The lug wings are then folded over the insulation and ¼ inch bared portion of the wire, and soldered to it as an extra precaution. Then the lug is cut as shown by dotted lines in diagram. This gives a firm connection but one that can readily be attached and detached, without removing the connecting screw.

MUSIC, NOT CANNED, BUT POTTED
A radio fan wrote in about his discovery of a good loud speaker. He was listening to Westinghouse Station WBZ at the time, and as a result wrote a letter to the station telling them of his invention. A jardiniere, in less fancy language known as a flower pot, was placed near the radio receiving set, and the earphones were placed inside. The result was a perfect loud speaker, and the members of the listening family withdrew into another room quite distant, and enjoyed the entire program by means of the new loud speaker. All of which makes the ordinary flower pot a valuable piece of furniture now.
UNUSUAL sounds (as well as new noises) are constantly being carried by radio. We have heard nightingales singing from the depths of the ocean; we have even heard what goes on one hundred feet down under the surface of the ocean as picked up by a microphone carried by a diver. But scientists have recently gone the limit, and now it is possible to listen to the smallest particle of matter—the electron.

The vacuum tube amplifier, in which the increase in loudness is carried to a hundred-thousand fold, and with which a million fold can be reached, if desired, makes this possible. The sound produced in this way, is caused by bombardment of the plate by electrons, released from the hot filament. It is these negative charges, the smallest known particles of matter, which carry the current and which make the operation of the tube possible. The noise is therefore a fundamental property of their emission, a characteristic of the electron.

Reported to Physical Society

These facts were brought out in a paper read by Dr. A. W. Hall, of the research laboratory of the General Electric Company, Schenectady, N. Y., at the annual meeting of the American Physical Society at Ann Arbor, Mich., describing experiments conducted by Dr. N. H. Williams of the University of Michigan and himself, in which they listened to electrons.

While users of vacuum tubes are not usually interested in listening to the noise it is a phenomenon of scientific interest, and in the research laboratory of the General Electric Company at Schenectady, a careful study has been made of it. The work is being continued by Dr. Williams. It has been found that the noise is proportional to the number of electrons which fly across the tube each second.

It is these flying negative particles, you will remember, which carry the current. To be more accurate, we should not say "carry the current," for indeed they are the current. When electricity flows in a wire or across the space of a vacuum tube, it merely means that these infinitesimal pieces of electricity are moving in a procession, just as the flow of water in a river means that there is a parade of molecules of water along the river bed.

A Noise Like Niagara

The noise, due to the electrical oscillation which is set up by the impacts of the individual electrons on the plate, is known as the Schrot effect and was predicted before hand on theoretical grounds by radio engineers. The energy of each blow is extremely minute, but, like rain drops, the energies of the many individual impacts add up together, and their sum becomes very large. With sufficient amplification, they produce a roar in the phones like that of Niagara.

To listen to the sound of the electron is a feat in itself which gives an added interest to the vacuum tube. Hearing the electron, however, is but incidental to the studies which have been made by the scientists, who in this case were working with radio frequencies and studying vacuum tubes with special reference to finding out how big an electron is.

An Atom or a Molecule

This unit charge of electricity is the smallest subdivision of electricity which is conceived of and is undoubtedly one of the two materials, of which the whole universe is built. The smallest particle of water, (for instance), which can exist and still be water is called a molecule. This may be broken up into two other materials, oxygen and hydrogen. Naturally the two parts of the molecule are smaller than it is. The smallest particles of oxygen and hydrogen which can exist are termed "atoms." We can not have an atom of water, since when we break down the molecule of water into its fundamental parts, it is no longer a liquid, but becomes a couple of gasses as just explained.

For a long time scientists believed that the atom was the ultimate building block of all matter, but many people thought it was surprising that there should be some 80 or 90 different building materials, in the universe. They thought it was more logical to imagine each one of these elements to be made
up of one or two fundamental units, which were assembled in different quantities or shapes, to make up the atoms. It turns out that this idea is the correct one, and all the 92 possible elements are composed of nothing but positive charges (which are in the center of the atom) and negative charges or electrons. Since it is known how many of these

force of gravity and of electric charges on minute oil drops.

The idea can be grasped by referring to Fig. 1. Two flat metal plates are spaced horizontally, one above the other. Into the space between them is blown with an atomizer a very fine spray of oil. By using enough pressure and a fine enough nozzle, the little droplets

pairs go to make up every single element and that each element is composed of an exact, definite number of pairs, it seems reasonable to conclude that there is nothing smaller or beyond this division of matter.

You can readily see that the size or charge of this unit is a very fundamental constant of nature and there have been numerous attempts to find out its value. Accurate as the experiments are, however, it is desirable that they be checked by some independent method.

How the Oil Drops Helped

Millikan’s method of measuring the charge of an electron is based on the

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of oil are broken so fine that each one is only about three one hundred-thousandths of an inch in diameter.

