February 15, 1925
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RADIO PROGRESS

Reg. U. S. Pat. Off.

"Always Abreast of the Times"

In This Issue:

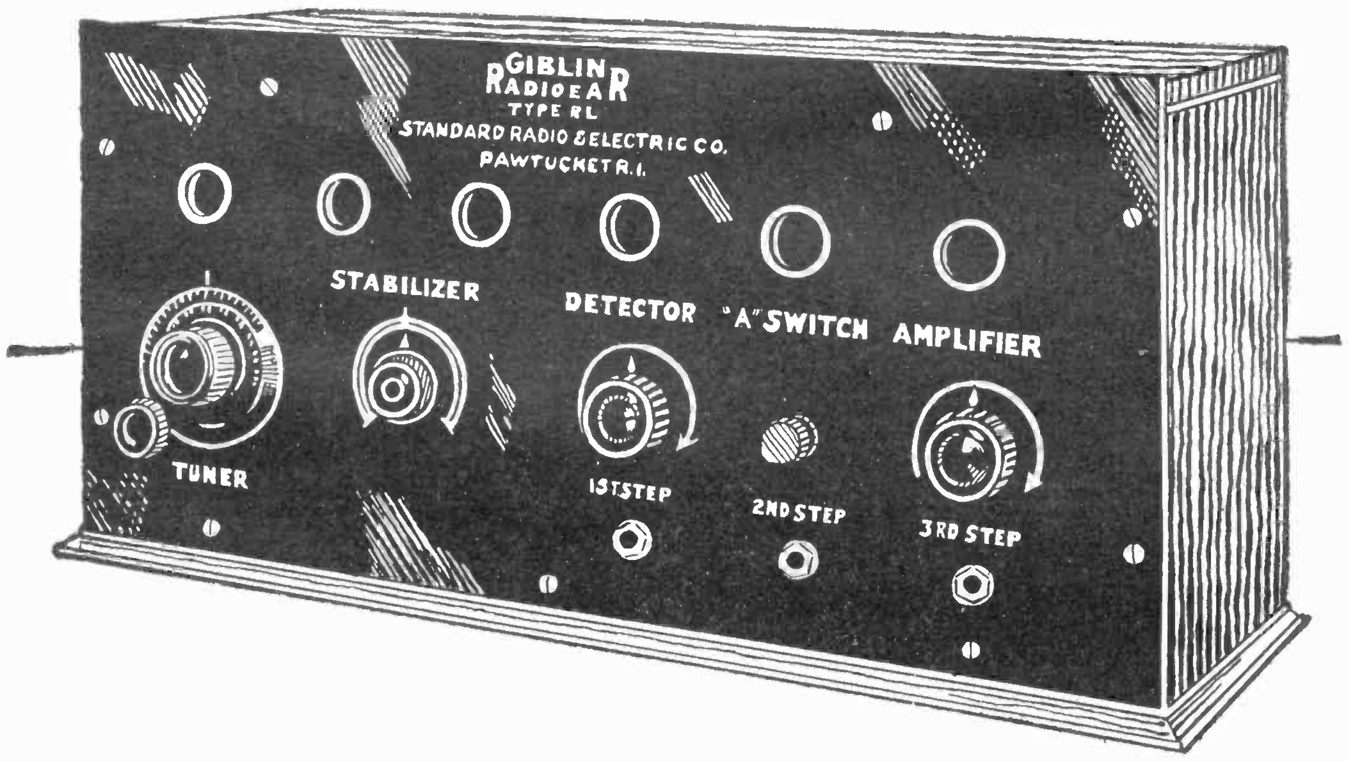
YOU WILL UNDERSTAND THIS MAGAZINE---AND WILL LIKE IT

PUBLISHED TWICE A MONTH

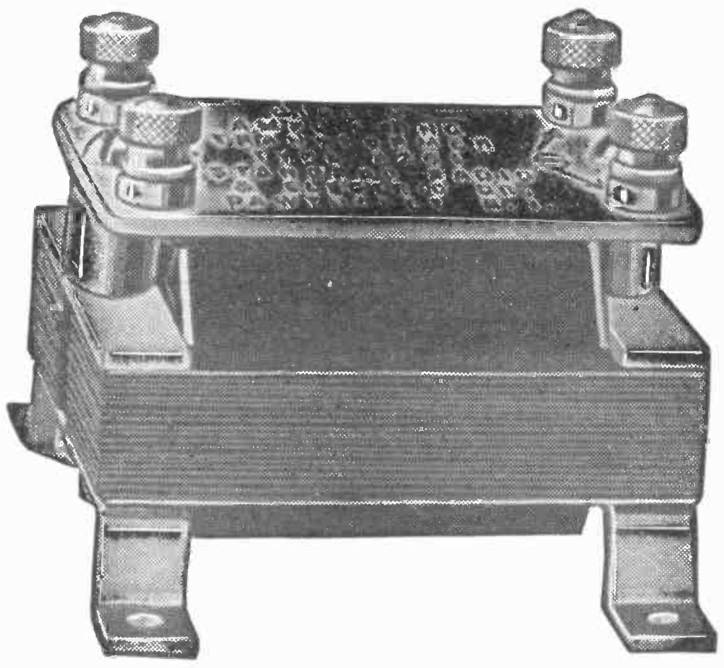
GIBLIN
RADIO APPARATUS

The Giblin Broadcast Receiver

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



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



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PAWTUCKET, RHODE ISLAND

RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 1 Number 23

Contents for

FEBRUARY 15, 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.

BE SURE YOU SEE NEXT ISSUE

HERE ARE SOME OF THE REASONS

Probably the most likely thing to go wrong in your set is a tube. If it burns too well and looks bright, that does **not** show that it is good. The apparatus to test all your tubes is described by Freed in **"Weeding Out Bad Tubes."**

It is surprising how radio is invading all lines of science. Central Stations are now using it to help keep the power on their lines. You know how disgusting it is to have your electric light flicker badly at night. This is now being avoided as told in **"How Radio Keeps Your Lights Burning,"** by Smith.

We see so much about the receiving end of broadcasting that we are apt to forget the sending station. Many amateurs are now putting in a sending equipemnt of their own and by keeping below 200 meters are able to **talk** to their friends. See **"The Sending End of Music,"** by Rados.

We have had considerable favorable comment on our Hook-up number and in particular various fans have asked for further details about making over a single circuit set so it will cut out locals. Arnold tells you how to do this and shows the paths of the various oscillations in **"Sharpen Your Single Circuit Set."**

In **"Seven Ages of Radio,"** Dr. Goldsmith shows the development of the art, not only from the electrical point of view, but also from the legal and commercial sides. This is a rather unusual article, and is very interesting.

Regenerative set, superheterodyne, neutrodyne, reflex—what do they all mean? Many intending purchasers of sets are now wondering which is which, and why. This is explained by Taylor in **"What Set Names Mean."**

Making it Easier to Handle Hook-ups

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

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

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

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

Radio Progress

"ALWAYS ABREAST OF THE TIMES"

Vol. 1, No. 23 FEBRUARY 15, 1925 15c PER COPY, $3 PER YEAR

Have You Met a Volt or Ampere?

These Two Common Names Are Often Badly Mixed Up

By HORACE V. S. TAYLOR

RALPH, the radio man, had a frown on his face until he saw his friend Bill, coming through the door. "Why so glum?" said the latter. "Have you been trying to make out your Income Tax Blank?" "No," was the reply, "but two of my customers were just in and I can't seem to remember their names."

"That's easy," said Bill, "compared with the trouble I have remembering volts and amperes. Sometimes I say one and mean the other, and sometimes the other, and don't mean anything. How can I tell them apart?"

"B" Battery an Exception

"There is a lot of confusion about them," said Ralph. "Lots of radio fans use them interchangeably, but there is a great deal of difference between them. In fact, they are no more alike than is the *length* and *width* of a piece of ground. Of course, in a general way, with the average plot of ground you know that if the length is great, the width is also apt to be fairly big. And in the same way, if you have a circuit with lots of voltage, it usually happens that the current is apt to be rather large. But just as you may find occasionally a long and narrow lot, so in the "B" battery circuit you have a high voltage and very small current."

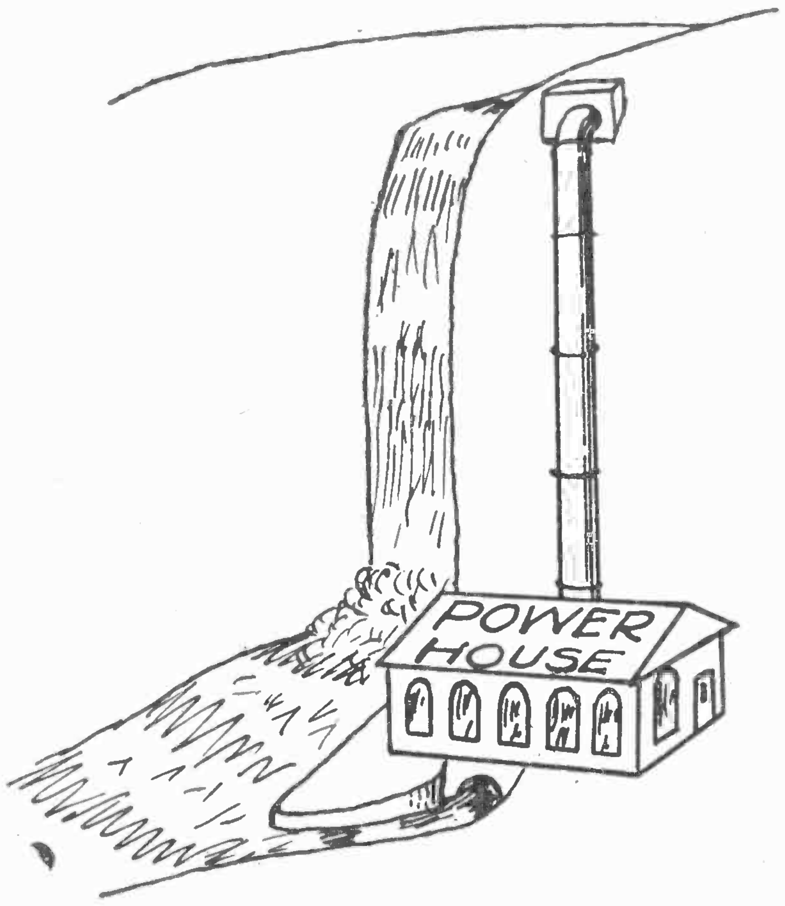

Fig. 1. High Voltage, Low Current

"Well, what is the difference between the two?" was the next question. "Just this," replied the radio man; "if you have a city main full of water, the pressure is measured in pounds per square inch. With a battery or generator, the electrical pressure is measured in volts. And the current flowing through the water supply pipe is expressed in gallons per minute. In the electric wire, the flow is rated in amperes."

Not Amperes Per Second

"Does that mean amperes per minute or per second?" asked Bill. "Fortunately we don't have to bother with the time when we talk about electric current. You know that if you have a river which flows 120 gallons per minute, that is the same thing as two gallons per second. Whichever we express it, it is the same amount of current. When names are given to electrical units, the flow is measured just as a *current*, and so the length of time is not needed in the expression. If one ampere flows through a wire for one hour, it reads on an ammeter just the same as if it had been measured at the end of the first second."

