January 1, 1925
15 Cents a Copy

RADIO PROGRESS

Reg. U. S. Pat. Off.

"Always Abreast of the Times"

In This Issue:

HOOK-UP NUMBER OUT JANUARY 15

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

PUBLISHED TWICE A MONTH

RADIO PROGRESS

SPECIAL HOOK-UP NUMBER

TO BE ISSUED

JANUARY 15th

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

Contents for

JANUARY 1, 1925

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

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 Crystal
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."**

RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. I, No. 20 JANUARY 1, 1925 15c PER COPY, $3 PER YEAR

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."

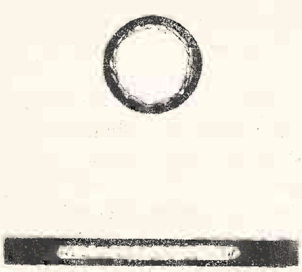


Fig. 1. Why Tape is Good

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," expostulated 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."

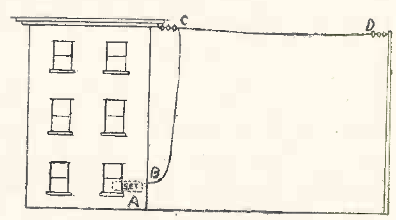


Fig. 2. Measuring Aerial Length

"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

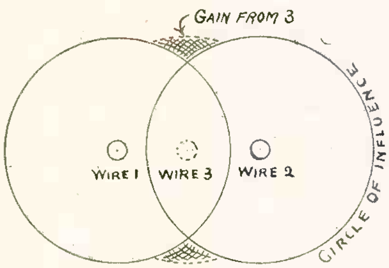


Fig. 3. Three Wires Unnecessary

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 it overlaps with the circle of Wire No. 1 but that does no harm. If we put 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."

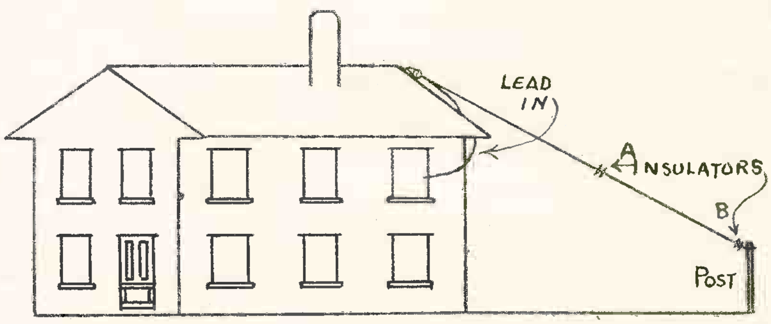


Fig. 4. Here it is Better to Shorten the Aerial

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, is 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.”

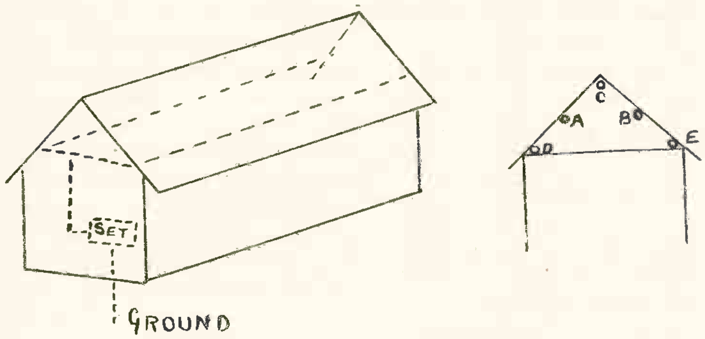


Fig. 5. Stringing Aerial in Your Attic

“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, but 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 electricty. 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.”

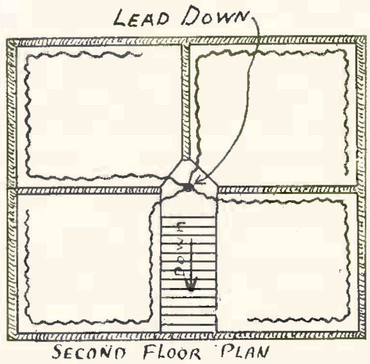


Fig. 6. Good Aerial for Small House

“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.”

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 their importance, to assert their interest and to voice their wishes. Broadcasting must be conducted to meet their demands and this necessarily means higher character in what is transmitted and better quality in its reproduction to the ears of the listener.

The broadcasters as a whole are alive to the situation. There is a growing realization on their part of the public responsibilities they assume in conducting an agency so greatly affecting the cultural progress of our people. The innovations of which we hear so much—national programs, wire interconnection, short wave rebroadcasting, increased power, and wired radio, which are already playing so important a part and are destined to have still greater influence for good—are based entirely upon the necessity for meeting the growing popular requirement of better service. The demand will continue to increase, and new methods of efficiency will continue to be found to meet it. But beyond all, radio has begun to enrich American life by a real contribution to the home. Yet it has far greater service to perform in this way and I believe the next year will see great and more definite advance in this direction.

There is no monopoly in the radio world at the present time, there being over 500 broadcasting stations of which not more than four are the property of any one institution.

57 Varieties

With only 57 wavelengths and 500 stations—rapidly increasing—we are today forced to certain duplication of waves and to the division of time between stations. If there were enough wave lengths for all, the matter would be much simpler. Any attempt to give preference among stations in the allotment of wave lengths on the basis of quality of programs raises the question of censorship, the implications of which I cannot at present accept.

Beyond this, three major things have developed during the last twelve months. The first is the interconnection of stations by which a single voice may be broadcast from all parts of the United States. This interconnection has been most successfully carried out by the use of the wire systems between broadcasting stations but other methods of interconnection are in use and process of development. It is difficult to see as yet what the public implications of interconnections will be.

Rights of Listeners

During the past year there have been discoveries in the use of higher power and therefore larger areas of broadcasting, which may result in a single station being able to cover a large portion if not all of the country. This raises questions of the rights of local stations and the rights of local listeners.

Still another development has been the fact that it has been found possible by indirect advertising to turn broadcastnig to highly profitable use. If this were misused we would be confronted with the fact that service more advantageous to the listeners would be crowded out for advertising purposes.

Shall We Limit the Number?

Because of this situation, there is growing up a demand for the limitation of the number of stations in a given area and that such a limitation would be based on the service needs of the community, just as public utilities are generally limited by the rule of public convenience and necessity. Again this enters a dangerous field of recognizing monopoly and implied censorship.

On the other hand, we may be in a rush of broadcasting, which may in time die down and the number of stations may decrease. Alternatively, improvement in the art may increase the number of available wave lengths and no priorities need then be contemplated.

These are not all of the shifts in progress and we may have to come to the conclusion that many station owners must be considered as having abandoned the field of private enterprise and entered that of public service. In view of these changes we may have to reconsider the regulation of the whole art from the point of view of the listener.

The public interest of radio broadcasting is rapidly widening. Entertainment and amusement have ceased to be its principal purposes. The public, especially our people on farms and in isolated communities, are coming to rely on it for the information necessary to the conduct of their daily affairs. It is rapidly becoming a necessity and they rightly feel that since the public medium of the ether is used to reach them, that they have a direct and justifiable interest in the manner in which it is conducted.

RADIO WAKES THEM UP

Announcement has been made by the Japanese Government that since December 1st, 1924, the ban on radio broadcasting has been lifted, and that radio broadcasting and receiving are now permitted on the part of the general public without Government interference.

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.

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.