If you remember being out in a mist or heavy fog, you will recall that when the particle of mists are very fine they settle quite slowly. As the units come together or coagulate into larger drops they fall faster and in case of rain, drops are big enough so that they fall quite rapidly. The same thing applies with oil. These droplets are so very tiny, that it takes ten seconds to drop one-quarter of an inch from the upper to the lower plate. A telescope instrument, (which is not shown in Fig. 1), is used to magnify these oil particles as they are illuminated by a powerful source of voltage, like a “B” battery. The plus terminal runs to the upper plate. This voltage has no effect at all on more than 99% of the oil drops. But in spraying the oil, through the nozzle, it so happens that once in a while a little droplet becomes charged by friction just as stroking the family cat will sometimes charge its fur and make it stand on end. The negative charge, which is picked up by the occasional ball of oil, is attracted by the opposite or positive charge of the upper metal plate and repelled by the similar charge on the lower plate. If this attraction upwards is strong enough to overcome that of gravity, downwards, then the little star of light as seen in the telescope, will not fall, but will rise.

By changing the voltage of the “B” battery it is possible to increase or decrease the upward force of the electrostatic attraction. When the “B” battery voltage is just right then the particle of light will stand without hitching, since gravity pulls down just as hard as electricity pulls up. Since the weight of the oil is known, the pull down can easily be calculated and since the electric pull up is just the same, this gives us a measure of how big the charge on that droplet is.

Here is one of the surprising things found by this experiment. Assuming for the moment that all the droplets had been made of the same size, and so have the same weight, it happens that almost all of the charged oil require exactly the same amount of voltage to float without rising or falling. This indicates that all the particles have picked up precisely the same charge. Notice that we said “almost all” of the particles. Some of them do not stay stationary, but “fall up,” just as fast as the uncharged droplets fall downward. Here evidently the action of gravity is not only neutralized, but actually reversed. That shows that these few droplets have picked up not one, but ex-
actly two negative electrons. A very few will fall upwards twice as fast, which indicates three electrons. And once in a while a droplet may pick up as many as four electrons.

**No Half Portions**

The startling thing about this determination is that in no case does a ball of oil pick up a fraction of a charge. It is always exactly one, two, three, etc. This makes it reasonable to suppose that the smallest charge (which is the most frequent) is the unit of electricity. That particular amount is therefore called one electron. Of course, we have no absolute proof that it is not two or a million ultimate units of electricity, but since all charge work out in whole numbers, it seems ridiculous to suppose any such thing.

It is just as if some one from Mars wanted to know what the unit of our money is. As he walked around the shops he would see articles marked 25c, 70c, $57.23, etc., all over the lot. He would naturally assume that 1c must be the unit since no amount smaller than that ever appeared.

**Hearing Instead of Seeing**

So much for the Millikan method of measurement. It seems desirable to check the value found by another method, even though the determination was very exact.

Doctors Hull and Williams have measured the charge of the electron in a different way, the means of the Schrot effect, and have opened a field for research, which promises to add materially to our knowledge of the electron and its properties. Previous attempts were made by German scientists to make the electron audible, and to measure the charge of the electron by this method. Only approximate values were obtained, however. By the procedure used by Drs. Hull and Williams, it is possible to obtain values of high accuracy thus getting an independent check on Millikan's determination. The measurements thus for made by this method give a value for the charge of the electron within 1/4 per cent. of that obtained by Millikan. Though as yet less accurate than the results of the experiments of Millikan, these measurements are capable of refinement, which may equal or exceed in accuracy the oil-drop method. The scientists made the measurements while working with radio frequencies in the course of studying the tubes. The method can be used also for determining whether one, two, or more electrons are given off as a unit in electronic phenomena.

**Four Step Amplifier Used**

Fig. 2, shows some of the apparatus used in making this determination. This includes a tier of five vacuum tubes, which consist of the electron detector and four RF amplifiers. The connection between the tubes are made by very sharply tuned RF transformers. Notice that each one of the tubes is shielded by a grounded metallic plate. This is necessary because the amplification of the four steps is so great that the most minute disturbance coming from outside would be increased to a horrible howl. For the same reason the entire apparatus has to be operated at all times in a cage of wire netting, which is also grounded. This is illustrated in Fig. 3.

Not long ago the electron was unknown. First scientists had the molecule, itself so small that man has not yet seen it. Then came the atom, the minute integral part of the molecule. For a long time the atom was considered as the ultimate particle of matter. But each element presents a different atom. Science was not content to rest. It sought to connect all phenomena, and the electron was the result.

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**CLOSED CIRCUIT BATTERIES FOR RADIO**

Continued from Page 11

It's like two tanks on the roof. A small tank gives as much pressure as a large, but will not give out nearly as much water.

In conclusion, either of the two batteries described in this article will be found to give good service in radio work and enable the enthusiast to get more comfort out of his set.
Report On Increased Power

Government Regulations on Size of Sending Stations

The National Radio Conference, held October 6 to 10, 1924, at the Department of Commerce, recommended that a general increase in power over 1,000 watts was desirable in all stations in order to overcome static and give better service to the listeners. This is a question entirely apart from so-called super-power stations of 25,000 or 50,000 watts, which are not here dealt with.