"Yes," Bill agreed, "I have noticed that when I park my automobile with the lights on at night, the ammeter points to 5 whether I leave it for a minute or an hour. I suppose that means five amepers are flowing all the time." "Yes, you are right. As a matter of fact, it is too bad that we haven't some convenient expression for the water current in a pipe or river without having to bring in the phrase expressing time in minutes or seconds."

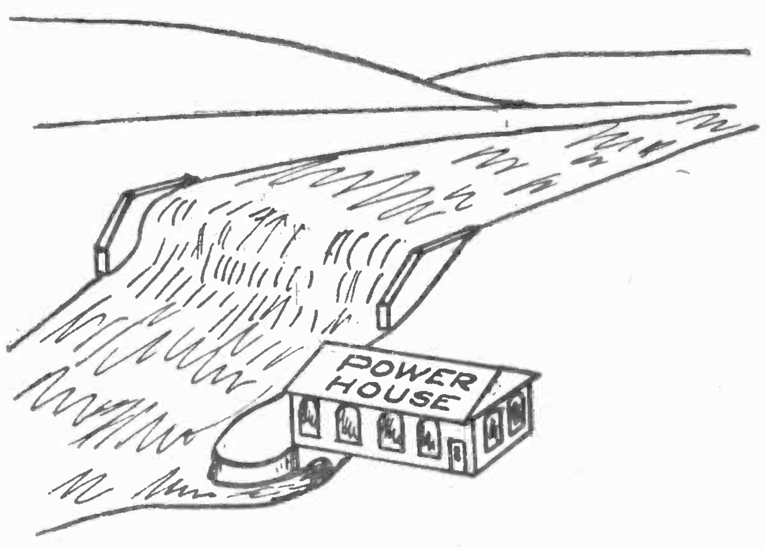

Fig. 2. Here the Voltage is Low

Nor Volts Per Square Inch

"Well, what is meant by a volt?" queried Bill. "That corresponds to pressure in pounds per square inch. And again the engineers who named electrical units used a lot more common sense than those that first called water pressure by name. If you have one pound per square inch, that is the same thing as 144 pounds per square foot, since there are that number of square inches to the foot; whichever way we express it, the pressure is the same. When we come to a dry cell, we say it has a pressure of 1.5 volts. It is not necessary to mention anything about square inches or feet, because the definition of a volt takes care of everything. The ordinary volt meter reads the answer directly on the scale, and no one has to worry about how big the meter or the battery may be.”

“Which of the two gives more power?” was next asked. “Neither one,” came back the snappy answer. “Let us look at a river to see the reason. Fig 1 shows a power house in the Alps. The water fall is very high, but the river itself is only a small stream, and does not have very much water. However, the big pressure (voltage) derived from the high falls combined with the amount of water, even though it may be only moderate, gives plenty of power at the station. Now look at Fig 2, which is a power house on the Mississippi River. There are no pronounced falls anywhere on this stream so the pressure (voltage) is low. But there is a tremendous stream flowing by and the current (amperes) is quite large. So the big current, even at the small pressure gives plenty of power at the power house.”

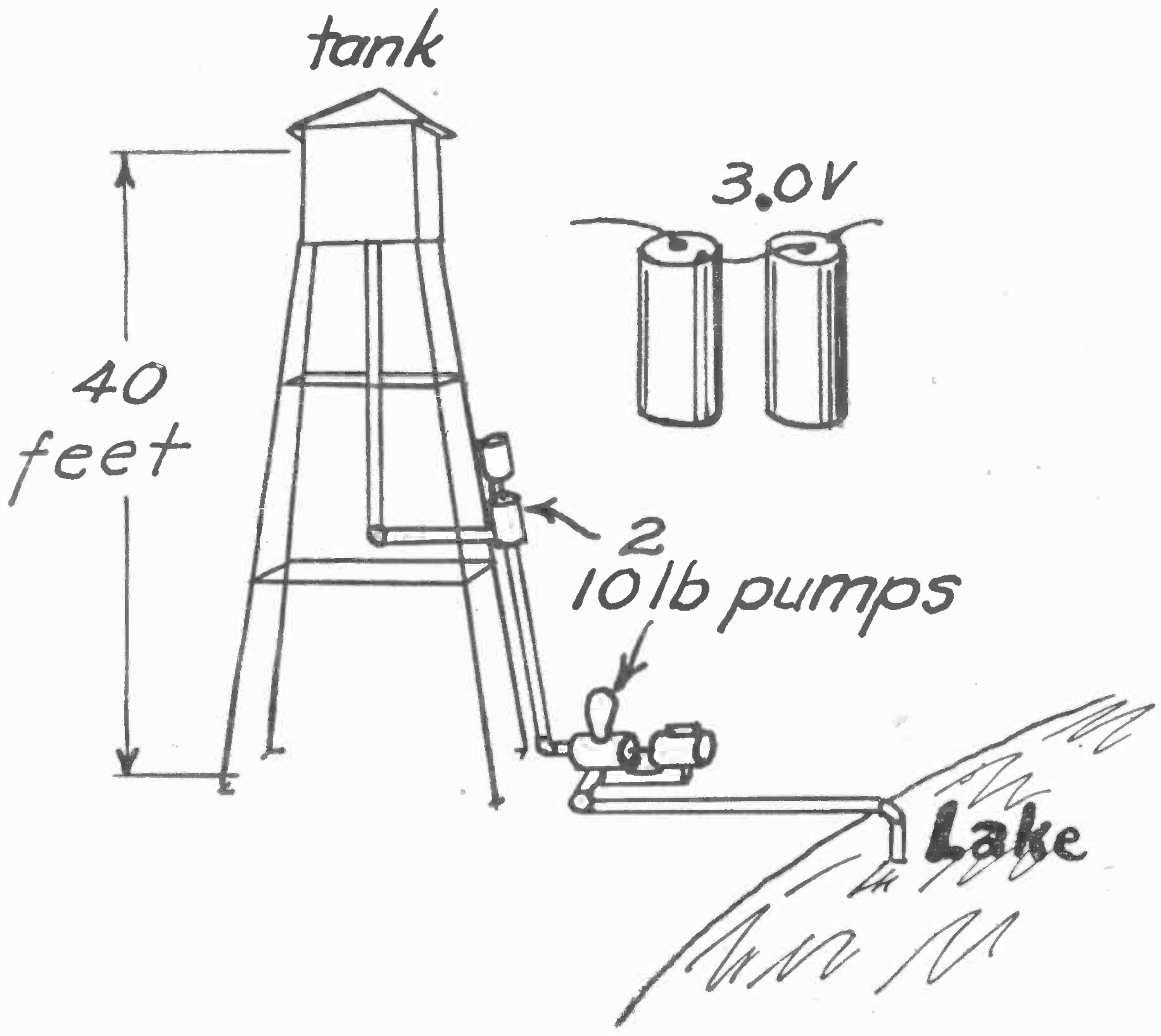

Fig. 3. Pumps in Series, Double Pressure

Two Horse Power Per Aerial

“Does that mean,” asked Bill, “that it is the current multiplied by the pressure that counts?” “Yes,” answered Ralph, “the same in electricity as in mechanics. If you want to use compressed air, it is the amount of air *times* the pressure which determines how much horse power you will use. The same thing holds true with a generator. The volts times the amperes gives the power. One-horse power exactly equals 746 of these volt-amperes or watts, as they are called. So you see that a 1500-watt broadcasting station, like KDKA or WGY, will have an output in the aerial of about two horse power.”

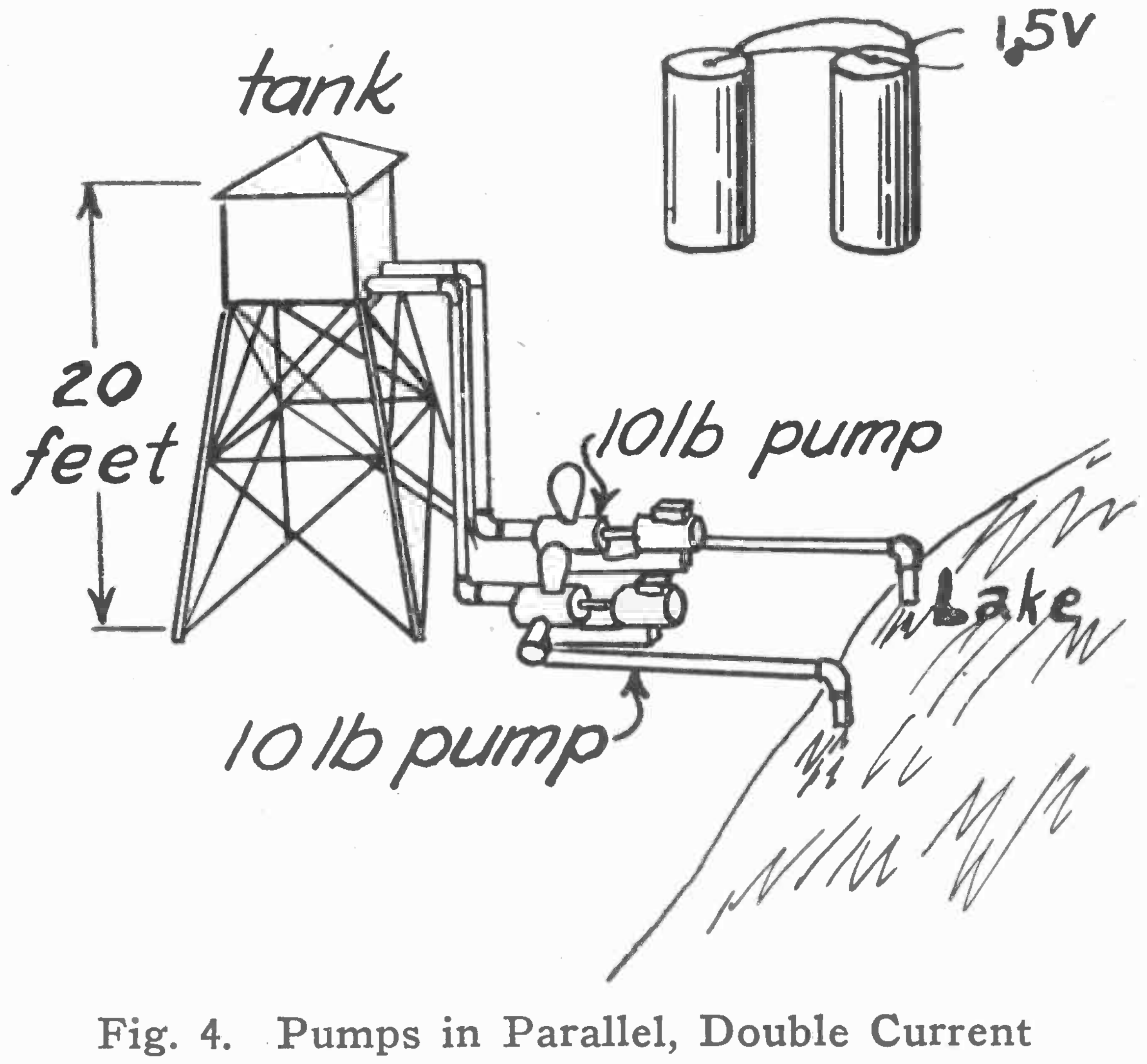

Fig. 4. Pumps in Parallel, Double Current

“Is that why they connect up several cells in a battery?” “Yes, partly. But it is unusual, however, to change the voltage rather than the power. The pressure of one dry cell for instance, is 1.5 volts when new. This drops off to one volt or less when ready to be discarded. In order to work a UV tube, it is necessary to hook up several of these together to get enough pressure for heating the filament of the tube to full brightness. Three dry cells are needed for the UV-199, for instance.”