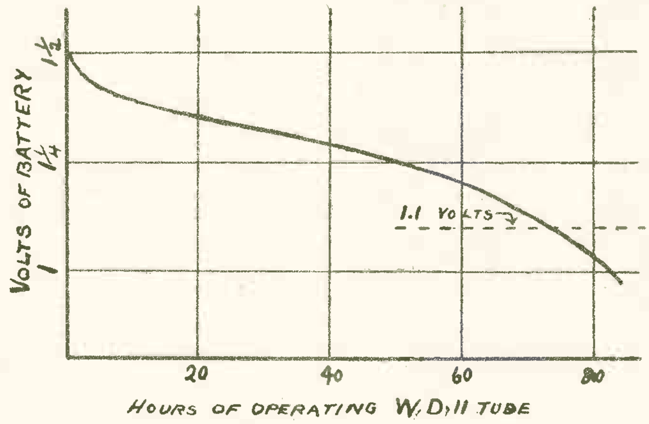


Fig. 1. How Dry Cell Lasts with WD Tube

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.

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 not in action. The writer has found out after some experimenting, that by making a few changes in the original designs of the Daniell 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

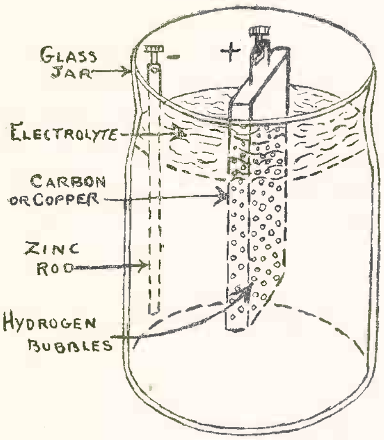


Fig. 2. Why a Battery Gives Out

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, coppers to zincs).

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

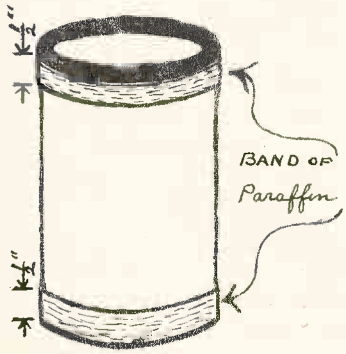


Fig. 3. Prevent Creeping

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.

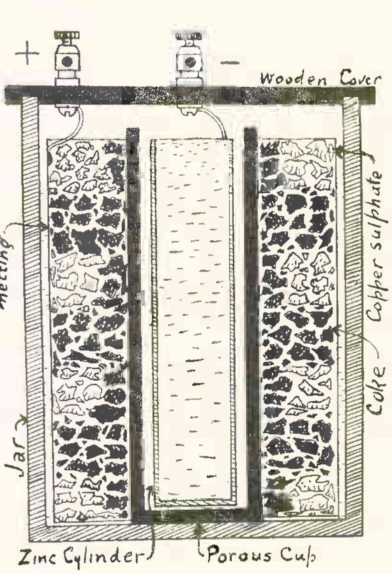


Fig. 4. Details of New Cell

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 MAILS

Practical use of the radio telephone for private conversation between individuals has been demonstrated by Donald H. Johnson of Euclid Beach Park of 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 8DGS. 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 8DGS 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 loudest European stations were F8AB, F8BF, G2NM and G2OD.

"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 telegraphic 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 2,428 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 centainly 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 goodness 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

TYPES OF SERVICE IN THE NEIGHBORHOOD OF NEW YORK				
	TYPE OF SERVICE	DISTANCE OF STATIONS	SERVICE AVAILABLE: MONTHS PER YEAR	SERVICE AVAILABLE: HOURS PER DAY
	LOCAL SERVICE	LESS THAN 100 MILES	11.7	24
LONG DISTANCE SERVICE	INTERMITTENT SERVICE	LESS THAN 500 MILES	9	8
LONG DISTANCE SERVICE	OCCASIONAL SERVICE	LESS THAN 2000 MILES	4	4
LONG DISTANCE SERVICE	"FREAK" SERVICE	OVER 3000 MILES	?	?

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 particularly 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-

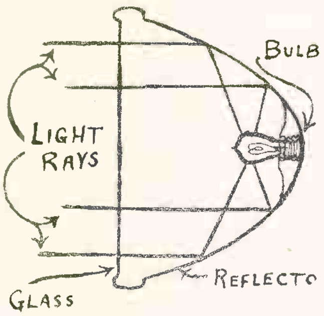


Fig. 2. How Headlight Focuses

vice" is generally to be had on a good receiving set with the right antenna. Real reception which is fairly reliable is obtainable up to 500 miles during the winter months in the evening. From October to June, it will usually be possible to hear such stations as soon as darkness has fallen, and they get better and better during the later hours of the evening. Roughly they are heard from seven o'clock in the evening to the early morning hours. It has therefore been estimated that service is O. K. from such stations, eight hours a night for about nine months of the year.

It is possible to get stations of this sort by daylight occasionally, and even in the summer months, but the values given are a conservative estimate of how useful such stations are to the regular broadcast listener who wants to pick up a station easily. Of course, many individual exceptions to these estimates occur, but on the average for the locality chosen, the reception will be about as stated. Some years are also better than others for radio in a given locality.

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 ringers, 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 transoceanic 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.

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.

When stations are from about five hundred miles to two thousand miles away, "occasional service" is obtainable, as Fig. 1. shows. During three of four of the coldest winter months, and during the late hours of the night (generally after ten or eleven o'clock), reception of such stations with fair intensity will be possible. Beyond two thousand miles, reception of fair character is more rare, being possible maybe ten or twenty days during the winter for an hour or two very late at night. This is "freak" service. On the other hand, using a very sensitive receiver, the more powerful stations having more than one-half kilowatt in the antenna can be heard across the United States not infrequently during the winter. Occasional and "freak" service depend on special transmitting conditions, and it is not possible to predict them ahead of time. It can only be stated that very cold weather (or times just before a change from or to, cold weather) together with the late evening hours in country locations tend to give phenomenal ranges.

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. To-day, 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 broadcast 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 ex-President Harding's message to the world from the high power trans-oceanic 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 telegraphs 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.

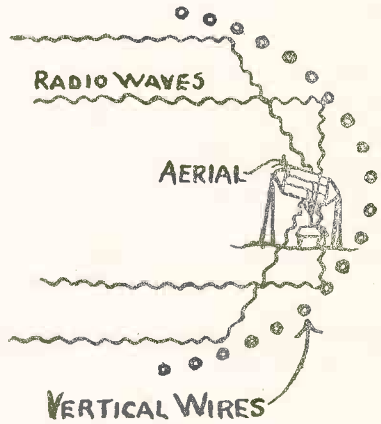


Fig. 3. A Radio Reflector

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

Continued on Page 16

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.

HOW FAR SHOULD A SET HEAR?

Continued from Page 15

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 selective broadcasting—that using directional transmission. That is, by the use of the higher frequencies or shorter wave lengths, and a suitable transmitting antenna system, a sort of searchlight beam of radio waves can be sent out which can be aimed in a certain direction. It can readily be received with full intensity by persons situated within the beam, but only with difficulty, or not at all, by all others.

Like a Car Head Light

The principal of this is illustrated in Fig. 2. Here we have a polished headlight reflector for an automobile. In the focus is placed an electric light bulb. Of course the rays of light coming from the filament spread out equally in all directions. When they strike the reflector, which is shaped like a parabola, they are re-directed in straight lines, which are parallel. That is why you get a beam of light which is almost as bright fifty feet away as it is near the lamp. Also notice that outside the beam the amount of light is small.

In the same way the radio waves are reflected. However, since the waves are spaced two to four hundred meters (yards) from peak to peak, it is not necessary to have a polished reflector. Instead it is found that a series of vertical rods or wires spaced six inches or so apart make a very good reflector. These are arranged on a line which is also a parabola as shown in Fig. 3. The sending aerial must be at the focus. It can easily be seen that a reflector of this kind is very large indeed and that is one reason why it is not used very often. Directional broadcasting may be combined with any of the forms described above, and may have some use in the future in the way of utilizing the broadcasters to feed those regions having the greatest number of listeners.

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.

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.