In order to include increases up to a maximum of 5,000 watts the department feels that it should be proceeded upon an experimental basis under strict limitations which will insure that this development may be made without interference with the service of other stations or with the reception now enjoyed by listeners. The department is receiving many inquiries as to the granting of licenses authorizing this use of increased power. Licenses for use in broadcasting of power up to 5,000 watts on a purely experimental basis will be issued under the following conditions:

1. Experiments may be carried on only after due notice to the supervisor of radio of the district, and must be at all times under the control and regulations of the supervisor and the department.

2. Stations operating under experimental licenses may at the outset use a power input to the antenna not exceeding 1,500 watts. Whenever the radio supervisor of the district and the department are satisfied that the public interest is served by the use of such increased power, and that no undue interference with other stations or with receiving sets results, its use may be continued. All applicants for such licenses must agree in advance they will reduce the power used during the course of the experimentation whenever the department or the supervisor of radio deems such a course to be in the public interest and so directs.

3. If as a result of the experimentation above specified the use of the additional power is found to be in the public interest and the station desires to make a further increase, such increase will be allowed in successive steps of 500 watts, and experiments may be carried on at each of such increased stages under the same conditions and restrictions as are above specified for the first increase.

4. The department anticipates difficulty in laying down any general rule which will be of universal application to all such stations. It will therefore consider each station as a separate entity and deal with it according to the local conditions involved.

5. It is anticipated that the location of the station will be a factor of great importance, and that the amount of power that may be safely used will be in direct proportion to the distance of the station from congested receiving centers.

6. All such experimentation will be absolutely at the risk of the station conducting it, both as to location and power used, and notice is given in advance that these licenses will carry with them no permanent rights or privileges of any character, are entirely temporary and experimental in their nature, and are subject to withdrawal or revocation by the department at any time in its absolute discretion.

The prime consideration of the department is directed to the listening public. The operators of stations must necessarily take the same attitude, for broadcasting is finally dependent upon them for its support.

PRIZE BAND CONCERT

The latest feature on super-power Station CKAC's schedule is that of a huge band contest, open to all cities of the province of Quebec, outside of Montreal itself, for the award of a magnificent silver cup, which will be decided by popular vote cast by listeners-in. The conditions of the contest are that a band must have been an organized musical corps for at least four years, and that the members can play at sight. This is required in order to provide nothing but first class concerts and at the same time interest musical critics and listeners-in, to take an interest in the competition.

Every Sunday afternoon a band comes to station CKAC, La Presse, Canada's largest daily newspaper and entertains critical ears, all eager to cast their votes in favor of the best, when the contest has ended. It is expected that some thirty provincial cities will be represented and that the final vote will not be cast before the end of April.

At these concerts, given by bands of outside cities, the mayor of the city whose band is being featured will deliver a "boom my town" talk, and fans will be influenced by the humour, wit or oratory of the small towns' first gentlemen.

52,500,000 SHREWS—WHALE

For a long while the directors at Springfield Station WBZ, were puzzled over the possible message in the following cablegram, recently received from England: "Fifty-two and a half million shrews equal whale." The code books were taken out and every conceivable means was used in an attempt to decipher the message. Then it dawned on the puzzled group that Thornton Burgess, nationally known naturalist, had given a radio talk on natural history and had described the shrew and the whale as the smallest and largest animals in existence. Mr. Burgess put the question, "How many shrews does it take to make a whale?" Of course, he furnished his listeners some guide as to how to figure it out. One of our English neighbors heard the query, sat down with pencil and paper, reached his answer, and cabled the station. How near right he was, we do not know, but he should be given mention at any rate, for his anxiety to make known his solution of the arithmetical question.
SHALL WE SUPER OR NOT?

Just now the biggest question before the house is whether it will be an advantage to allow broadcasting stations to increase their power up to 5, 10, 20, or even 50 kilowatts. Remember that until recently the largest station permitted in the United States was one kilowatt (1,000 watts). Up in Canada they permit considerably larger ones. For instance, CKAC, La Presse, the big newspaper of Montreal, has a station rated at 5 kw.

Both sides are airing their arguments in the press. On the one hand we have those who are afraid of this move for two reasons. In the first place, any one living fairly close to a station even as small as 500 watts, realizes how hard it is to get rid of them and tune in any other program when the local broadcaster is going. If this power were made ten or one hundred times as big, the chances for those near by for getting distance through the interference would drop to nothing. And the present difficulty would be extended to a radius of twenty or even perhaps one hundred miles.

Tentacles of Octopus

Besides this, some people profess to see the tentacles of a powerful monopoly being reached out to strangle the smaller stations. There is no doubt that if a 50 watt station tried to run at the same time and in the same city as a 5,000 watt, it would be something like a mosquito buzzing in a boiler factory. They think that with the big superpower stations linked together under the control of a very few large corporations, there is considerable danger of their being used for purposes of propaganda.