Adding Two Pumps

“In such a case do you hook them up in series or in parallel?” asked Bill. “In this case it will be in series, since we wish to add up the pressures of the different cells. Look at Fig. 3, and you will understand how this is done. We have a tank 40 feet high, which contains water. This will give about 20 pounds per square inch of pressure at the lake. The pumps which are to raise the water, let us suppose have a maximum pressure of only ten pounds. How are we going to get this water into the tank? There is only one way,—that is to have the output from the first pump feed into the next one, and the two together will then add their pressure as shown. This is just like two batteries connected in series, with the plus of one cell running to the minus of the next. Just as the pumps add 10 and 10 to give a pressure of 20, so the cells add 1.5 and 1.5 to make a total of 3 volts.”

“The two pumps together don’t give any more water than before,” remarked Bill. “No, the output in current for the two is just the same as it was for one alone. It is only the pressure that is added up. By getting twice the pressure you see we have twice the power. If the current were also increased at the same time, we would get more than twice the power and that means that we would be getting something for nothing, which can't be done in mechanics any more than in oil stocks."

How to Double the Current

"How could we get more current if we wanted it?" inquired Bill. "By putting the two pumps in parallel we should get just this effect. Fig. 4 shows how it is done. Since *neither* pump will raise water more than twenty feet, we shall use a tank of that height. The two pumps working side by side, each delivers an equal quantity of water to the cistern, and so the amount is double. Notice, however, that the pressure is just the same as before. This is like hooking up two cells in parallel, as shown in Fig. 4. Each one has a pressure of 1½ volts, and a total current capacity when new of 25 or 30 amperes. By connecting zinc to zinc and carbon to carbon, we still have only 1½ volts, but are now able to take from 50 to 60 amperes."

"When would such a connection be used?" was the next question. "This is done in three tube sets using WD tubes," answered Ralph. "You see either the WD-11 or WD-12 requires only 1.1 volts, and this is easily supplied by a single 1.5 volt cell by inserting a rheostat to cut down the extra pressure. Such a single cell *will* furnish current to operate three tubes in parallel, but the efficiency is not as great as it might be, because of the heavy current drain. Each WD takes ¼ ampere, which means ¾ for the set.

Boosting the Battery Efficiency

"By using two cells in parallel, this current is divided into ⅜ ampere through each. The cells are much more efficient at this rate. Of course, by using three or four of these units, the drain is still further reduced with slight further increase in proportionate length of battery life. However, it usually does not pay to use more cells than you have tubes with a WD set."

Portrait of Popular Performer

Marcel Dupre

Marcel Dupre is a famous French organist, whose recitals on the Wanamaker Concert Organ, New York City, have been broadcast by Stations WJY, New York; WGY, Schenectady, and WRC, Washington, on Thursday evenings. He has shown great skill on this four manual organ.

"Which is it that kills a person," asked Bill, "volts or amperes?" "It is the volts which are dangerous," Ralph explained; "you can walk right up to a generator used for copper or nickle plating and put your hand on a wire carrying 2000 to 10,000 amperes, and never feel the slightest thing, as the pressure for such work is very low. On the other hand, a voltage as low as 220, will give you something of a jolt, and 550 volts has often times proved fatal. So keep away from high voltage lines," was the final advice of the radio man.

A MOOSE LOUD SPEAKER

The receipt of programs of entertainment by radio must be a welcome item for the Maine loggers in their picturesque surroundings, if the letters from such camps are any indication. A group in East Sullivan, Maine, write that they are indebted to radio and, in their letter, describe natural surroundings, which should make radio entertainment a popular feature. They are six miles from he nearest store. They live in the woods all the time. In the winter, their only mode of travel is either by dog-team or snow shoes. They haven't many things in common with the outside world. But their long evenings are made happy by their receiving set. Moose horns are used for loud speakers, and they fit the case nicely. Aspiring Nimrods in the States would be interested in the report from the loggers that deer are plentiful and black ducks run in swarms.

American Radio Relay League

ECLIPSE THROUGH CLOUDS

The people of Minneapolis could not see the recent eclipse owing to dense clouds, so a radio amateur went up above the clouds in an airplane and told them all about it by radiophone. It was planned entirely by three amateurs. The voice that literally came down from the air was a big surprise to hundreds of listeners throughout the midwest states whose sets were tuned in at the time.

The success of the plan was made possible through a relay system using two different wavelengths and involving two types of radio transmitters and one receiver. The three operators used such good team work that the thing was accomplished without a hitch and reports of clear reception subsequently were received from radio listeners in the Dakotas and Montana.

In the first place, an amateur radiophone transmitter was installed in the airplane by Hugh S. McCartney and operated by him in giving a description of the glories of the corona. His view of the phenomenon was just as good as that obtained in the eastern part of the country under more favorable conditions. He gave a rapid-fire description of the event while the bank of clouds drifting below shut off the view of many thousands.

His voice carried perfectly, and was picked up by Raymond Pfisterer, operator of amateur station 9CCX, on a low loss receiver from which it was relayed to the remote control panel WCCO, the 500 watt broadcast station of the Washburn Crosby Company of Minneapolis. Lyoll K. Smith, city manager of the American Radio Relay League, operating the latter station sent the report over the air on the broadcast waves.

ASSOCIATED PRESS GETS ACROSS

All the wires were down. No telegraph lines connecting with the Associated Press national news source were in order following a heavy snow fall. But the "Decatur (Ill.) Herald," a morning newspaper, went to press as usual with all important events fully covered through the timely assistance of amateur radio. Five front page stories under various date lines distributed between New York and Los Angeles carried the head "By Amateur Radio."

In a subsequent issue, after the rush and excitement of the emergency had subsided and the wires had been repaired, "The Herald" carried a detailed story of the most unusual incident in its history under the heading: "Radio Amateurs Responsible for Herald Associated Press News." This graphic story of news gathering under the most trying circumstances told how Mark Spies of Decatur and W. C. Fowler of St. Louis, youthful operators of private telegraph code transmitters, worked "nine-hour watches" for two nights in order to keep the people of Decatur in touch with news of the outside world.

When the Worst Happens

In all newspaper offices, no event is more dreaded than an accident which cuts off all contact with vital news sources, and the wires, usually so busy, suddenly grow silent. Immediately every resource of the paper is used to bridge the break. In this case, there appeared to be no solution until Herbert B. Rickards, radio editor of "The Herald," got in touch with Spies of the American Radio Relay League who reported by telephone that he had "raised" an amateur in St. Louis and was already prepared to receive dispatches from the A. P. Headquarters in that city.

In Spies Radio room, things were by no means running smoothly. The weight of ice on the antenna wires caused a pull on the lead-in, which broke the window and let the cold north wind into the room. There was nothing handy to stop up the hole and Spies could not leave his receiver for some time to repair the damage. He turned up his coat collar and stuck to his work.

"In addition to these difficulties," declared Radio Editor Rickards, in describing the event in "The Herald," fading made frequent repetition necessary and reception uncertain. Both operators however, 'stuck to their keys,' working continuously without stopping for supper, and rendered a service which is perhaps unprecedented in the history of amateur radio."

LEARN THE CODE WEDNESDAY

The New Mexico College of Agriculture and Mechanic Arts, Station KOB, started a radio broadcast course in telegraphy in January. The regular Wednesday night period of KOB's schedule (7:30 to 8:30 p. m., Mountain time) will be devoted to this. Anyone may enroll in the course by writing the Radio Department of Station KOB for an application blank. There is no expense connected with the course except for postage and the purchase of a small practice set.

The lessons will be given regularly every Wednesday. These should be received by the student and written down. He will be expected to practice the lesson on his set until mastered. From time to time tests will be sent which the student should copy and mail in with a stamped return envelope for correction and grading. A careful record will be kept of these sheets so that the progress of each student may be watched and commented upon. Certificates will be graded as students attain speeds of ten, twelve, fifteen and twenty words per minute. As the course progresses, the lesson hour will be divided into periods representing stages of progress.

There are undoubtedly many fans becoming more and more interested in learning the code used in telegraphic communication. That it is a language and not simply a code, as is popularly supposed, will be attested to by all operators of experience. Just as in English or other language, each letter or group has a particular sound, so does each letter when expressed in the language of the telegrapher. Likewise, words are built up of combinations of letter sounds. The telegrapher, however, has the added responsibility of writing down the received words.

Chopping a Slice of Vibrations

How Selective Should the Best Set be Made?

By ALFRED N. GOLDSMITH, B. S., PhD., Fellow I. R. E., Chief Broadcast Engineer, Radio Corporation of America

RADIO designers have always wanted to reach the last word in freedom from interference with radio programs. A receiver was desired which would be the very limit of selectivity—which would let only one signal be heard while completely excluding all others. But, partly owing to an imperfect knowl edge of just what the limit really was and partly because the making of an ultra-selective radio is a very complicated matter, this result has only recently been put on the market.

It is well known that every sending station has its own frequency (expressed in meters.) It is also found that two stations, if their frequencies are too close together, interfere with each other in the following way.

1. The speech or music of both of them can be heard at the same time in the loud speaker, which results in confusion. Sometimes one of them is so much fainter (perhaps farther away) than the other that its program is not heard even though it is on nearly the same frequency.

That Bad Beat Note

2. More serious, however, is the continual whistling note (called a "beat note" by the engineers) which always results when two stations operate on frequencies less than about ten kilocycles (10,000 oscillations per second) apart. This objectionable note will be quite audible even when one of the interfering stations is so faint that it is not possible to understand speech or even to hear music from it.

It follows, then, that powerful stations must not be nearer to each other in frequency than ten kilocycles (kc.) and the Department of Commerce, in its frequency assignments to the various broadcasters has carried out this idea as recommended by the Second and Third National Radio Conference. For example, WJZ at New York has a frequency of 660 kilocycles, and therefore no other broadcasting stations can be in operation in that region from 650 to 670 kc., at the same time without causing interference and the whistling note

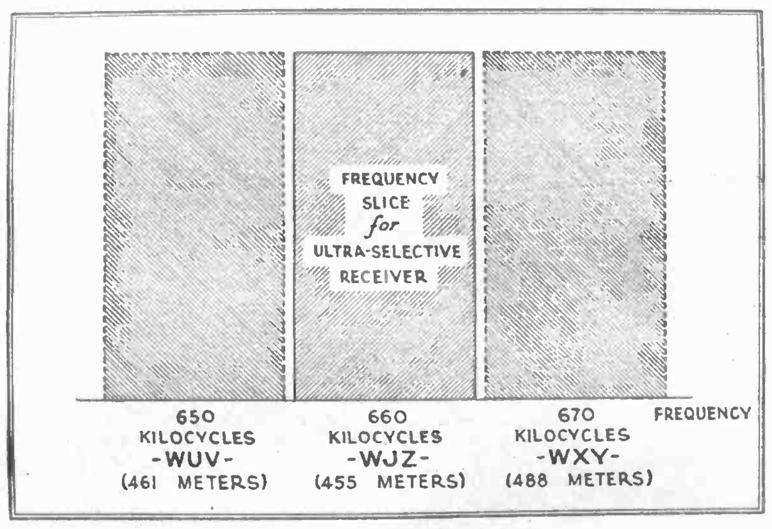

Fig. 1. Size of Block Needed

mentioned above. (As a matter of information, 660 kc., corresponds to 455 meters wave length, and 650 and 670 kc., are equivalent respectively to 461 and 448 meters.)