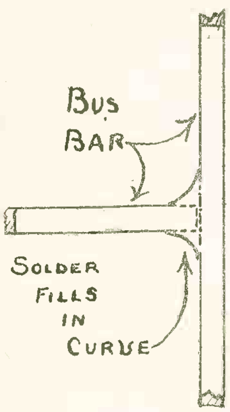


Fig. 1. A Fillet of Solder

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 leakage-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 too great a percentage 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.

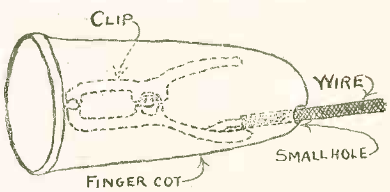


Fig. 2. A Fool-proof Connector

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. In order to get such a smooth effect, it is absolutely necessary to have the iron hot enough to bring the wires up to a fairly high temperature. The smaller the iron is the hotter it will have to be to raise the temperature of the wires to the right point. 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 500° 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

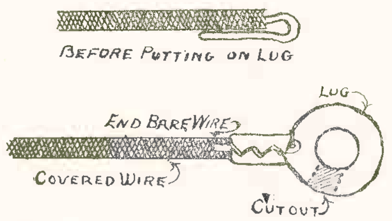


Fig. 3. Quick Change Connecter

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 panel, and then the heads are painted with black paint or black lustre.

Many experimenters are troubled with having loose wires around, leading from battery terminals. Where the ends of the wires are bare, there is always danger of short circuits, burned-out tubes, etc. A home-made substitute for the similar manufactured device, is a small spring clip soldered to the end of the wire, this clip being covered with either a rubber finger cot of proper size (procurable at drug stores), or else by a short piece of large size rubber gas tubing.

Cut for Insulation

This is illustrated in Fig. 2. Notice that a small hole is cut though the end of the finger cot to pass the wire. By pressing the clip right through the rubber it is easy to open its jaws and grab hold of an insulated wire, the end of which has been stripped of its covering.

Since the rubber will stretch, the clip can be adjusted inside the cover but it is prevented from touching other wires. Slips that open when the ends are pressed together should be used, as shown.

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 ear phones 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.

How Electrons Can Be Heard

Smallest Thing in Nature Makes a Racket in Our Ears

BY GUS BARTLETT

UNUSUAL sounds (as well as new noises) are constantly being carried by radio. We have heard nightingales singing from the depths of the forest; the swish of the sea has startled the inhabitants of the prairies; 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. Hull, 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.

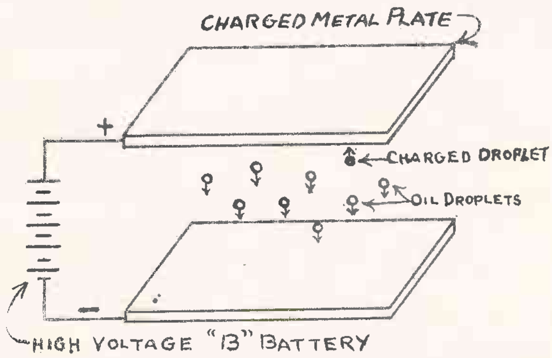


Fig. 1. How Electron Makes Oil Drop Dance

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 individaul 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 sub-division of electricity which is concieved 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 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 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 of oil are broken so fine that each one is only about three one hundred-thousands 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 lamp. When viewed through the telescope, they look like miniature stars, and these are seen slowly dropping across the field of vision.

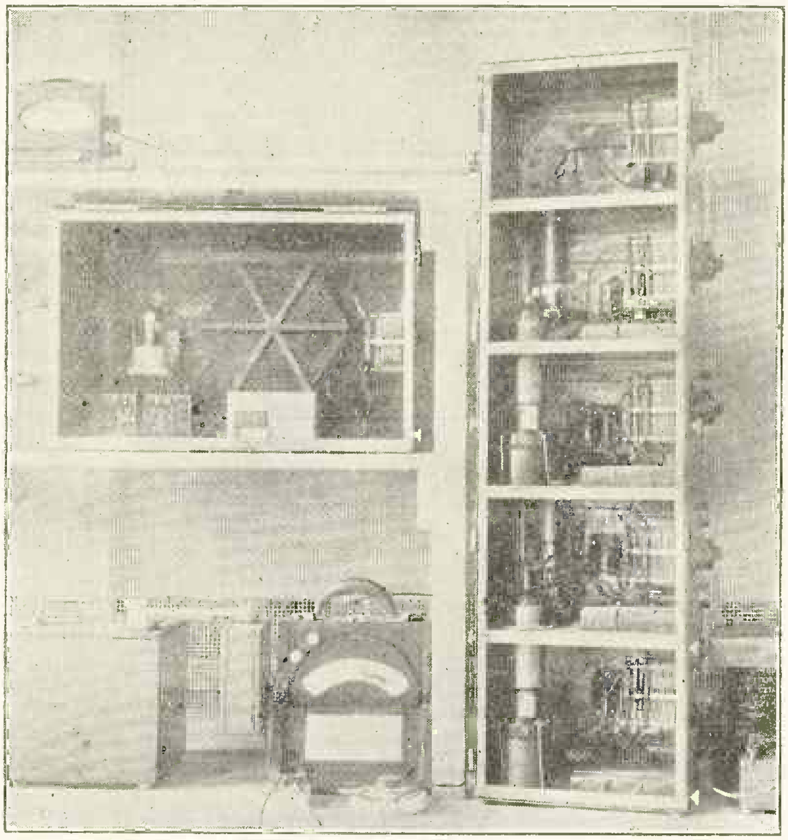


Fig. 2. This Apparatus Makes Electron Talk

Making Them Fall Upwards

Observe that each of the plates is connected to the terminals of 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 exactly 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 ½ 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.

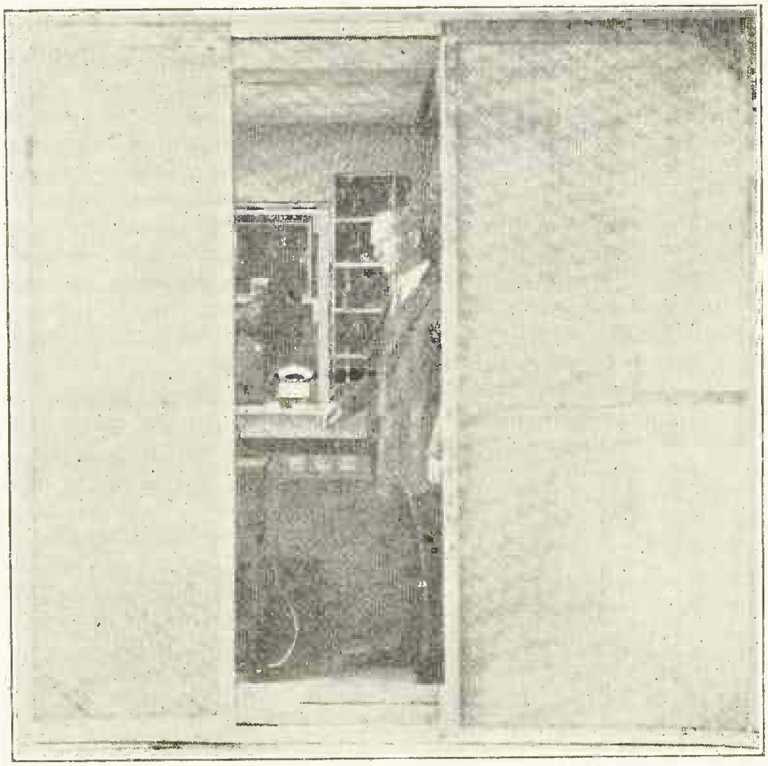


Fig. 3. Even Operator Must Be Shielded

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.

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 superpower 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 descretion.