On the other hand, those who favor this development point out that the local station is a great boon to the largest number of broadcast listeners in any city fortunate enough to boast of one. Such a station can be heard even on a night of bad static. Crystal users depend entirely on their home talent. And even those who boast a six or eight tube set usually know what is going on at home. If they never listen to it, how does it happen that they know all about it?

Local for 100 Miles

The proponents of the increased power claim that under their scheme any big station within say one hundred miles would be as good for both crystal and tube user as the present local stations. They admit that the interference within a few miles would be so great as to put the distance hunters temporarily out of business. But if such stations run on a schedule of only four or five days a week, it would give plenty of time for those who want to play radio golf to lie about the distance which they did not get the night before.

They also assert that there is no danger of a monopoly for these reasons. First, the broadcasting public would not stand for it. When all a listener has to do to get rid of propaganda is merely to twist a dial, it does not seem likely that many fans will have to listen to anything against their will. Besides this, with the unusually efficient Department of Commerce on their trail, the big factors in broadcasting would be afraid to try any such tactics.

What Sec. Hoover Thinks

On the opposite page will be found a copy of the regulations which the Department has issued to those broadcasters who want to increase their power. Notice that the same common sense is displayed, which is usually found in anything which the Secretary does. The general proposition is this. Any station has the right to apply for additional power in blocks of 1/2 kilowatt each. That is, any 1,000 watt station may ask to be allowed to use an additional 500 watts of power.

Notice that permission is given to any one to apply for this raise. Whether or not it is granted depends entirely on the local conditions. If KABC is given permission, that does not mean that WXYZ will also be allowed to go ahead. Whether this permit is extended or not depends among other things on whether the station is located at a site which is likely to cause undue interference with a large number of people. Doubtless the style of program which the station has been putting out in the past will also be a factor. In the same way the standing and prestige of the Company itself will be taken into account. All this is as it should be.

No “Vested Rights” in Air

Another thing which is made very plain is that the stations do not own the air by any means. You hear a lot of talk about “vested interest,” which means that when any one has spent a lot of money on a piece of property, that very fact will have a bearing on legal decisions made about it. But if a broadcasting company spends thousands of dollars to increase
the size of their station, that fact will not have any influence with the Department of Commerce in deciding whether they are a nuisance or not. If they do not behave themselves, or if, with the best intentions they annoy their neighbors too much, with the stroke of a pen the Department can recall their license for the extra power and make them reduce it to 1,000 watts again.

This may seem like rather arbitrary power. And indeed, some fans and also some broadcasters are rather frightened at the prospects. However, as we look at it, increased power has been a factor in the growth of every other science and we think it is bound to come. If the power granted to the Secretary of Commerce is great, it is because the need for it is also great.

STATIONS IN PAIRS

If superpower is about to burst upon us (and it looks that way) then one of the chief objections to it might be overcome in the following way.

Residents of a city, which happens to be located within a few miles of the sending aerial of a powerful station, naturally complain that they are able to hear only one program. There is no choice at all, and if they are not pleased with the particular numbers which are being transmitted they have no recourse other than to turn off their switches and go to bed.

If they wish to go through the big local noise and listen to a faint peep from across the country, we fear there is no remedy—they are out of luck. But if it is only a matter of being able to choose which of two or more programs they will listen to, then the following scheme will be a decided advantage.

Super for Big Cities Only

Undoubtedly the call for big stations will come only from broadcasters located for the most part in big cities. Oftentimes there are two or more large concerns in the same town. If the superpower licenses were granted always to at least two sending stations in one place, then any one who could pick up one could also shut him out and get the other. It is not because one station is any way away that it is hard to pick it up through local interference, but because it is very weak. Even if both stations were very close to a listener, by using a short aerial or no aerial at all, he could tune out the unwanted station, no matter how powerful, and pick up another which had nearly the same amount of energy in the air. This would allow all listeners, even with crystal sets, a choice of at least two programs.

HOW ABOUT BEDTIME STORIES?

One of the most popular features of broadcasting programs (at least with the youngsters) is the bedtime story. Many a boy and girl have their first interest in radio awakened by the accounts of the doings of Peter Rabbit and his friends.

Since this has become a pretty well fixed part of the usual program from many of the large broadcasting stations, it has been suggested that our readers might find their children interested in a write-up of some of the bedtime stories, before they are put to bed.

Since this magazine belongs to its readers, we welcome your opinion in this matter.

ADVERTISING ONESELF

Is it a good thing or not to advertise yourself? It depends somewhat on how good the advertisement is. For instance, when station WLAG in Minneapolis shut down because the owners went into the hands of a receiver, the business men of the Twin Cities (Minneapolis and St. Paul) got together and subscribed enough money to continue a local broadcasting station. They felt that the prestige of their town would suffer if, after being known far and wide over the whole country, their voice were suddenly silenced. The sale of a good deal of radio supplies also depends a lot on whether or not there is a sending station in the vicinity. This knowledge undoubtedly may have an influence on such a decision, but the big thing in the minds of a Chamber of Commerce is to get the name of the city before the nation. That is why communities are continually advertising in national periodicals.