How Big a Slice

It is clear, then, that the ideal receiver, having the best selectivity, should chop out a slice of frequency certainly less than twenty kc., wide, and should permit receiving all stations within that band or slice while totally excluding all remaining stations having frequencies outside of that band. But it is not clear, offhand, how narrow the slice of frequency, which the receiver will admit, may be made with safety. For example, it might be asked: would it not be a good idea to reduce the width of the slice of frequency actually receivable to two kilocycles? The answer is emphatically, no.

Theory and practice agree in the conclusion that the best set must permit a band of frequency about ten kilocycles wide to be passed through. If this is not done, the quality of the music will be ruined because either the high notes or the low notes will be suppressed and lost, and the effect will sound unpleasant. The ideal receiver will then act as shown in the accompanying drawing, Fig. 1. It is seen that it admits a slice of frequency ten kilocycles wide and nothing else.

Therefore, it will enable perfect reception of the music from WJZ at 660 kilocycles, while totally excluding the stations WUV and WXY (imaginary call letters) on 650 and 670 kilocycles respectively. It will do this even if WJZ were being received from a great distance whereas the other two stations were nearby and powerful ones. Such a feature is of course a great advantage to the critical radio listener who wants to pick-up a concert from far away right through transmission by powerful local stations on nearby frequencies or wave lengths.

Must Not be too Good

It may seem somewhat startling at first to learn that a receiver simply must not hew out less than a ten-kilocycle slice of frequency for broadcast reception. However, up to the present, receivers have been very far from meeting any such requirement as this, and it has needed the use of every resource of modern radio engineering finally to design such sets. The Radiola Super-VIII and Radiola Super-Heterodyne (see Fig. 2.) receivers are two designs which fully meet the necessary requirements for ultimate selectivity. This radio (they use the same circuits) has a number of very interesting qualities which are shared by no other type of set. For one thing, its selectivity is entirely independent of the adjustment of the receiver. That is, it always picks out just the same width for its received slice of frequency.

Unlike most regenerative receivers, and even most non-regenerative radios, these two sets have a selectivity once and for all fixed by the designer and the factory at the highest value which will permit perfect broadcast reception. Furthermore, this selectivity and freedom from local interference from other broadcasting stations, is found to be astonishingly high, way above that of the usual receiver.

Fig. 2. This Set Will Pull in Slice of Vibrations

Two Frequencies at Once

The general way of obtaining this selectivity is by getting away from the ordinary methods of tuning altogether. That is, instead of tuning the antenna circuit alone, or any other one having the same frequency, the vibration speed of the incoming signals is first shifted by a single simple adjustment to a new lower fixed frequency. Then the actual picking out of the desired station and the exclusion of all other stations is accomplished here. In other words, the set tunes not only to the frequency of the incoming signal but also to a new and more favorable wave length into which the incoming frequency has been directly reduced. This is what is called by engineers the super-heterodyne system of reception.

Furthermore, the amplification of the incoming signal largely takes place on the new or transformed frequency, and is therefore accomplished not only with complete stability but with the utmost efficiency. Thus great sensitiveness of the receiver and full use of the tubes are obtained. Radio listeners have found the effects of this "transformed frequency" and the selectivity it allows to be a distinct and pleasant novelty. Handling a circuit which "cuts sharp" in the most definite possible fashion, no matter how the receiver is adjusted, is a real aid to the user. It is particularly important in neighborhoods where there are a good many stations to be heard and where the listener does not wish to take the trouble to adjust delicately a critical circuit.

No Birds in This Hand

The possibility of producing "birdies" or twittering notes by having the receiver in an oscillating condition has been entirely avoided in this receiver, which does not effect its neighbors at all and is therefore another example of the "Golden Rule" type. It is also of great practical interest to note that this style is so sensative that no antenna or ground are needed at all, (including "short grounds" and "balancing wires" and lots of other electrical curiosities.) Only a small unseen, and self-contained loop aerial, actually forming a part of the receiver, is employed, and with this it is possible to get louder signals from distant stations than with ordinary regenerative three-tube sets using a large outdoor antenna! So it is quite proper to call such circuits and the radio containing them not only as the last word in selectivity, but also as ultimate in practical sensitiveness.

WHEN WBZ SELLS STRAPS

It is a good thing to live in a city lodging a broadcasting station of national range. While a Springfield man was on a recent motor trip one of the straps on his tire carrier broke and arriving in Ashtabula, Ohio, the harness maker of the town was paid a visit. Leather straps were sought but the prices were staggering.

"Why, where I come from we can buy the same strap for certainly one-half that price and possibly one-third," he said. The harness maker inquired as to this city of cheap prices and when he was told it was Springfield, Mass., his face lit up with a glow. "Then you know a lot about that WBZ station which Westinghouse operates there."

The strap-seeker admitted that he did know a few interesting facts about it. The harness maker listened intently, stating that WBZ was his family's best bet, but suddenly left the room and came back with a strap which he offered at a figure way below the one originally asked. If the visitor had known a little more of the station and its personnel the harness man might have paid him to take the strap.

Building the New Deresnadyne

Two Steps of Radio Without a Neutralizing Condenser

By HARRY J. MARX

THE five tube set with two steps of tuned radio amplification detector and two audio steps is quite popular. Most such circuits require a neutralizing condenser to prevent the first two tubes from oscillating. It is rather difficult to get these condensers set at exactly the right spot to give the best results. Also when your tubes wear out and have to be replaced it seems that the trouble of neutralizing the set must be had all over again.

The Deresnadyne hook-up gets rid of the oscillations without this bother of neutralizing. The general theory is this. When the vibrations from the output or plate of a tube are led to the next transformer they are, of course, very much stronger than the input which caused them. A second step still further multiplies the effect. Naturally, this is what you use amplification for. But if any of the output vibration happens to get back to the grid of the first tube by electric or magnetic leakage then this energy even though small, will add to that which is already coming in and the result will be that once an oscillation is started it keeps itself going.

Detuning the Plate Circuit

In this set the method of preventing the action just described is to detune or deresonate the plate circuits of the tubes by proper design of the RF transformers. This method was described at greater length in the January 1, 1925, issue of RADIO PROGRESS in "A Spiderweb Neutrodyne." Instead of using spiderweb coils this new hook-up employs a special form of winding, called the paddlewheel coil from its general appearance, as shown in Fig. 1.

The number of turns in the radio frequency transformers, are reduced to such a point that maximum signal strength is obtained without oscillation. In this condition, the plate circuit is not resonant to the signal being received and to which the grid circuit is tuned.

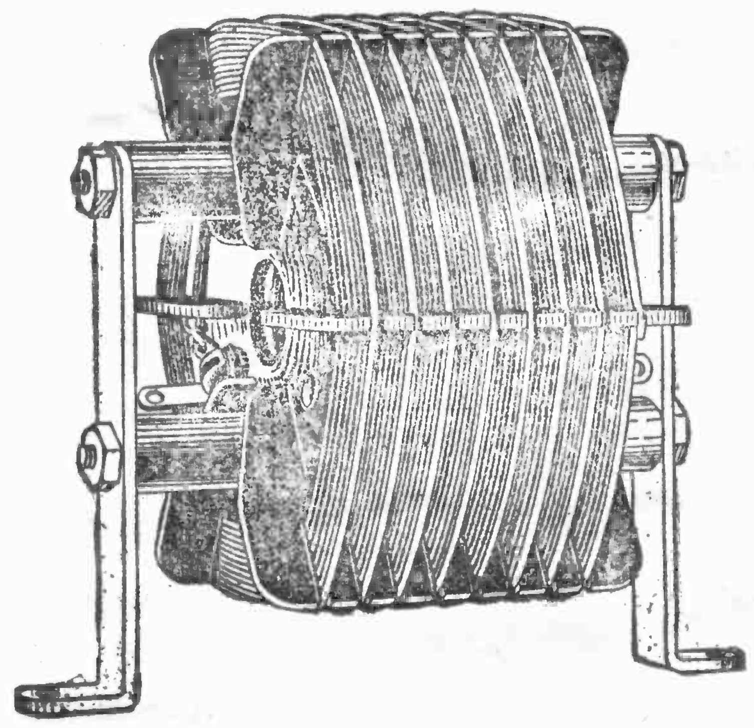

Fig. 1. Called "Paddle Wheel' Coil

Due to the increased tendency to oscillate at lower wave lengths, we must provide some means to prevent the voltage across the plate circuit from increasing as the set is tuned to receive

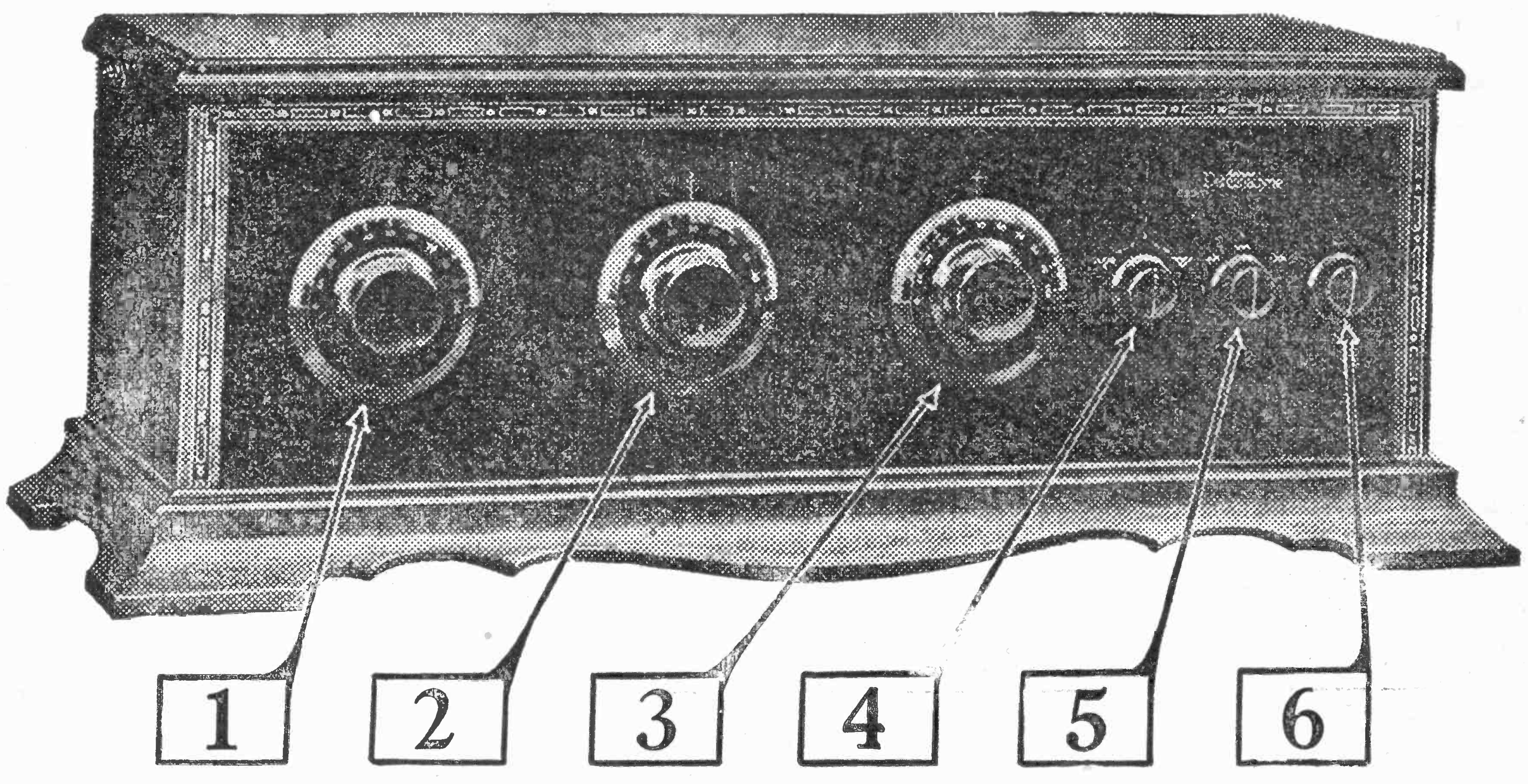

Fig. 2. First Three Dials Pick Station; 4, Volume; 5, Switch; 6. Rheostat

the lower wave length station. There are several ways by which this can be accomplished. One of these is the use of the plate control to lower the plate voltage of the radio frequency tubes as lower wave length stations are tuned in. This method will be described later on. Although these methods are the subject of several patent applications their free use by the home builder is encouraged. this type the insulation supporting the coil winding is made in such a shape that absorption losses are almost eliminated. The high inductance value is shown by the fact that variable condensers with only 13 plates are used for tuning over the entire wavelength range.