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

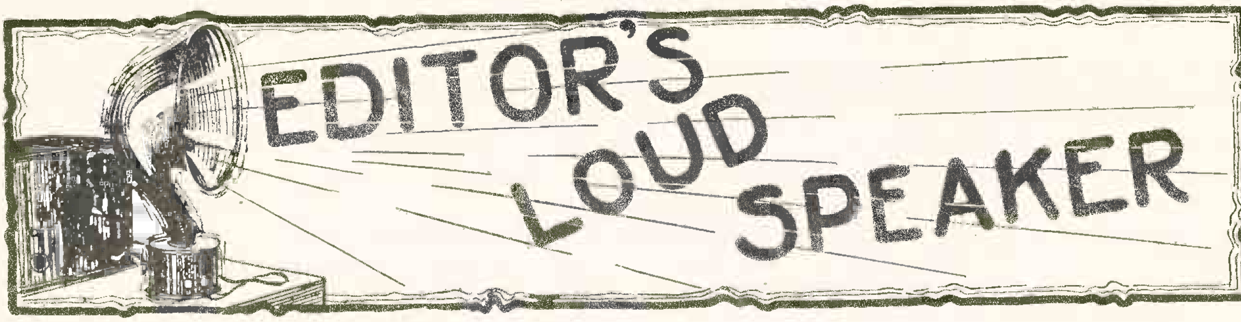
The latest feature on super-power Station CKAC's schedule is that of a huge band contest, open to all cities of the province of Quebec, outside of Montreal itself, for the award of a magnificent silver cup, which will be decided by popular vote cast by listeners-in. The conditions of the contest are 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 ran 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 ½ 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 far 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 Rabit 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 on the air.

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 acrimonus 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 party of the first part.

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 honest 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 is well known, the tendency of the radio frequency tubes, to break into oscillations or act as minature 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 potientiometer, 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 most sensitive adjustment of the set is when the grid bias is made as negative as possible without quite allowing the oscillations to start.

How the New Hook-Up Does it

The use of a potientiometer 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.

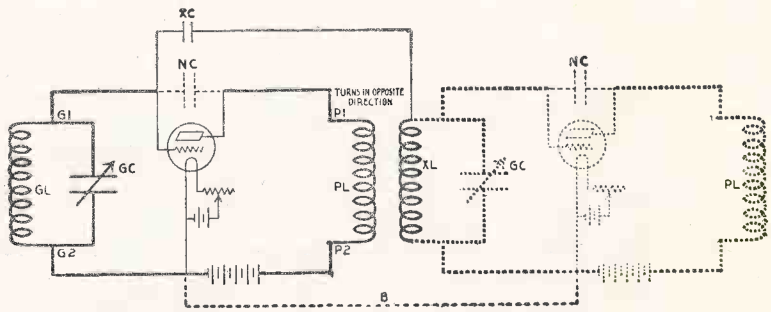


Fig. 1. Neutralizing Circuits of a Neutrodyne

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.

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.

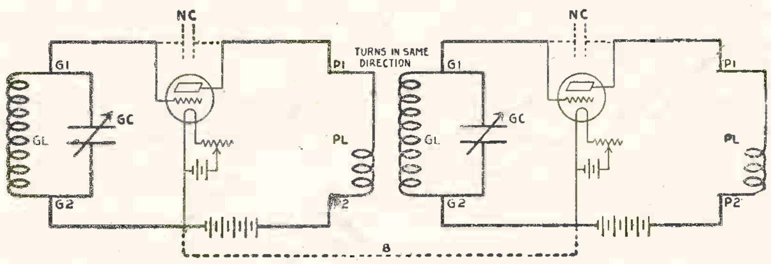


Fig. 2. Tuning Details of the New Hook-up

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.

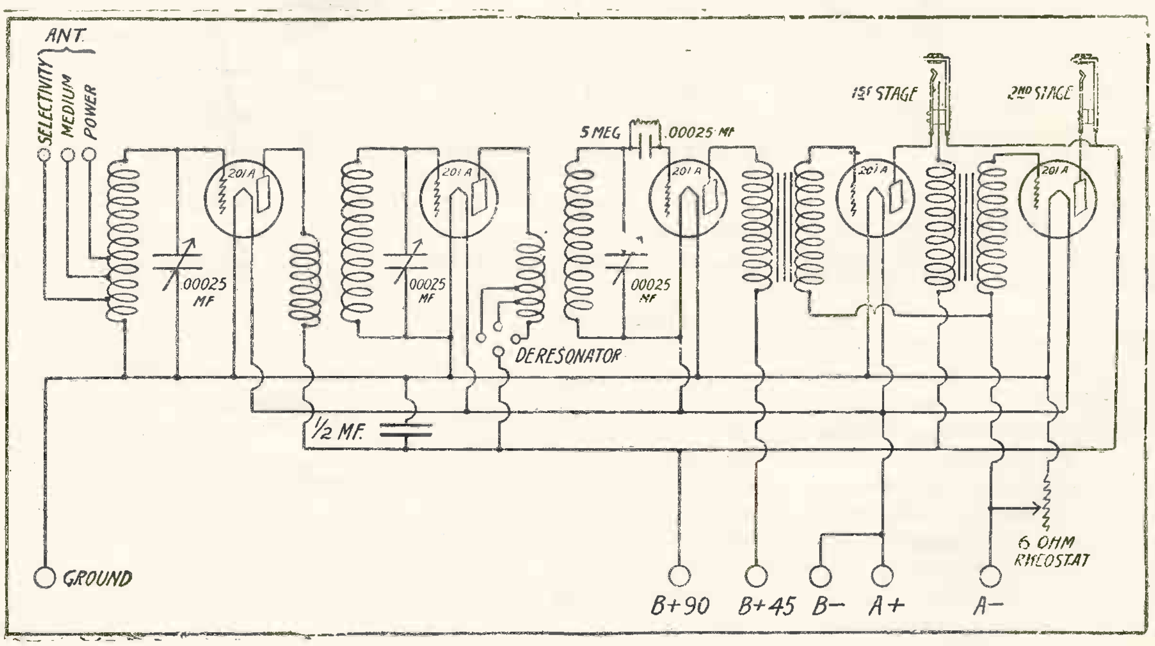


Fig. 3. Complete Wiring Diagram of Deresnadyne. Note Deresonator Between 2nd and 3rd Tube

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:

1 Panel 7x26, approximately,
1 Baseboard 9 inches wide to fit,
5 Tube sockets,
3 Adjustable condensers, .00025 mfd.
3 Spider web forms. These should be 4 inches diameter, although 5 inches may be used,
2 Audio transformers, ratio 3½ to 1,
1 Grid condenser, .00025 mfd,
1 Grid leak, preferably adjustable
1 Large fixed condenser, .1 to .5 mfd. (optional),
2 Jacks (one with three springs),
1 Rheostat, 6 ohms,
¼ lb. No. 28 insulated wire (double cotton or silk),
One tenth lb. No. 26 insulated wire (double cotton or silk),
7 Binding posts,
1 Six point tap switch,
Busbar, screws, solder, etc.

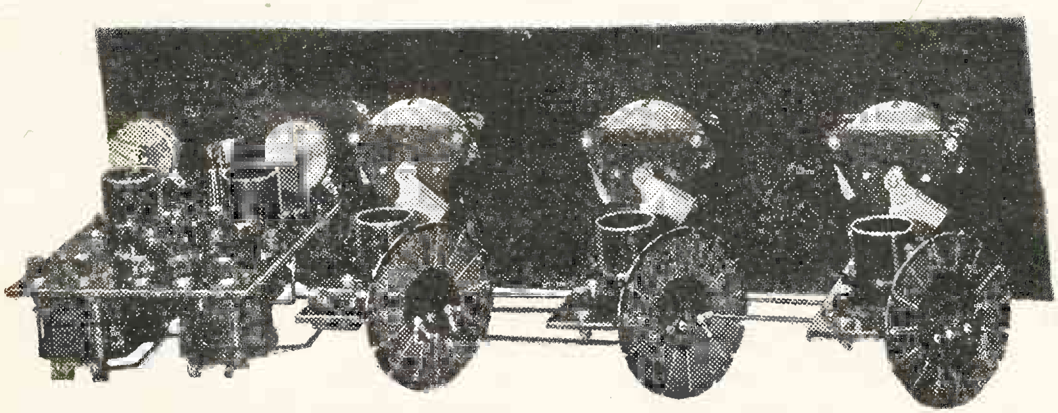


Fig. 4. Notice Three Spiderweb Radio Frequency Transformers

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 are 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 Slackputter, rushing up. "I know where ye are!"—*Radio Merchandising*

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.*

BANQUET TO FRENCH AMBASSADOR

The speeches incident to the banquet to be tendered the retiring French Ambassador, Jules A. Jusserand, on the evening of January 10, at 9:30, will be radioed by Station WRC of the Radio Corporation of America.