An Advertising Censor

On the other hand, there is considerable unfavorable comment directed against stations which use their power for the purpose of politics. As an illustration, notice, in the public press at the present time there is considerable discussion stirred up about Station WNYC. This is the municipal broadcaster of the City of New York. The claim is made that many political secrets are whispered to its microphone, but always by only one side.

In a rather acrimonious discussion recently, between the ins and the outs, the party which happened to be in power gave numerous talks explaining why they were right and their opponents wrong. When it came time for the opposition to present their views, they were not allowed to broadcast until they had submitted a type-written copy of their proposed talk in full and had it censored by the Bureau of the first party.

We do not know the merits of this particular controversy. However, we believe that matters of religion or politics about which there is a wide difference of opinion, should not be broadcast from any station unless both sides in the argument are granted equal privileges. Almost any one is willing to listen to the remarks of his opponent provided he knows that he in turn will be given an equal hearing. But if he knows that he will not be allowed to present his side of the case, his sense of fair play is outraged and broadcasting will be given a black eye.
A Spider Web Neutrodyne

Deresnadyne Like Neutrodyne, but Does Not Use Condensers

By OLIVER D. ARNOLD.

After you have experimented with various hook-ups, using a detector and one or two steps of audio frequency amplification, you will probably come to the conclusion that only so much volume can be had out of such a set. If you want to get louder results of a greater range, it does not do very much good to add another step of audio. If you try this you will find in general that the set has a very strong tendency to howl and even if it does not go as far as that at least the noise is apt to be unpleasantly loud.

If then you want to add one or more tubes to your three tube set it has to be in the line of radio frequency amplification. Probably the best known example of RF (radio frequency) steps is found in the neutrodyne. This set is a very good one, and is quite popular. Of course, the factory built units are ordinarily adjusted correctly so that they are properly neutralized. If this adjustment is wrong, then the music is apt to come through in a rather squeaky fashion, and the set will have a blurred tone.

Neutralizing Your Own Set

If you try to build your own set you will have to adjust the neutralizing condensers, as the last operation in its construction. This is not such an easy proposition. Many radio fans put good material and first-class workmanship into a neutrodyne, but owing to trouble in neutralizing, do not get as good results as they should.

A rather interesting hook-up, which uses the principles of RF, but does not require this experimenting with neutralizing condensers, is known as the Deresnadyne. As it is well known, the tendency of the radio frequency tubes, to break into oscillations or act as miniature sending stations themselves, must ordinarily be controlled. The neutrodyne uses the method of connecting a small condenser between the grid of one tube and that of the following. Various other manufacturers use, instead, a potentiometer, which changes the voltage or bias on the grid of the first step. As this is made more positive it prevents the tube from oscillating. With such a control the vibration, the primary is no longer tuned to the incoming signals, but is de-resonated (not resonated). This is where the Deresnadyne gets its name.

In general, it is found that a single, well designed transformer (which corresponds to a neutroformer in the neutrodyne), is sufficient for the first step of RF, while for the second it is desirable to have a few taps taken off running to a tap switch. As one after another wave length is picked up, it is well to make a slight adjustment with this tap switch in case the set begins to give a mushy tone because of oscillations.

How the New Hook-Up Does it

The use of a potentiometer in the grid circuit causes some losses, which cut down the selectivity and range. The Deresnadyne accomplishes the same result without the need of such a resistance. For this reason, strictly speaking, it should not be called a neutrodyne, but it looks very much like the same hook-up. Preventing the radio stages from oscillating is done in this way. Instead of having the primary and secondary of the RF transformers wound in opposite directions on two different cylindrical tubes, both windings run in the same direction, and are wound on the same spider web form. The proportion between the number of turns is such, that for long wave lengths the plate circuit is practically in resonance through the primary coil. On shorter wave lengths, that is, faster speeds of vibration, the primary is no longer tuned to the incoming signals, but is de-resonated (not resonated). This is where the Deresnadyne gets its name.

Not a Neutrodyne

This essential difference between these two circuits can be seen from looking at the hook-up. Fig. 1 shows the first two tubes of a conventional neutrodyne. The first step is shown in heavy lines, and the second, which is just like it, in dotted lines. The condenser marked "NC" does not exist as a separate unit, but is the internal tube capacity between the grid and plate. This is the value which must be neutralized. The reason is this: Suppose a radio wave, which we will assume at the instant to be the positive loop, comes in from the grid coil GL. This is impressed on the grid. The same wave comes from the output of the plate, magnified four
or five times, by the action of the tube itself.

Since the capacity NC exists as described in the tube itself, a part of this radio frequency positive wave will be carried through this condenser and be again impressed on the grid. There it strengthens the incoming signal, or in other words, feeds back energy. It is the same kind of regeneration which is sought after in the regenerative detector, but causes oscillation in the amplifier.