List of Parts

1 Panel, 3/16 x 7 x 26.
1 Stage control switch, SP SW.
2 Audio Frequency Transformers, 3½ to 1, AT 1, 2.
3 Dials, 4 inch.
1 Cabinet, to fit.
Miscellaneous wire, terminals, screws, etc.

Extras

5 Vacuum tubes.
"A" battery, 6 volts.

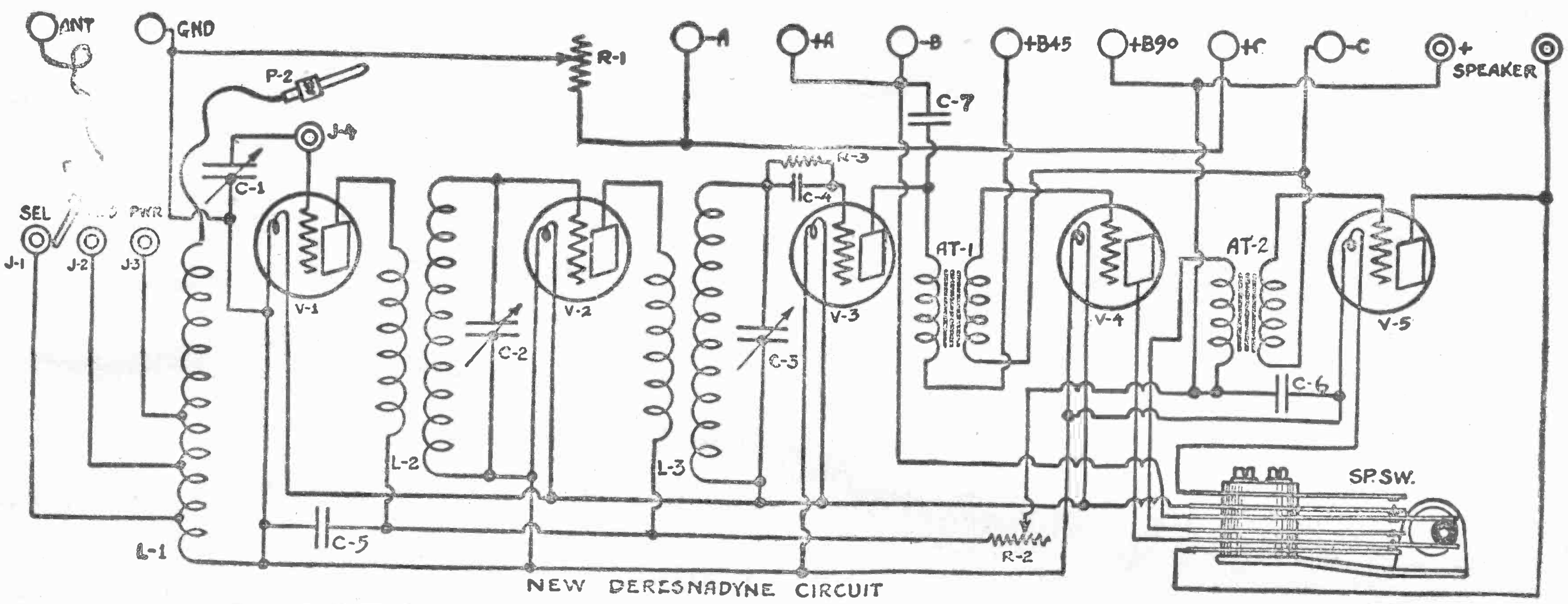

Fig. 3. Hook-up. Switch at Right Controls Steps of Audio Amplification

The Paddlewheel Inductances

The efficiency of the circuit as a whole, depends to a very great extent upon the efficiency of the coupling coils used in the stages of tuned radio frequency amplification.

It is often times foolish to spend a lot of money to get a low loss condenser if you are going to use a coil which has large losses. It is like walking to town to save a nickle and then throwing away all the money you have when you get there.

This Paddlewheel Inductance (Fig. 1.) is a new type of real low loss of inductance unit. In measuring coil efficiency, the highest possible ratio of inductance to resistance is wanted. In a coil of

1 Baseboard, ½ x 9 x 25¾.
9 Binding Posts.
Insulating strip for posts.
3 RF coils (Paddlewheel). L 1, 2, 3.
3 Variable condensers, .00025 mfd., 13-plate, C 1, 2, 3.
5 Standard tube sockets, V 1, 2, 3, 4, 5.
1 Grid condenser with clips, .00025 mfd., C 4.
2 Fixed condensers, .1 to .5 mfd., C 5, 6.
1 Fixed condenser, .001 mfd., C 7.
1 Rheostat, 2 to 6 ohms, R 1.
1 Variable resistance, 0 to 200,000 ohms, R 2.
1 Adjustable grid leak, R 3.
"B" battery, 90 volts.
"C" battery, 4½ volts.
Aerial and ground.

Optional

1 or 2 jacks to take the place of the special switch.
1 Battery switch.
1 Tap switch and points for antenna control.

The Panel Lay-out

The use of a seven by twenty-six inch panel gives good spacing of the three variable condensers and the paddlewheel coils so as to avoid coupling in the radio frequency stages. Trying to save a few inches of panel stock and crowding the apparatus close together

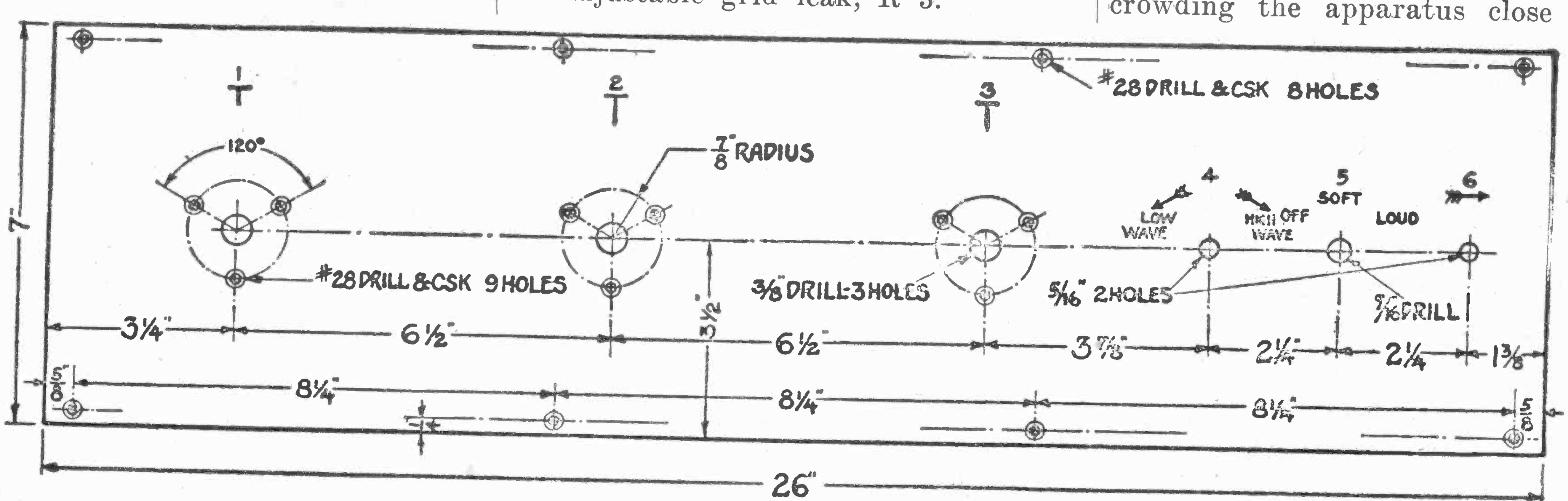

Fig 4. Panel Diagram Showing Drilling and Lettering

will soon convince the constructor of his foolishness when he starts operating the set. Compactness is a good thing, but not at a sacrifice of quality and efficiency.

All told there are only six units to be mounted on the panel. The three variable condensers (1, 2, and 3 in Fig. 2.) are kept to the left as shown in Fig. 4. The next knob, 4, is the variable resistance, then comes the stage control switch, 5, and last the rheostat, 6, (Fig. 2), which controls the lighting of all five tubes.