The most distinguished of those to give addresses on this occasion include Honorable Frederick F. 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 with five Presidents of this country.

READING BOOKS BY RADIO

Many people like to appear intelligent on the subject of the latest literature, but you have not the time to sit down and wade through all the output of the press. Such often find it advisable to look over the book reviews. Dr. Clifford Smyth, the journalist, newspaper and magazine editor, and literary advisor to several prominent publishing houses, will deliver the first of a series of international book reviews by radio from WJY, New York, on Friday, January 2.

SPIDER WEB NEUTRODYNE

Continued from Page 27

Thrown out of Resonance

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 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 goes to the primary of the first step of AF (audio frequency) amplification in the usual way. The secondary of this feeds to the grid of the first step. Its plate is connected to the second transformer, which in turn passes the program along to the grid of the second step. 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 minimun 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.

℞ DR RADIO PRESCRIBES.

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

Question. 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.

Fig. 1. Eliminates Both "A" and "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 direct to the "A" plus and "A" minus binding posts of the set. No adjustment is needed, as the rheotsat 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-Liminator 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 miliamperes, depending on the "B" battery voltage and also on whether you use a "C" battery or not. That means 10 or 15 miliamps 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 what is actually on the tubes when the tester is removed.

Fig. 2. Allows Adjustment of Voltage

UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

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

Station	W.L.	K.C.	W.P.
KDKA—Westinghouse Elec. & Mfg. Co., East Pittsburgh	326	920	1000
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O.	270	1110	500
KDPT—Southern Electrical Co., San Diego, Cal	244	1230	100
KDYL—Salt Lake Telegram, Salt Lake City, Utah	360	833	100
KDYM—Savoy Theatre, San Diego, Cal	280	1070	100
KDYQ—Oregon Institute of Technology, Portland, Ore	360	834	100
KDZB—Frank E. Seifert, Bakersfield, Cal	240	1250	100
KDZE—The Rhodes Co., Seattle, Wash	270	1110	100
KDZF—Auto. Club of So. Cal., Los Angeles, Cal	278	1080	500
KFAB—Buick Auto Co., Lincoln, Neb	240	1250	200
KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz	360	908	100
KFAE—State College of Washington, Pullman, Wash	330	910	500
KFAF—Western Radio Corp., Denver, Col	360	833	500
KFAJ—University of Colorado, Boulder, Col	360	833	100
KFAQ—City of San Jose, San Jose, Cal	360	833	250
KFAR—Studio Lighting Service Co., Hollywood, Cal	227	1320	100
KFAU—Boise High School, Boise, Idaho	270	1110	150
KFBB—F. A. Buttrey & Co., Havre, Mont	275	1090	100
KFBK—Kimball-Upson Co., Sacramento, Cal	283	1060	100
KFCF—Frank A. Moore, Walla Walla, Wash	360	833	100
KFCL—Los Angeles Union Stockyards, Los Angeles, Cal	236	1270	500
KFCM—Richmond Radio Shop, Richmond, Cal	244	1220	100
KFCZ—Omaha Central High School, Omaha, Neb	259	1160	100
KFDH University of Arizona, Tucson, Ariz	268	1120	150
KFDM—Magnolia Petroleum Co., Beaumont, Texas	306	980	500
KFDX—Frst Baptist Church, Shreveport, La	250	1200	100
KFDY—So. Dakota State College, Brookings. So. Dakota	273	1100	100
KFEL—Winner Radio Corp., Denver, Col	254	1180	100
KFEQ—J. L. Scroggin, Oak, Neb	268	1120	100
KFEX—Augsburg Seminary, Minneapolis, Minn	261	1150	100
KFFV—Graceland College, Lamoni, Iowa	360	834	100
KFFY—Louisiana College, Alexandria, La	275	1090	100
KFGC—Louisiana State University, Baton Rouge, La	254	1180	100
KFGD—Chickasha Radio & Elec. Co	248	1195	200
KFGH—Leland Stanford Jr. Univ., Stanford Univ., Cal	273	1100	250
KFGJ—Mo. Natl. Guard, 138th Infantry, St. Louis, Mo	265	1130	100
KFGX—First Presbyterian Church, Orange, Tex	250	1200	50C
KFGZ—Emmanuel Missionary Col., Berrien Springs, Mich	268	1120	500
KFHD—Utz Elec. Shop Co., St. Joseph, Mo	226	1365	100
KFHJ—Fallon & Co., Santa Barbara, Cal	360	833	100
KFHR—Star Elec. & Radio Co., Seattle, Wash	263	1140	100
KFI—Earle C. Anthony, Inc., Los Angeles, Cal	469	640	1500
KFIF—Benson Polytechnic Institute, Portland, Ore	360	833	100
KFIX—R. C., Jesus Christ of L. D.Stas., Ind'p'nd'n'e,Mo	268	1120	250
KFIZ—D'ly C'm'nw'h & S. Radio C'p., Fond d'L'c, Wis	273	1100	100
KFJC—Seattle Post Intellegencer, Seattle, Wash	270	1110	100
KFJF—National Radio Mfg. Co., Oklahoma, Okla	261	1150	225
KFJK—Delano Radio & Electric Co., Bristow, Okla	233	1290	100
KFJM—University of N. Dakota, Grand Forks, N. Dak	280	1070	100
KFKB—Brinkley-Jones Hospital Assn., Milford, Kans	286	1070	500
KFKQ—Conway Radio Laboratories, Conway, Ark	250	1200	100
KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb	285	880	1000
KFLE—National Education Service, Denver, Col	268	1110	100
KFLR—Korber Wirelss Station, Albuquerque, N. Mexico	254	1180	100
KFLZ—Atlantic Automobile Club, Atlantic, Ia	273	1098	100
KFLV—Swedish Evang. Mission Church, Rockford, Ill	229	1310	100
KFMQ—Univ. of Arkansas, Fayetteville, Ark	263	1140	100
KFMX—Carleton College, Northfield, Minn	283	1071	500
KFNF—Henry Field Seed Co., Shenandoah, Iowa	266	1145	500
KFOA—The Rhodes Co., Seattle, Wash	454	660	500
KFOC—First Christian Church, Whittier, Cal	236	1290	100
KFON—Echophone Radio Shop, Long Beach, Cal	234	1290	100
KFOU—Hommel Mfg. Co., Richmond, Cal	254	1180	100
KFOX—Technical High School, Omaha, Neb	248	1210	100
KFPG—Garretson & Dennis, Los Angeles, Cal	238	1260	100
KFPL—C. C. Baxter, Dublin, Texas	252	1190	100
KFPO—Colorado Nat'l Guard, Denver, Col	231	1300	500
KFPR—L. A. County Forestry Dept., Los Angeles, Cal	231	1300	500
KFPT—The Deseret News, Salt Lake City, Utah	360	833	500
KFPX—First Presbyterian Church, Pine Bluff, Ark	242	1240	100
KFPY—Symons Investment Co., Spokane, Wash	283	1060	100
KFBG—Search Light Publishing Co., Fort Worth, Tex	254	1180	100
KFQC—Kidd Brothers Radio Shop, Taft, Cal	227	1320	100
KFQD—Chovin Supply Co., Anchorage, Alaska	280	1070	100