**Why it Must be Neutralized**

Now notice that the secondary XL of the first neutroformer has a tap running to neutralizing condenser XC, then to the grid of the first tube. Since the secondary of the neutroformer is wound in the opposite direction from the primary, the loop will be negative (instead of positive) in coil XL. This negative loop will be fed through transformer XC to the grid. When the neutralizing condenser XC is adjusted to the right capacity, then it will transfer just enough of the negative loop from the secondary to the grid to counteract exactly the positive loop, which ran backwards through internal capacity, NC. Of course, if this capacity is either too high or too low, the neutralization will not be exact.

Note also the dotted line B connecting the negative of the "A" battery to the various tubes. Of course, this connection exists in all sets as only one "A" battery lights all the filaments. The line B, you will observe, is the return path for the oscillation going through condenser XC, that is, the waves oscillate from the right hand side of neutralizing condenser XC, through coil XL, negative connection B, grid coil GL, back to the left hand side of XC.

**Same Direction of Windings**

On the other hand the Deresnadyne uses coils wound in the same direction. Fig. 2 gives the idea. The feedback, which is not wanted, would naturally occur across internal tube capacity NC, as just explained. However, by designing the secondary with the correct amount of inductance, it becomes a tuned plate, and will resonate at the frequency for which it is adjusted. By proper attention to the primary winding of the transformer this action is used to neutralize the loss through leakage capacity through the tube.

Connection B links the two circuits together, just as it did in Fig. 1, since the same "A" battery is used for lighting all the tubes. However, in this case, this wire might be omitted and separate "A" batteries used for each tube without preventing the operation of the set. Of course, this point is of no value in actual construction, as naturally no one would think of using so many "A" batteries but it explains the difference in the theory and action of this hook-up.

**List of Parts Needed**

To build this set the following material is needed:

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<td>2 A</td>
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<td>2 F</td>
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<td>7 B</td>
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<td>Bus</td>
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Two neutroformers are used, although one could use the first transformer as a two stage amplifier as follows:

The placing of the tuning coil is considered as wound at the left hand side. The second coil is used as winding A.

The first winding on the coil, on the first tube, is as follows. Two turns turn the set out of phase. Three slight

**Fig. 2. Tuning Details of the New Hook-up**

**Fig. 3. Complete Wiring Diagram of Deresnadyne. Note Deresonator Between 2nd and 3rd Tube**
Winding the Transformers

Two regular audio frequency transformers are used of a ratio of 3½ to 1, although a higher ratio may be used in the first audio step, if desired. The radio transformers are wound on spider webs as follows:

The first coil has only a single winding on a regular spider web form. This consists of 60 turns of No. 28 wire wound in either direction. Take taps off at the fifth, tenth, and fifteenth turns counting from the inner end. These are used to vary the amount of selectivity, as will be described later.

The second transformer is made by first winding on the primary of eight turns of No. 26 wire in either direction. Two turns of ordinary string may be put on to keep the two windings spaced slightly apart. Then wind on in either direction sixty turns of No. 28 wire. This comprises the secondary.

The third transformer will have twelve turns in the primary tapped every second one at the second, fourth, etc. These six taps are to be run to the contacts of the six point tap switch. The lever of this switch connects direct to the plus terminal of the "B" battery.

Varying the Selectivity

The hook-up of this set appears in Fig. 3. Notice the three taps from the first coil as described. When the antenna is connected to the five turn tap, as marked "selectivity" then the coupling is loose between the aerial and the grid and the set is most selective. When the antenna runs to the fifteenth tap, marked "power," then the coupling is much tighter, which gives louder signals, but is not so sharp tuned in cutting out interference. The middle tap, "medium," will split the difference between the other two.

The tap switch, marked "deresonator," is used to cut out any slight tendency to oscillate by throwing the plate circuit out of resonance. Oftentimes it may be left on the same connection for picking up a great many different stations. Some of the primary turns may need to be cut out when picking up the short wave lengths in order to keep the signals at their loudest point without regeneration. This can be found by trial.

Mounting the Transformers

The transformers to be mounted so that the secondary turns run in the same direction. Connect the inside of the primary to the place and the outside to the "B" battery. The inside of the secondary hooks on to the filament negative lead and the outside, as usual, connects with the grid of the next tube. Turn the transformers as shown in Fig. 4, so that they are set at an angle of about 55 degrees to the panel.

Notice the condenser, which is connected between the ground lead and the B+90 terminal. This is not really necessary for the operation of the set, but is desirable as it further tends to prevent oscillations from starting between one tube and another owing to the increasing resistance of the "B" battery as this unit gets old and falls off in voltage. It will also have something of a soothing effect on possible noises, which originate in the set.

Operation of The Set

The way the circuits run with this hook-up can be easily followed. The radio waves come from the aerial to one of the three taps shown at the left (depending on whether selectivity or loudness is most desired) and continue through the few turns of this coil direct to ground. This completes the primary circuit of the first tube.