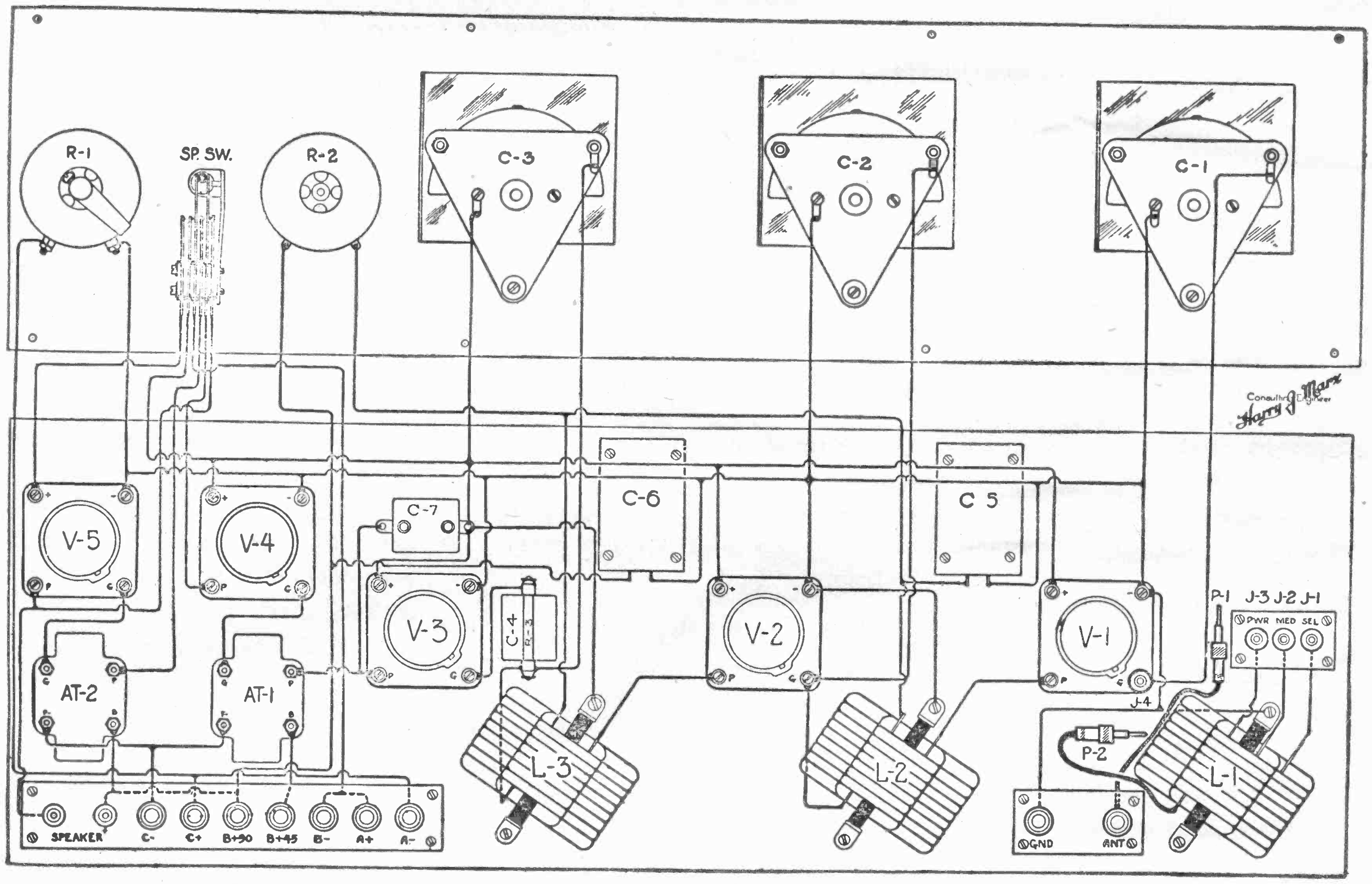

Fig. 5. Lay Out of the Parts. This Corresponds to Hook-up, Fig. 3

Plate Balance Control

In order to secure highest efficiency at long wavelengths, the Paddlewheel inductances have their primary turns so proportioned as to give maximum amplification without oscillation. A variable resistance, R2, Fig. 3, is connected in series between the plate coils and the "B" battery terminal to prevent oscillation at high frequencies (short wave lengths).

This resistance is connected right in the line from the "B"+90 to the plates of the first two tubes. The current from the "B" battery runs through it before reaching the primary of the RF transformers, L2 and L3. R2 can be varied from 0 to .2 meghom. When this value is small the full pressure of the "B" is impressed on the RF tubes. By increasing the resistance the pressure is cut down to a point were the tubes will not oscillate.

Keep Tuning Sharp

This would naturally decrease the sharpness of the tuning, so to prevent it the large capacity, C5 bridges this resistance to the filaments. The radio frequency (RF) waves do not have to flow through the resistance but return directly through this capacity to the filament.

This variable resistance provides a means of reducing plate voltage and thus the plate circuit energy. At low radio frequencies (long waves), with the knob turned to the right (zero resistance) the deresonance of the plate coil is depended on to stabilize the circuit. As the tuning approaches the higher frequencies, say 1000 kc. and gets closer to the natural resonance point of the plate circuit, the set approaches the oscillation point. Now, by turning the knob to the left, resistance is inserted between the plate and the battery, thus lowering the voltage, and with it the plate energy and thus preventing self oscillation. By keeping just below this oscillating point, the greatest radio frequency amplification is obtained with wonderful clearness of tone. It also acts as a volume control.

Picking the Parts

In building the set, Fig. 2, the first point of importance, after the circuit is understood, is the selection of the parts. It is useless to take particular pains in getting the best of some parts and then neglecting the rest by buying the first thing that is offered. Low-loss variable condensers have been discussed to such an extent that the average fan has become quite familiar with the subject. How many are taking the same pains in purchasing their audio frequency transformers? Don't buy the high ratio type (10 to 1), unless you are willing to accept distortion as a price for volume. Low ratios (3½ to 1) will always give you good quality amplification.

A little shielding between the variable condensers and the panel will do lots of good in preventing body capacity, so don't leave it out because it adds a little more work. Have you ever stopped to consider how many manufactured sets use shielding? The manufacturer wouldn't put it in if it weren't worth while. The shield should be connected to ground.

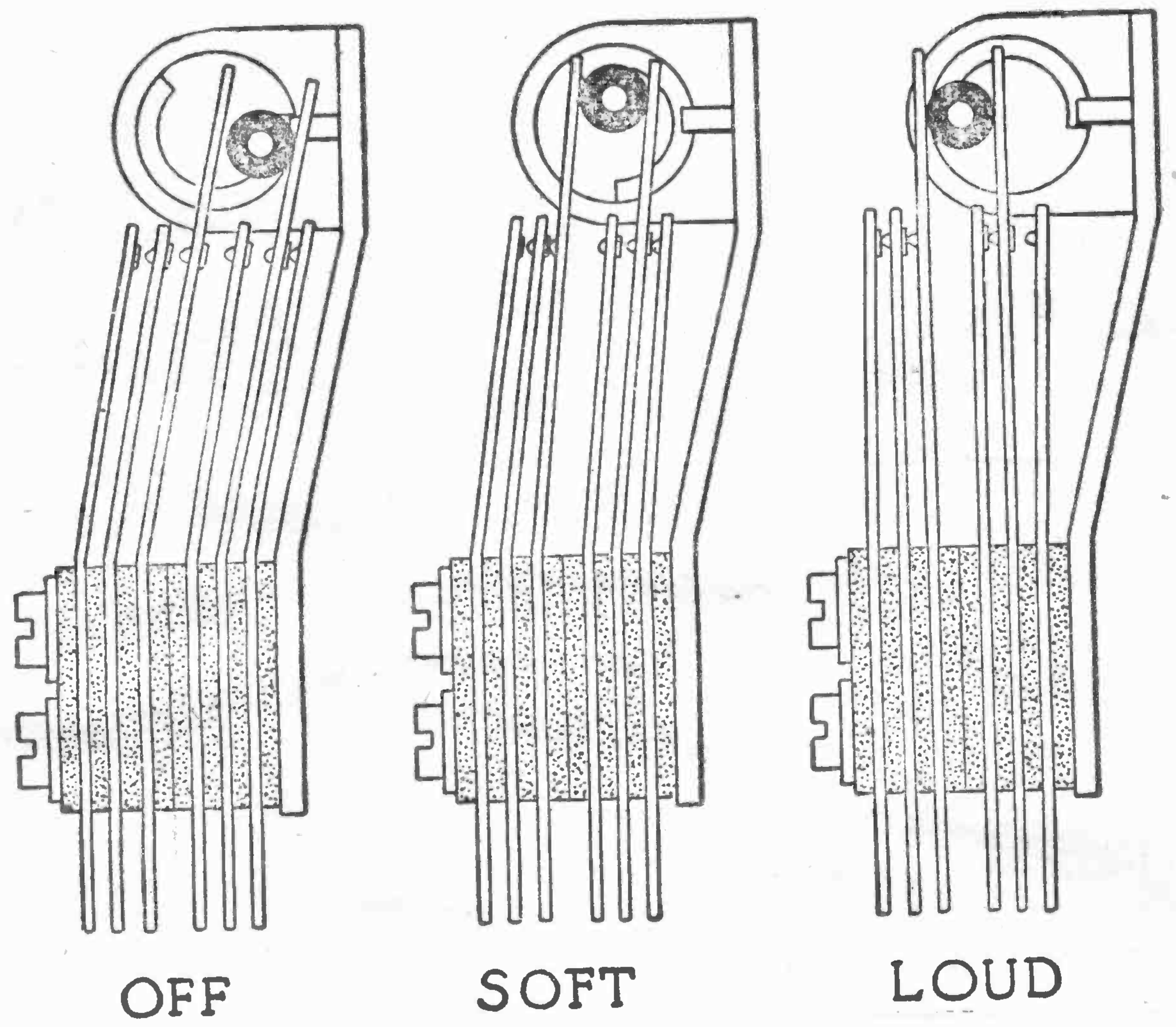

Fig. 6. This Automatic Switch May be Replaced by Jacks

In buying fixed condensers, get good ones. Those of mica are best. In buying tube sockets, get the kind in which the springs make good positive contact with the prongs on the base of the tubes. Poor contact between spring and prong will make more trouble than can be imagined.

The special resistance, R2, Fig. 3, from zero to 200,000 ohms must be of the non-inductive type. A wire-wound type would not only be impractical but would have an inductance value that would effect tuning. The special switch SP, SW, Fig. 3, not only acts as a battery switch, but also connects the loud speaker for either one or two stages of audio frequency amplification as required. If desired the regular jack system and a battery switch may be substituted. No provision is made for plugging in headphones as they are unnecessary; all tuning in can be done with the loud speaker.

It seems to be a simple matter for the average fan to assemble the apparatus on the front panel, but for some reason or other the rear of many a set looks like a cross-word puzzle. Perhaps the inside is not visible for guest's criticism, but don't overlook the fact that in nine cases out of ten, its the rear of the panel that is the cause of unsatisfactory operation. Fig. 5 gives a clear illustration of the best arrangement of apparatus on the baseboard and at the same time indicates the logical locations of wiring to conform to the hook-up diagram, Fig. 3. There is ample room on the baseboard, so no fears need be entertained regarding the accessibility of the various units for soldering the leads.

Terminal Strips

The hook-up, Fig. 5, shows three binding post strips; the long one at the bottom left takes all the battery connections. The one at the right contains aerial and ground terminals. Of course, these could be mounted on the same strip as the batteries if you wish. There is also a strip with 3 connections marked J3, J2, J1. A plug is shown connected to the antenna which is inserted in one of the 3 binding posts and gives greatest power at the left and greatest selectivity at the right. Instead of this plug scheme a 3 point tap switch may be used.

Using a Loop Aerial

An additional jack is mounted on the grid terminal of the tube socket, V1, making electrical connection with it. When using an outdoor aerial, the plug, P2, which is connected by a flexible lead to the grid terminal of the paddle-wheel inductance L1, is plugged in to this grid jack J4.

When a loop is used, connections are made directly to the antenna and ground binding posts, but plug P2, is taken from jack J4 and left disconnected, while the plug P1, is inserted in jack J4, instead. This takes the coil L1 from the grid circuit and directly connects the one side of the loop to the grid. The other end of the loop, on the ground post, connects to the negative filament but inside of the rheostat, R1.

Kind of Tubes

The tubes should be all of the 201-A type, but be sure you are using good ones. Poor tubes will ruin the best set. A detector tube of the UV-200 or C-300 type is not recommended here.

The storage battery should be of a good reliable make with about 80 ampere-hour capacity, in order to avoid frequent recharging. It would be advisable to buy a good charger for this purpose. The use of dry cells is possible but will not be found economical.