KFQG—Southern Cal. Radio Assn., Los Angeles, Cal	226	1330	100
KFGH—Radio Service Co., Burlingame, Cal	231	1298	100
KFQI—Thomas H. Ince Corp., Culver City, Cal	234	1280	100
KFQM—Texas Highway Bulletin, Austin, Texas	268	1120	100
KFQU—W. Riker, Holy City, Cal	234	1280	100
KFQV—Omaha Grain Exchange, Omaha, Neb	231	1300	100
KFQX—Alfred M. Hubbard, Seattle, Wash	233	1290	500
KFQZ—Taft Radio Co., Hollywood, Cal	240	1250	250
KFRA—Marvin S. Olsen, Carver, Minn	240	1250	100
KFRB—Hall Brothers, Beeville, Texas	248	1210	250
KFRN—United Churches of Olympia, Olympia, Wash	220	1360	100
KFSG—Echo Park Evangelistic Ass'n, Los Angeles, Cal	278	1069	500
KGO—General Electric Co., Oakland, Cal	312	960	1000
KGU—Marion A. Mulreny, Honolulu, Hawaii	360	833	500
KGW—Portland Morning Oregonian, Portland, Ore	492	610	500
KHJ—Times-Mirror Co., Los Angeles, Cal	395	760	500
KHQ—Louis Wasmer, Seattle, Wash	360	833	100
KJR—Northwest Radio Service Co., Seattle, Wash	270	1110	100
KJS—Bible Institute of Los Angeles, Los Angeles, Cal	360	833	750
KLS—Warner Brothers, Oakland, Cal	360	833	250
KLX—Tribune Publishing Co., Oakland, Cal	508	590	500
KLZ—Reynolds Radio Co., Denver, Col	283	1060	500
KNT—Grays Harbor Radio Co., Aberdeen, Wash	263	1140	250
KNV—Radio Supply Co., Los Angeles, Cal	256	1188	100
KNX—Los Angeles Express, Los Angeles, Cal	337	890	500
KOA—General Electric Co., Denver, Col	323	930	1500
KOB—N. M. C. of Agri. & Mech. Arts, State Col., N. M.	360	833	500
KOP—Detroit Police Dept., Detroit, Mich	286	1050	500
KPO—Hale Bros., San Francisco, Cal	422	710	500
KQV—Doubleday-Hill Electric Co., Pittsburgh, Pa	275	1090	500
KSD—Post Dispatch, St. Louis, Mo	545	550	500
KTHS—New Arlington Hotel, Hot Springs, Ark	375	....	500
KTW—First Presbyterian Church, Seattle, Wash	360	833	750
KUO—Examiner Printing Co., San Francisco, Cal	360	833	150
KUS—City Dye Works & Laundry Co., L. Angeles, Cal	360	833	100
KUVQ—Kreetan Co., Johnswood Drummond Island, Mich	450	666	1000
KWG—Portable Wireless Tel. Co., Stockton, Cal	360	833	100
KWH—Los Angeles Examiner, Los Angeles, Cal	360	833	500
KYQ—Electric Shop, Honolulu, Hawaii	270	1110	100
KYW—Westinghouse Elec. & Mfg. Co., Chicago, Ill	535	560	1500
KZM—Western Radio Institute, Oakland, Cal	360	833	100
KZKZ—Electrical Supply Co., Manila, P. I	270	1110	100
KZN—The Desert News, Salt Lake City, Utah	360	834	500
WAAB—Valdemar Jensen, New Orleans, La	268	1120	100
WAAC—Tulane University, New Orleans, La	360	833	400
WAAF—Chicago Daily, Drovers Journal, Chicago, Ill	278	1080	200
WAAM—I. R. Nelson Co., Newark, N. J	263	1140	250
WAAW—Omaha Grain Exchange, Omaha, Neb	286	1050	500
WAAZ—Hollister-Miller Motor Co., Emporia, Kans	360	833	100
WABE—Y. M. C. A., Washington, D. C	283	1060	100
WABI—Bangor Ry. & Elec. Co., Bangor, Me	240	1250	100
WABL—Conn. Agri. College, Storrs, Conn	283	1060	100
WABM—F. E. Doherty Auto. & R'dio Co., Saginaw, M.	254	1180	100
WABP—Robert F. Weinig, Dover, Ohio	265	1130	100
WABT—Holliday-Hall Elec. Engineers, Washington, Pa	252	1190	100
WABU—Victor Talking Machine Co., Camden, N. J	225	1330	100
WABX—Henry B. Joy, Mount Clemens, Mich	270	1110	150
WAHG—A. H. Grebe & Co., Richmond Hill, N. Y	316	950	500
WBAA—Purdue University, West Lafayette, Ind	283	1060	250
WBAD—Sterling Electric Co., Minneapolis, Minn	360	833	100
WBAK—Penn. State Dept. of Police, Harrisburg, Pa	400	750	500
WBAN—Wireless Phone Corp., Paterson, N. J	244	1230	100
WBAP—Wortham-Carter Pub. Co., Fort Worth, Tex	476	630	1000
WBAV—Erner & Hopkins Co., Columbus, Ohio	390	770	500
WBAW—Marietta College, Marietta, Ohio	246	1220	250
WBAX—John H. Stenger, Jr., Wilkes-Barre, Pa	254	1180	100
WBAY—American Tel. & Tel. Co., New York, N. Y	492	610	500
WBBF—Georgia School of Technology, Atlanta, Ga	270	1110	500
WBBG—Irving Vermilya, Mattapoisett, Mass	248	1210	500
WBBL—Grace Covenant Church, Richmond, Va	283	1060	100
WBBM—H. Leslie Atlass, Chicago, Ill	226	1330	200
WBBR—Peoples' Pulpit Ass'n, Roseville, N. Y	244	1230	100
WBL—T. & H. Radio Co., Anthony, Kansas	254	1180	100
WBN—Ott Radio, Inc., La Crosse, Wis	244	1230	500
WBR—Penn. State Police, Butler, Pa	286	1050	250
WBS—D. W. May, Inc., Newark, N. J	360	833	100
WBT—Southern Radio Corp., Charlotte, N. C	360	833	500
WBU—City of Chicago, Chicago, Ill	286	1050	500
WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass	337	890	1500
WCAD—St. Lawrence University, Canton, N. Y	263	1140	250
WCAE—Kaufmann & Baer Co., Pittsburgh, Pa	461	650	500
WCAH—Entrekin Electric Co., Columbus, Ohio	286	1050	100
WCAJ—Nebraska Wesleyan Univ., Univ. Place, Neb	280	1070	500
WCAL—St. Olaf College, Northfield, Minn	360	833	500
WCAP—Chesapeake & Potomac Tel. Co., Washingt'n, D. C.	469	640	500
WCAR—Alamo Radio Elec. Co., San Antonio, Texas	360	833	100
WCAS—W. H. Dunwoody Ind. Inst., Minneapolis, Minn	280	1220	100
WCAT—S. Dakota State Sch. of Mines, Rapid City, S. D.	240	1250	100
WCAU—Durham & Co., Philadelphia, Pa	278	1080	500
WCAX—Univ. of Vermont, Burlington, Vt	360	834	100
WCAY—Milwaukee Civic Broad. Assn., Milwaukee, Wis	266	1130	250
WCBC—Univ. of Michigan, Ann Arbor, Mich	229	1310	200
WCBD—Wilbur G. Voliva, Zion, Ill	345	870	500
WCBN—Chicago, Ill.	266	....	500
WCBI—Nicoll, Duncan & Rush, Bemis, Texas	226	1330	100
WCBQ—First Baptist Church, Nashville, Tenn	236	1270	100
WCBT—Clark University, Worcester, Mass	238	1260	250
WCCO—Washburn-Crosby Co., Minneapolis, Minn	417	720	500
WCK—Stix, Baer & Fuller Dry Goods Co., St. Louis, Mo.	360	833	100
WCX—Detroit Free Press, Detroit, Mich	517	580	500
WCKB—E. Richard Hall, St. Petersburg, Fla	266	1130	500
WCM—Texas Mkts. & Warehouse, Dept., Austin, Tex	268	1120	250
WDAE—Tampa Daily Times, Tampa, Fla	273	1100	250
WDAF—Kansas City Star, Kansas City, Mo	411	730	500
WDAG—J. Laurance Martin, Amarillo, Texas	263	1140	100
WDAH—Trinity Methodist Church, El Paso, Texas	268	1120	100
WDAR—Lit Brothers, Philadelphia, Pa	395	760	500
WDAU—Slocum & Kilburn, New Bedford, Mass	360	833	100
WDAX—First National Bank, Centerville, Iowa	360	833	100
WDBH—C. T. Sherer, Co., Worcester, Mass	268	1120	100
WDBR—Tremont Temple Baptist Church, Boston, Mass	256	1170	100
WDBY—North Shore Cong. Church, Chicago, Ill	258	1160	500
WDWF—D. W. Flint, Providence, R. I	286	1050	500
WEAA—Frank D. Fallon, Flint, Mich	234	1280	100
WEAF—Amer. Tel. & Tel. Co., New York, N. Y	492	610	1500