The secondary of the first coil, which includes the entire winding, is tuned by the first .00025 mfd. condenser. This voltage is applied between the grid and the filament of the first tube. The output from this first step goes to the primary of the RF transformer direct to the B+90 terminal. The secondary of the RF transformer is tuned by the second variable condenser and its voltage is impressed on the grid of the second tube.

Continued on Page 28
Fone Fun For Fans

Smart Cop

The speeding motor swerved, collided with a telephone pole, and turned wrong side up, with the driver underneath.

"Tain't no use trying to hide under there, young feller!" called Constable Slackpunter, rushing up. "I know where ye are!"—Radio Merchandizing

Mrs. Knutt: "I bought three hams here a month ago and they were very nice. Have you any more of them?"

Butcher: "Yes ma'am. There are 10 hanging up there now."

Mrs. Knutt: "Well if you are sure they are off the same pig, I'll take two more."—Wall Street Journal

Ascum: "I see there's some talk of having the people vote at the next State election upon the question of abolishing capital punishment. Would you vote to abolish it?"

Fogie: "No, sir; capital punishment was good enough for my ancestors, and it's good enough for me."—Washington Star

"I must say this khaki camping skirt is a loose fit."

"Why auntie! That's the boy's tent you have on."—Crosley Radio Weekly

The most distinguished of those to give addresses on this occasion include Honorable Frederick P. Gillette, speaker of the House of Representatives; Associate Justice of the Supreme Court of the United States, Edward T. Sanford; Senator-elect of Connecticut Hiram Bingham; Major-General John A. Le Jeune, Commandant of the U. S. Marine Corps, and, of course, the French Ambassador.

The dinner is to be given in the grand ballroom of the New Willard Hotel and subscriptions filed thus far indicate that it will be one of the most brilliant affairs ever held in the nation's capital. The leading statesmen, scientists, jurists, clergy and business men of the country will be present to pay homage to the "Dean of the Diplomatic Corps" who has served France in this country for 22 years and has negotiated affairs of state for the U. S. in this country for 22 years and has negotiated affairs of state for the U. S. and, of course, the French Ambassador.

The output from the second tube runs from the plate through the primary of the RF transformer to the deresonator. This is adjusted to prevent oscillations or feedback, just as it has been already described. The secondary of this transformer, tuned by the third adjustable condenser, runs to the grid of the detector, through the customary grid condenser and leak. A five megohm leak is shown in the hook-up, although another value may be needed to conform to the particular detector tube which you happen to use. UV-201A tubes are specified for all sockets, but a UV-200 detector tube if properly adjusted, is more sensitive.

The output of the detector tube goes to the primary of the first stage of AF (audio frequency) amplification in the usual way. The secondary of this feeds to the grid of the first stage. Its plate is connected to the second transformer, which in turn passes the program along to the grid of the second stage. The output for phones or speaker may be plugged at the first stage jack, or if greater volume is wanted, at the second stage. In both these positions jacks with the minimum number of springs are shown. Naturally four spring units could be substituted in either location.

This set is unusually easy to build, and merits the attention of any radio fan who is interested in putting together a good five-tube set.

THE MYSTERY OF THE UNSIGNED CARD

In the mail received at WEAF has been found, as each week goes by, an unsigned card always in the same handwriting with the inscription "Astor Coffee Orchestra fine. Thanks." This praising phrase has been written on a regulation stamped government post card, enclosed in a sealed two cent stamped envelope and addressed to WEAF each week since November 16, 1923. At first this peculiar letter was not particularly noticed by the correspondence department at that station but it has now aroused so much curiosity that it has actually come to be known as the "mystery post card." No one knows who sends it.
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. Why is it that some tubes have grayish colored glass, while others are silvery?

Answer. The color of the glass is caused by the kind of chemical which is used to remove the last traces of air when getting the vacuum. The tubes put out by the Radio Corporation have a silvery color, while similar ones of Cunningham manufacture are gray. Some tubes have a fairly thick layer of color, and others are nearly transparent. However, the shade and the depth of tone have nothing at all to do with the operation of the tube.

Question. Why is an untuned primary more selective in a tuner?

Answer. Many of the new tuners on the market which are quite selective, are not tuned. In general the primary of such a coil will consist of from 1 turn as recommended in the Cockaday circuit, up to 8 or 10. The reason that such tuners are quite selective is because the number of turns in the primary is small, and this gives a loose coupling. The same sharpness of tuning may be had by any other method which uses a loose coupling, as for instance, separating primary and secondary for an inch or two, or by turning the primary so that it is nearly at right angles to the secondary. If these untuned primaries of a few turns used, a variometer or condenser in series with them and this latter were adjusted so that the primary circuit were tuned to the desired wave length, then you would find that the signals would be a great deal louder than when it was untuned, and furthermore, the selectivity of the circuit would be still further increased. The only reason for leaving the primary untuned is to avoid the complication of another piece of apparatus and its control.

Question. What is the advantage of using blue prints for hook-ups rather than black and white diagrams?