The "B" battery may consist of four 22½ volt blocks or two 45 volt units. The heavy type is recommended for greater economy in the long run. Storage "B" batteries will also be found very satisfactory, but good ones must be purchased.

When it comes to the subject of loud speakers, naturally a good one is advised. The writer's experience in this line is that you get just what you pay for! The cheaper the price, the pooreer the quality. It will surprise many, to know how much the loud speaker has to do with satisfactory reception.

The Stage Control Switch

The stage control switch presents some interesting features. The illustrations of Fig. 6 shows this in the OFF SOFT and LOUD positions. In the OFF position, the "A" battery connection is closed and the loud speaker is connected to the plate of tube V4. When the knob is turned to the LOUD position, the plate of tube V4, is connected to the plate terminal of audio transformer AT2 and the loud speaker is already in the plate circuit of tube V5. In the SOFT position, one stage of audio amplification is used, while the LOUD covers both stages.

Continued on Page 22

Why the Wave Lengths Change

Your Favorite Stations Don't Come in Where They Used to

ONE of the results of the third radio conference recently held by the department of commerce under secretary Hoover, was the change in the basis of assigning wave lengths. The old ratings of the various broadcasting stations were bunched together at some wave lengths and at others they were wide stretches where no waves came in.

As a result of this irregularity it often happened that five or six stations would be picked up together with a shift of only a few degrees of the tuning dials while at other points all of ten degrees would be passed over without hearing a peep. Naturally this caused considerable interference at the spots where the stations came in together.

Frequency Beats Wave Length

In reassigning the waves to powerful stations there were two possibilities. Stations might be given wave lengths varying by an equal number of meters. For instance, they might be assigned 350, 355, 360, 365 etc. Another way that this might be accomplished is to make the frequency or speed of oscillation equally spaced. Under that plan the readings would run like this: 860, 870, 880, 890, etc. kilocycles (kc.). This is a short way of writing 860,000 vibrations per second. Of the two plans the latter is much better.

It is found that when two stations are broadcasting using nearly the same wave they can be separated by a good sharp-tuned radio if they are spaced 10 kc., apart. This holds true no matter whether two frequencies are high or low. For instance it is just as easy (or hard) to separate 550 from 560 kc., as it is to differentiate between 1050 and 1060 kc. But this does not hold true when you talk about wave length in meters. Five meters is a big difference and makes easy tuning if the stations happen to be on short waves as for instance, 280 and 285 meters. But this same separation will not work at all even with the best and sharpest receiving set at the long wave stations like 540, 545 meters.

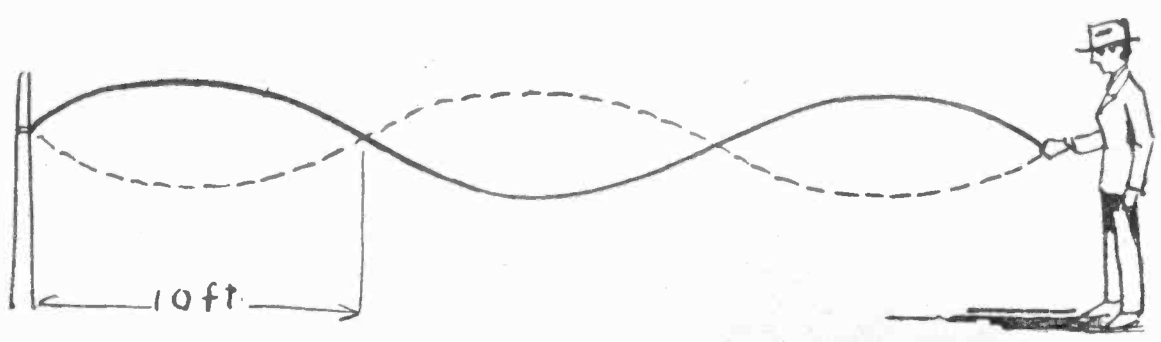

Fig. 1. Why Frequency Beats Wavelength

Easy Way is Best

As just explained the kilocycle separation is always the same but the wave length distance varies all over the lot. Besides this it is much easier to get the idea of speed of vibration than it is to grasp length. In Fig. 1, a clothes line is vibrated up and down three times a second so anyone can see in an instant it has a frequency of three vibrations per second. But only a measurement would show that each wave length was ten feet long. In the same way if you are told that KDKA is oscillating 970,000 times every second (970 kc.) you will have a picture of this high speed in your mind. But if you are informed (what amounts to the same thing) that the wave length is 309.1 meters do you get any real grasp of the fact?

For these two reasons the Department of Commerce is now assigning a

Fig. 2. Stations by Frequency

Call Letters.	Location.	W. L. Meters.	Freq. K.C
WNAC	Boston	280.2	1070
WOAN	Lawrenceburg, Tenn.	282.8	1060
WREO	Lansing, Mich.	285.5	1050
WEMC	Berrien Springs	285.5	1050
WKAR	East Lansing, Mich.	285.5	1050
KFKX	Hastings, Neb.	288.3	1040
Reserved.		291.1	1030
WEAO	Columbus, O.	293.9	1020
WBAV	Columbus, O.	293.9	1020
KFRU	Bristow, Okla.	296.9	1010
WPG	Atlantic City, N. J.	299.8	1000
WTAS	Elgin, Ill.	302.8	990
WJJD	Mooseheart, Ill.	302.8	990
WJAR	Providence, R. I.	305.9	980
KDKA	East Pittsburgh, Pa.	309.1	970
Reserved.		312.3	960
WAHG	New York, N. Y.	315.6	950
WGBS	New York, N. Y.	315.6	950
KFDM	Beaumont, Texas	315.6	950
WGR	Buffalo, N. Y.	319.0	940
KOA	Denver, Col.	322.4	930
WMH	Cincinnati, Ohio	325.9	920
WSAI	Cincinnati, Ohio	325.9	920
Reserved.		329.5	910
WBZ	Springfield, Mass.	333.1	900
WSAC	Clemson College, S. C.	336.9	890
KFMX	Northfield, Minn.	336.9	890
WCAL	Northfield, Minn.	336.9	890
WKAQ	San Juan P. R.	340.7	880
KSAC	Manhattan, Kans.	340.7	880
WLS	Chicago, Ill.	344.6	870
WCBD	Zion, Ill.	344.6	870
KOB	State College, N. Mex.	348.6	860
WTIC	Hartford, Conn.	348.6	860
WWJ	Detroit, Mich.	352.7	850
WJAD	Waco, Texas	352.7	850
Reserved.		356.9	840
WHN	New York, N. Y.	361.2	830
WHB	Kansas City, Mo.	365.6	820
WDAF	Kansas City, Mo.	365.6	820
WEBH	Chicago, Ill.	370.2	810
WGN	Chicago, Ill.	370.2	810
KTHS	Hot Springs, Ark.	374.8	800
WGY	Schenectady, N. Y.	375.9	790
WHAZ	Troy, N. Y.	379.5	790
WMBF	Miami Beach, Fla.	384.4	780
WTAM	Cleveland, Ohio	389.4	770
WEAR	Cleveland, Ohio	389.4	770
WFI	Philadelphia, Pa.	394.5	760
WDAR	Philadelphia, Pa.	394.5	760
WOAI	San Antonio, Texas	394.5	760
WHAS	Louisville, Ky.	399.8	750
WOR	Newark, N. J.	405.2	740
WJY	New York, N. Y.	405.2	740
Reserved.		410.7	730
WCCO	Minneapolis, Minn.	416.4	720
WLW	Cincinnati, Ohio	422.3	710
WMH	Cincinnati, Ohio	422.3	710
WSB	Atlanta, Ga.	428.3	700
NAA	Arlington, Va. (Reserved)	434.5	690
WDWF	Cranston, R. I.	440.9	680
WOS	Jefferson City Mo.	440.9	680
WQJ	Chicago, Ill.	447.5	670
WMAQ	Chicago, Ill	447.5	670
WJZ	New York, N. Y.	454.3	660
WCAE	Pittsburgh, Pa.	461.3	650
WCAP	Washington, D. C.	468.5	640
WRC	Washington, D. C.	468.5	640
WEEI	Boston, Mass.	475.9	630
WBAP	Fort Worth, Texas	475.9	630
WFAA	Dallas, Texas	475.9	630
WHAA	Iowa City, Iowa	483.6	620
WOC	Davenport, Iowa	483.6	620
WEAF	New York, N. Y.	491.5	610
WMC	Memphis, Tenn.	499.7	600
WOO	Philadelphia, Pa.	508.2	590
WIP	Philadelphia, Pa.	508.2	590
WCX	Detroit, Mich.	516.9	580
WNYC	New York, N. Y.	526.0	570
WHO	Des Moines, Iowa	526.0	570
WOAW	Omaha, Neb.	526.0	570
KYW	Chicago, Ill.	535.4	560
WHA	Madison, Wis.	535.4	560
KSD	St. Louis, Mo.	545.1	550
KFUO	St. Louis, Mo.	545.1	550

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Amusing Adventures of Radio Speaker

Trials of Talking to a Mike Which is Mum

By RICHARD K. MORTON

A SICKLY looking red light (and, like other red lights, it certainly meant danger!) was burning. I was in a tomb-like room, devoid of echoes and, it seemed, of everything else that would bring comfort to the nerves. Even the light gleamed in a weird color. My shoes sank into a thick carpet. Heartless spectators, and a cynical announcer, watched me critically and without mercy, as if it had suddenly been discovered that I was in dire need of a serious surgical operation, or as if I had been a previously unknown kind of worm.

As I looked into an instrument that seemed like a cross between a chicken's water-supply pan and an automatic vender of penny candy, I imagined that every listener-in was already chuckling over my predicament. My knees were playing "Home Sweet Home," with considerable jazz mixed in, I guess. The "mike" had holes around its edge, which looked large enough to put twenty-five cent pieces in. Indeed, I should gladly have deposited ten dollars, then and there, if that act would have whisked me away—somewhere, anywhere! Never in my life did I want more earnestly to indulge in generous glups.

Talk No. 1

My first radio talk! That's how it seems to the radio speaker who innocently aspires to speak over the air. Announcers have their stories to tell, but radio artists also have their adventures which are about as colorful. That is how it might seem to you, if you were to apply to a nearby station for the privilege to broadcast.

The "atmosphere" in a studio always seems to me like a mixture of a mystical seance and a funeral. A radio speaker has a harder time than the musician, to get oriented in his new surroundings. The voice of a piano rarely trembles.

One night, I went to a studio, alone, for the purpose of delivering a short talk. To my embarrassment, I found the studio filled with musical artists—together with all their admirers they could get to come with them, it seemed. They took possession of the entire place, watched every move, and so comically tried to disguise their gaping at the studio fittings, that I had a hard time to get through. The announcer told me that the observation of the actions of admirers brought along by artists was the big reason why he could always make his announcements so cheerful.

MISS MIRIAM STEEP, star of the Washington Square College Players, will be heard in a series of radio dramas from Station WJZ, New York City, during February, March and April.

Like a Telephone Booth

On another occasion, I arrived in a large studio, just a few moments before my time. The studio had been used continually for the previous two hours; it had been filled with artists and visitors; and it had been almost hermetically sealed. The announcer had been vigorously smoking a cigarette. What an enchanting atsmophere in which to talk ten minutes! To make things worse, I could hear the visitors making sophisticated and belitting remarks about me and my talk.