Station	W.L.	K.C.	W.P.
WEAH—Wichita Board of Trade, Wichita, Kas	280	1070	100
WEAI—Cornell University, Ithaca, N. Y	286	1050	500
WEAJ—Univ. of S. Dakota, Vermillion, S. Dakota	283	1060	100
WEAM—Borough of N. Plainfield, N. Plainfield, N. J	261	1150	250
WEAN—Shepard Co., Providence, R. I	273	1100	100
WEAO—Ohio State University, Columbus, Ohio	360	834	500
WEAP—Mobile Radio Co., Mobile Ala	263	1140	100
WEAS—Hecht Co., Washington, D. C	360	833	100
WEAU—Davidson Bros. Co., Sioux City, Iowa	275	1090	100
WEAY—Iris Theatre, Houston, Texas	360	833	500
WEB—Benson Radio Co., St. Louis, Mo	273	1130	500
WEBH—Edgewater Beach Hotel Co., Chicago, Ill	370	810	1000
WEBJ—Third Avenue Ry. Co., New York, N. Y	273	1100	500
WEBL—R. C. A. United States (portable)	226	1330	100
WEBW—Beloit College, Beloit, Wis	268	1120	500
WEEI—Edison Elec. Ill'm'n't'g Co., Boston, Mass	303	990	500
WEV—Hurlburt-Still Electric Co., Houston, Texas	263	1140	100
WEW—St. Louis University, St. Louis, Mo	280	1070	100
WFAA—Dallas News & Dallas Journal, Dallas, Tex	476	630	500
WFAB—Carl F. Woese, Syracuse, N. Y	234	1280	100
WFAN—Hutchinson. Elec. Serv. Co., Hutchinson, Minn	286	1050	100
WFAV—Univ. of Nebraska, Dept. of E. Eng., Lincoln, Neb	261	1250	250
WFBB—Eureka College, Eureka, Ill	261	1250	150
WFBG—William F. Gable Co., Altoona, Pa	261	1150	100
WFBH—Concourse Radio Corp., New York. N. Y	273	1100	500
WFBI—Galvin Radio Supply Co., Camden, N J	236	1270	100
WFBK—Dartmouth College, Hanover, N. H	256	1170	100
WFBL—Onondaga Hotel, Syracuse, N. Y	286	1050	100
WFBM—Merchants Heat & Light Co., Indianapolis, Ind	268	1120	250
WFBN—Radio Sales & Service Co., Bridgewater, Mass	226	1330	200
WFBR—5th Infantry, Maryland, N. G., Baltimore, Md	254	1180	100
WFBW—Ainsworth-Gates Radio Co., Cincinnati, Ohio	309	970	750
WFI—Strawbridge & Clothier, Philadelphia, Pa	395	760	500
WGAQ—Youree Hotel, 406 Market St., Shreveport, La	263	1140	100
WGAY—Northwestern Radio Co., Madison, Wis	360	833	100
WGAZ—South Bend Tribune, South Bend, Ind	275	1090	250
WGBS—Gimbel Brothers, New York, N. Y	316	950	1000
WGI—Am. R'dio & Res'ch Corp., Medf'd Hillside, Mass	360	833	100
WGL—Thomas F. J. Rowlett, Philadelphia, Pa	360	833	500
WGN—Drake Hotel (Whitestone Co.), Chicago, Ill	370	710	1000
WGR—Federal Manufacturing Co., Buffalo, N. Y	319	940	750
WGY—General Electric Co., Schenectady, N. Y	380	790	1000
WHA—University of Wisconsin, Madison, Wis	275	1090	500
WHAA—State Univ. of Iowa, Iowa City, Iowa	484	620	500
WHAD—Marquette University, Milwaukee, Wis	280	1070	100
WHAG—University of Cincinnati, Ohio	233	1290	100
WHAM—University of Rochester, Rochester, N. Y	283	1060	100
WHAR—Seaside Hotel, Atlantic City, N. J	275	1090	200
WHAS—Courier-Journal & Louisville Times, Louisville, Ky	400	750	500
WHAV—Wilmington Elec. Spec. Co., Wilmington, Del	266	1130	100
WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y	380	790	500
WHB—Sweeney School Co., Kansas City, Mo	411	730	500
WHK—Radiovex Co., Cleveland, Ohio	283	1060	100
WHN—Loew's State Theatre Bldg., New York, N. Y	360	833	500
WHO—Bankers Life Co., Des Moines, Iowa	526	570	500
WHQ—E. M. Tellefson, Mackinac Island, Mich	300	999	200
WIAC—Galveston Tribune, Galveston, Texas	360	833	100
WIAD—Howard R. Miller, Philadelphia, Pa	234	1180	100
WIAK—Journal-Stockman Co., Omaha, Neb	278	1080	250
WIAR—Paducah Evening Sun, Paducah, Ky	360	833	100
WIAS—Home Electric Co., Burlington, Iowa	283	1060	100
WIK—K. L. Electric Co., McKeesport, Pa	234	1280	100
WIP—Gimbel Brothers, Philadelphia, Pa	508	590	500
WJAB—American Electric Co., Lincoln, Neb	229	1310	100
WJAD—Jackson's Radio Eng. Laboratories, Waco, Tex	360	833	150
WJAG—Norfolk Daily News, Norfolk, Neb	283	1060	250
WJAN—Peoria Star, Peoria, Ill	280	1070	100
WJAR—The Outlet Co., Providence, R. I	360	833	500
WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa	286	1050	500
WJAX—Union Trust Co., Cleveland, Ohio	390	770	500
WJAZ—Zenith Radio Corp., Chicago, Ill. (portable)	268	1120	100
WJH—Wm. P. Boyer Co., Washington, D. C	273	1100	100
WJJD—Supreme Lodge Moose, Mooseheart, Ill	278	1080	500
WJY—R. C. A., New York, N. Y	405	660	500
WJZ—Broadcast Central, New York, N. Y	454	660	500
WKAA—H. F. Parr, Cedar Rapids, Iowa	278	1080	100
WKAF—W. S. Radio Supply Co., Wichita Falls, Tex	360	833	100
WKAQ—Radio Corp. of Porto Rico, San Juan, P. R	360	833	500
WKAR—Michigan Agr. College, E. Lansing, Mich	280	1070	500
WKY—WKY Radio Shop, Oklahoma, Okla	360	833	500
WLAG—Cutting & Radio Wash. Corp., Minneapolis, Minn	417	720	500
WLAH—Samuel Woodworth, Syracuse, N. Y	360	834	500
WLAL—Naylor Electric Co., Tulsa, Okla	360	833	100
WLAN—Putnam Hardware Co., Houlton, Me	283	1060	250
WLAW—Police Dept., New York City, N. Y	360	834	500
WLBL—Wisconsin Dept. of Markets, Stevens Pt., Wis	278	1080	500
WLS—Sears, Roebuck & Co., Chicago, Ill	345	870	500
WLW—Crosley Radio Corp., Cincinnati, O	423	710	1000
WMAC—Clive B. Meredith, Cazenovia, N. Y	275	1090	100
WMAF—Round Hills Radio Corp., Dartmouth, Mass	360	833	500
WMAH—General Supply Co., Lincoln, Neb	254	1180	100