Answer. The difference is entirely one of psychology. Machinists and others, who are used to reading blue prints, doubtless would be able to follow such drawings a little easier than those in black and white. But persons who have not had much previous use for this form, will undoubtedly find the ordinary black and white drawings easier to follow. Of course, such a drawing is like the other fellows, while a blue print is different.

Question. Some manufacturers are making double condensers. What is the advantage of this style?

Answer. We are not sure just what you mean by a double condenser. One make on the market uses a rotor with the plates divided into two sections. These are spaced opposite each other, so that when one set is down the other will be up. The stator, of course, has a similar arrangement so that all the plates go in and out together. The reason for this construction is that it keeps the rotor in perfect balance all the time, so that it does not turn around under vibration. For this reason the bearings can be set rather loosely, which gives an easy running dial. The disadvantage of this style is that it costs a good deal more to manufacture it.

Another type of double condenser is one which has two entirely separate units mounted on the same shaft. These are made as nearly alike as possible. They may be connected in series or in parallel, or used separately. They are shown in some hook-ups with the two sections connected in two different circuits. This is not usually regarded as the best practice, however. Even if the two halves of the condenser are identical (which is doubtful) they do not necessarily require the same setting to tune the two different circuits. For instance, in a neutrodyne, the three dials are supposed to be set all alike. As a matter of fact, we have never seen one of these instruments where this equality of setting obtained on all wave lengths. That is the reason why it is not practical to gear the three dials together to turn as one. For this reason, we doubt the advisability of having both sections adjusted by a single dial.

Question. What is meant by a two ball hydrometer?

Answer. Since some hydrometers are rather hard to read owing to the fact that their lines are spaced quite close together, and also because the exact reading is not usually needed, a new style of unit is made which has two celluloid balls for floats. They are the same size, but have different weights. When both of them float at the top of the syringe, the battery is fully charged. When one sinks it is the case that it is about half full, and when both are down, the battery is nearly empty and should be recharged. If it is desired to keep the battery in the best of shape it is well to start charging it before it shows the empty signal.
New Products of Unusual Interest

Drive Against "B" Batteries

It seems that the use of "B" batteries is one of the things the fans are all trying to avoid. In response to the big demand for some device which will operate on electric light current and furnish a steady direct current supply for the tubes, many manufacturers are developing products which will replace "B" batteries.

As has been often explained, the chief trouble which must be avoided comes from the fact that the big proportion of ordinary electric light is supplied from alternating current. That is because AC can be transmitted over long distances economically, while DC (direct current) is limited to a mile or two for efficient transmission. Of course, the center of a town could be supplied with DC by the central station and the outlying parts with AC. However, the electric light companies find it inadvisable to use two different kinds of current, and since they must have AC, they usually supply an entire community with it.

In changing AC to DC the trouble is not to prevent the reversal in polarity of the waves, but to get direct current, which will not have a bad ripple in it. Such a ripple is heard in the phones as a loud hum.

Fig. 1 shows a Recto-Filter put out by Mu-Rad. This combines a rectifier for the "B" battery and also a source of current at six volts for lighting the filaments, thus doing away with both "A" and "B" batteries at the same time. The two upper terminals are connected directly to the "A" plus and "A" minus binding posts of the set. No adjustment is needed, as the rheostat in the radio itself gives control of pressure on the filaments.

The four lower binding posts are for B-, B+ 20, B+ 45 and B+ 100 volts. If your set uses a 199 tube for a detector, it should be operated on the B+ 45 tap. With any other style of detector the B+ 20 is the correct one to use. To operate the amplifier either the B+ 45 or the B+ 100 will give the best results. The latter terminal ordinarily gives louder signals.

The Timmons Co. put out the B-Limiter as shown in Fig. 2. Only three terminals are used (not shown in cut, as they are at the rear). One is for the "B" minus and the other two for detector and amplifier binding posts. Instead of having six pressures to operate the set, there are two knobs in the front which give an adjustment over the entire range.

The maximum pressure obtainable on the amplifier post is slightly over 100 volts. This can be reduced as desired by turning down the knob. For instance, if a local station is being picked up, it may be so loud as to be objectionable in the phones. Instead of having to throw the tuning off somewhat to reduce the volume, it is possible to accomplish the same result without distortion by turning down the "B" voltage.

The detector knob enables any potential from sixteen to forty-five to be impressed upon the detector tube. Thus the maximum efficiency can be had out of a soft tube which may require a critical plate pressure.

In testing either one of these devices a rather interesting point will be discovered. The natural thing to do to find what voltage you are getting on the tubes is to use a volt meter or "B" battery tester. Unfortunately, neither of these instruments will give very much of an indication of what pressure you are actually putting on the plates of your tubes. Each tube, when actually operating, takes something like two or three milliamps, depending on the "B" battery voltage and also on whether you use a "C" battery or not. That means 10 or 15 milliamps for a five-tube set. But many a battery tester will take ten times this current. As a result the pressure drop through the circuit of the device supplying the plate current is so great that the meter may read only half of what is actually on the tubes when the tester is removed.
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