WMAK—Norton Laboratories, Lockport, N. Y	273	1100	500
WMAP—Utility Battery Service, Easton, Pa	246	1220	150
WMAQ—Chicago Daily News, Chicago, Ill	448	670	500
WMAT—Paramount Radio Corp., Duluth, Minn	226	1130	250
WSY—Alabama Polytechnic Institute, Auburn, Ala	250	1200	500
WMAY—Kingshighway Presbytern Church, St. Louis, Mo	280	1070	100
WMAZ—Mercer University, Macon, Ga	261	1150	100
WMC—"Commercial Appeal," Memphis, Tenn	500	600	500
WMH—Ainsworth-Gates Radio Co., Cincinnati, Ohio	309	970	750
WMU—Doubleday-Hill Elec. Co., Washington, D. C	261	1150	100
WNAC—Shepard Stores, Boston, Mass	278	1080	100
WNAD—University of Oklahoma, Norman, Okla	254	1180	100
WNAP—Wittenberg College, Springfield, Ohio	275	1090	100
WNAT—Lenning Brothers Co., Philadelphia, Pa	250	1200	100
WNAX—Dakota Radio Apparatus Co., Yankton, S. D	244	1230	100
WNYC—City of New York, New York, N. Y	526	570	1000
WOAC—Pagan Organ Co., Lima, Ohio	265	1130	150
WOAI—Southern Equipment Co., San Antonio, Tex	384	780	500
WOAL—William E. Woods, Webster Groves, Mo	229	1310	100
WOAN—Vaughn Conserv't'y Music, Lawrenceb'rg, Tenn	360	833	200
WOAR—Henry P. Lundskow, Kenosha, Wis	229	1310	100
WOAV—Penn. Nat'l Guard, 2d Bat., 112th Inf., Erie, Pa	242	1240	100
WOAW—Woodmen of the World, Omaha, Neb	526	570	500
WOAX—Franklyn J. Wolff, Trenton, N. J	240	1250	500
WOI—Iowa State College, Ames, Iowa	360	833	500
WOO—John Wanamaker, Philadelphia, Pa	508	590	500
WOQ—Unity School of Christianity, Kansas City, Mo	278	1080	500
WOR—L. Bamberger & Co., Newark, N. J	405	740	500
WOS—Mo. State Marketing Bureau, Jefferson City, Mo	441	680	500
WPAB—Pennsylvania State College, State College, Pa	283	1060	500
WPAC—Donaldson Radio Co., Okmulgee, Okla	360	833	100
WPAH—Wisconsin Dept. of Markets, Waupaca, Wis	360	833	500
WPAJ—New Haven, Conn	268	1120	100
WPAK—North Dakota, Agri Col., Agri. College, N. D	283	1060	250
WPAL—Avery & Loeb Elec. Co., Columbus, Ohio	286	1050	100
WPAM—Auerbach & Guettel, Topeka, Kansas	275	1090	100
WPAZ—John R. Koch (Dr.), Charleston, W. Va	273	1100	100
WQAA—Horace A. Beale, Jr., Parkesburg, Pa	220	1360	500
WQAC—E. B. Gish, Amarillo, Texas	234	1280	100
WQAM—Electrical Equipment Co., Miami, Fla	268	1120	100
WQAN—Scranton Times, Scranton, Pa	250	1120	100
WQAO—Calvary Baptist Church, New York, N. Y	360	833	100
WQAQ—Abilene Daily Reporter, Abilene, Tex	360	833	100
WQAS—Prince-Walter Co., Lowell, Mass	265	1130	100
WQAX—Radio Equipment Co. Peoria, Ill	248	1210	100
WQJ—Calument Rainbo Broadcasting Co., Chicago, Ill	448	670	500
WRAL—No. States Power Co., St. Croix Falls, Wis	248	1210	100
WRAM—Lombard College, Galesburg, Ill	244	1230	250
WRAV—Antioch College, Yellow Springs, Ohio	242	1240	100
WRAX—Flexon's Garage, Gloucester City, N. J	268	1120	100
WRBC—Immanuel Lutheran Church, Valparaiso, Ind	278	1080	500
WRC—Radio Corp. of America, Washington, D. C	469	640	500
WREA—Reo Motor Car Co., Lansing, Mich	288	1040	500
WRK—Doren Bros. Electric Co., Hamilton, Ohio	270	1110	200
WRL—Union College, Schenectady, N. Y	360	833	500
WRM—University of Illinois, Urbana, Ill	273	1100	500
WRW—Tarrytown Radio Research Lab., Tarrytown, N. Y	273	1100	500
WSAB—State Teachers College, Cape Girardeau, Mo	275	1090	100
WSAC—Clemson Agri. Col., Clemson College, S. C	360	833	500
WSAD—J. A. Foster Co., Providence, R. I	261	1150	100
WSAH—A. G. Leonard, Jr., Chicago, Ill	248	1210	500
WSAI—U. S. Playing Card Co., Cincinnati, Ohio	309	970	1000
WSAJ—Grove City College, Grove City, Pa	254	1180	250
WSAP—7th Day Adventist Church, New York, N. Y	263	1140	250
WSAR—Doughty & Welch Elec. Co., Fall River, Mass	254	1181	100
WSAV—Clifford W. Vick Radio Const. Co., Houston, Tex	360	833	100
WSAY—Chamber of Commerce, Port Chester, N. Y	233	1304	100
WSAX—Chicago Radio Laboratory, Chicago, Ill	448	670	1000
WSB—Atlanta Journal, Atlanta, Ga	428	700	500
WSK—Reiss Steamship Co., Sheboygan, Wis	300	999	1000
WSL—J. & M. Electric Co., Utica, N. Y	273	1100	100
WSOE—School of Eng. of Milwaukee, Milwaukee, Wis	246	1220	100
WSY—Alabama Power Co., Birmingham, Ala	360	833	500
WTAB—Fall River Daily Hearld, Fall River, Mass	248	1130	100
WTAC—Pennsylvania Traffic Co., Johnstown, Pa	275	1090	150
WTAM—The Willard Storage Battery Co., Cleveland, O	489	770	1500
WTAN—Orndorff Radio Shop, Mattoon, Ill	240	1250	100
WTAQ—S. H. Van Gorden & Son, Ossea, Wis	254	1180	100
WTAR—Reliance Electric Co., Norfolk, Va	261	1150	100
WTAS—Charles E. Erbstein, Elgin, Ill., near	286	1050	500
WTAT—Edison Electric Illum. Co., Boston, Mass	246	1220	100
WTAW—Agri. & Mech. College, College Station, Texas	270	1110	250
WTAY—Oak Leaves Broadcasting Station, Oak Park, Ill	283	1330	500
WTG—Kansas State Agri. Col., Manhattan, Kas	485	620	1000
WWAD—Wright & Wright, Inc., Philadelphia, Pa	250	1200	500
WWAE—Alamo Ball Room Joliet, Ill	242	1240	500
WWAF—Galvin Radio Sup. Co., Camden, N. J	236	1260	500
WWAO—Michigan College of Mines, Houghton, Mich	244	1230	250
WWI—Ford Motor Co., Dearborn, Mich	273	1100	500
WWJ—Detroit News, Detroit, Mich	517	580	500
WWL—Loyola University, New Orleans, La	268	1120	100