Not long ago, I essayed to be the director of a radio program lasting two hours. I was also to give a short talk. I had to round up all those who had agreed to take part. When the date arrived, I never was more miserable in my life. Artists were late—they boarded the wrong car, misunderstood directions, etc., ad infinitum. They brought music barred from broadcasting. Others got chronic attacks of nervousness. I paced the studio floor, trying to think of ways to keep my crowd rounded up—I would rather go out West and round up all the cattle on a Texan ranch than repeat the experience. When you are listening to a program given by a club or society, just remember this, and sympathize with the director of it.

Why Announcer Fainted

During another talk, the announcer became nervous, and he kept hoping that I would end my talk. Misinterpreting a gesture that I made, he waved for members of a large orchestra to take their places near me. Then, I suddenly picked up four more pages of typewritten manuscript, and the unhappy

Continued on Page 22

How Vacuum Tubes are Made

Differences Between the Various Kinds are Explained

An Interview from J. L. BERNARD

PLOP! goes a tube on the floor. Which means that $3.00 does a fadeaway from your pocketbook. Or perhaps you accidentally drop the "B" battery connection on the filament circuit. Or even, a too high voltage from the "A" battery if impressed on the tube for a long time will ruin it. In any event, when you buy a new tube you may wonder what is inside and how it is built.

To begin with there are five different styles in ordinary use. The ones we are about to describe are those made by the Radio Corporation but the product of other manufacturers is substantially the same. Of these five, two (WD-11 and WD-12) are exactly alike electrically and differ only in the base. The WD-11 has a special base with the prongs for plate and grid on opposite sides, while the WD-12 fits in a standard socket with these two prongs side by side.

Differences of the Four

Taking the tubes up in order the UV-200 was the one first invented. This dates back a good many years. It is a detector tube and is probably the most sensitive one known. It uses five volts on the filament and consumes one ampere. This current is at least four times as large as that taken by any other tube and for this reason it is becoming somewhat unpopular with users who have not any means of charging their own storage batteries.

This style is what is called a "soft tube." It contains a small amount of inert gas which does not have any effect on the filament as air would. This has the result of making the detector action stronger, but with it the drawback that it can not be made in quantities with very great regularity. While other styles of tubes can be depended on to repeat their characteristics so that if one is burned out another can be substituted, without changing the adjustment, the UV-200 varies so from one specimen to another that it is quite necessary to check up the adjustments with a new tube. For instance, the grid leak may need a change and more or perhaps less feedback will often be required.

The Loudest Amplifier

A 201-A makes the loudest amplifier of the series. The filament uses five volts and one-quarter ampere. This tube is used as standard on a large number of sets, both as radio and audio amplifiers. Used with the UV-200 detector they undoubtedly give the best all round performance of any receiver. Owing to the variations in individual UV-200 detectors and also the large current consumption of the latter, as just described, the 201A is also used as a detector in many hook-ups.

The WD-11 and WD-12 (alike except for base) were developed to meet the demand for tubes which would work without a storage battery. They use just as much current as a 201-A but at a much lower pressure. Instead of requiring five volts on the filament a pressure 1.1 (1-1/10) volts gives full brightness. Since a dry cell has a pressure of 1½ volts when new it will operate several WD's in parallel. But, better efficiency from the batteries is obtained by allowing two or three cells

Kind of tube	UV-200	UV-201A	WD-11 & 12	UV-199
Battery used	Storage	Storage	Dry	Dry
Number of cells	Three	Three	One	Three
Kind of filament	Tungsten	Alloy	Coated	Alloy
Filament voltage	5.0 volts	5.0 volts	1.1 volts	3.0 volts
Filament current	1.0 amps	¼ amps	¼ amps	1/16 amps
Rheostat for 1 or 2 tubes	2 or 6 ohm	6 ohm	6 ohm	30 ohm
Rheostat for 3 to 5 tubes	Not used	2 or 6 ohm	2 ohm	10 or 20
Plate voltage detector	15 to 25	20 to 45	20 to 45	20 to 45
Plate voltage amplifier	Not used	20 to 100	20 to 80	20 to 80
Use as detector	Best	Good	Good	Good
Use as audio amplifier	Not used	Best	Good	Good
Use as radio amplifier	Not used	Good	Poor	Best
Color of filament burning	Bright	Dim	Very dim	Dim
Color of glass	Clear	Silver	Clear	Silver
Amount of vacuum	Fair	Highest	Highest	Highest

Fig. 1. All the Features of Five Kinds of Tubes Are Listed Here

for a three tube set. That is, two cells will last about 2½ times as long as one.

The Best Radio Amplifier

The best tube for use as a radio amplifier is the UV-199. Owing to the extremely low internal capacity between the grid and filament there is very small loss of energy at this point. This low capacity, or condenser action, is found because of the arrangement of the leads. These are separated as far as possible, and are also made very short where they project from the base. For this reason they are preferred to the 201A where the utmost in radio amplification is wanted. As audio amplifiers, they are not quite as good as the 201A especially on loud signals.

The current consumption is the lowest of any style. Only 1/16 ampere at three volts is required to light the filament. Three dry cells, when new, give a pressure of 4½ volts, and this is reduced by the rheostat to three, at the terminals. For ordinary dry cell use this tube is perhaps better than the WD, where several are employed. For the single tube sets, the WD has a great advantage in that one cell only is needed while with the 199 a minimum of three must be connected in series to get the proper voltage.

Comparing the Requirements

The table as given in Fig. 1 shows the characteristics of these tubes:

Parts of Tube

The elements in a Radiotron consist of a "filament" like that in an ordinary incandescent lamp, surrounded by a "grid," which in turn is surrounded by a "plate". In the UV-200 and UV-201A the filament is the shape of a hair pin; in the others it is a straight wire. The grid of the UV-200 and UV-201A is oval shape in a plan view; the others are cylindrical in form. The plates of various tubes are similar in shape to conform with the grid.

This can be seen in Figs. 2, 3 and 4, which represents the parts of the UV-200, WD and 199 tubes respectively. At "A" in each of these drawings is shown the plate while "B" represents the grid. The filament is not pictured separately as it is a piece of plain wire, stretched inside the grid.

The three elements are mounted in a glass bulb from which the air is later exhausted to a high degree. The amount of vacuum in the UV-200, however, is not as high as the others and it is called a "soft" tube, the others being "hard." The elements are rigidly supported so that they will not touch each other. "Leading-in" wires, connecting the elements with the terminals of the base are sealed into glass making an air tight joint, as shown at "C". Two wires are required for the filament, one connected to each end, one for grid and one for plate; hence four wires pass through the seal.

Wet by Red Hot Glass

These wires, where they thread this seal, are of a special composition which expands and contracts at about the same rate as glass. Another interesting thing about the wire—it must be *wet* by melted glass. It is not difficult to find various metals or alloys which have the same rate of expansion with temparature that glass has. However, most of these when poked through a piece of red hot glass will not stick to it completely. The result is that when cooled there is a tiny crack around the wire between it and the glass. This crack is so small that it cannot be seen by a microscope. However, it is big enough to let in a slow trickle of air. This destroys the vacuum in time. The special alloy used in these bulbs prevents this action.

The elements are mounted on a glass "stem," this "mount" being inserted into a bulb. This is shown at "D." The "flare" on the stem is fused to the nesk of the glass bulb,

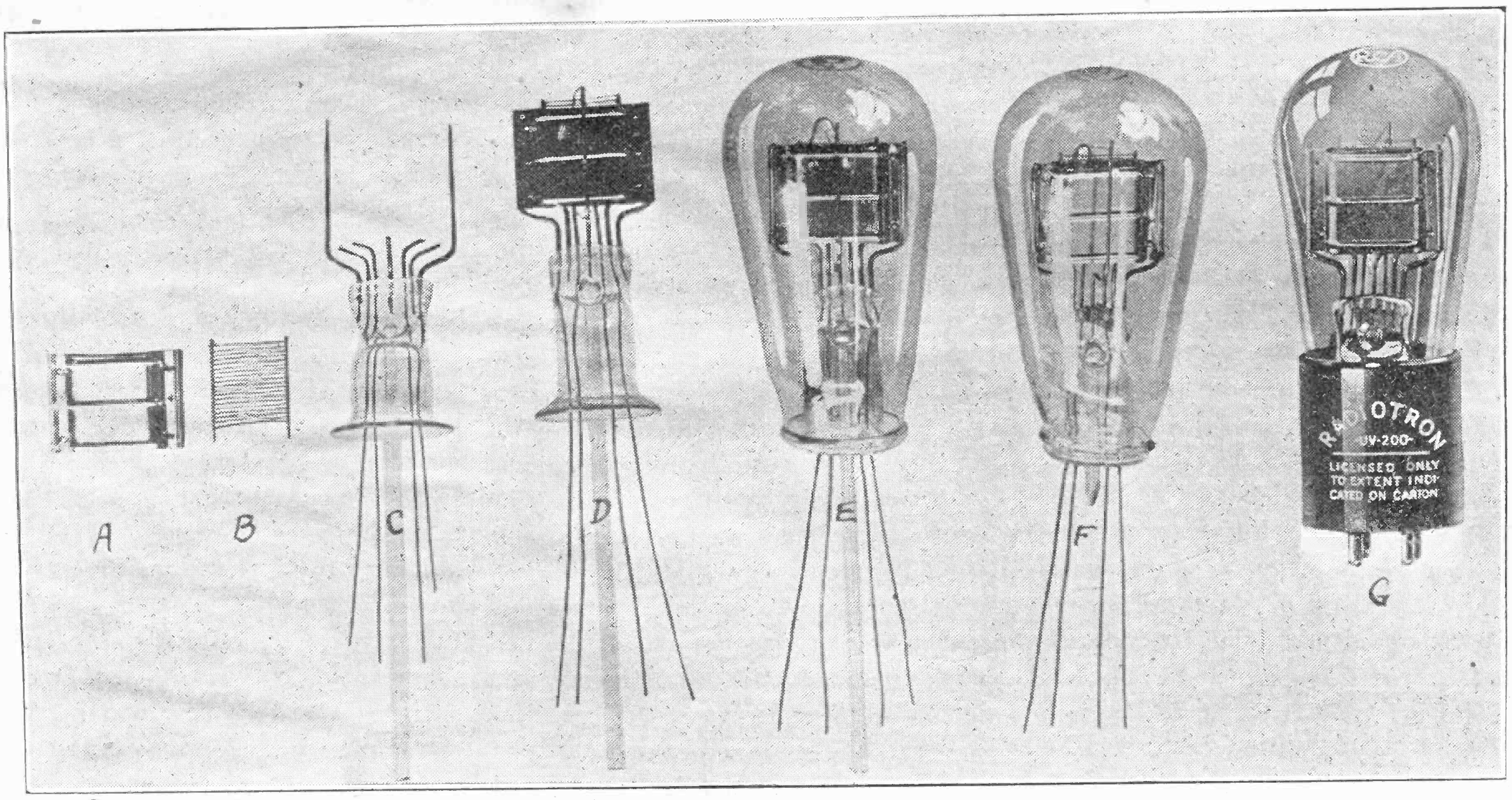

Fig. 2. Shows the Various Steps in Manufacturing the UV-200 Detector Tube

"E," and the air is then exhausted through a glass tube which is afterwards melted off, "F." The base is cemented to the neck of the bulb, the four lead-in wires being soldered to the terminals of the base, "G."

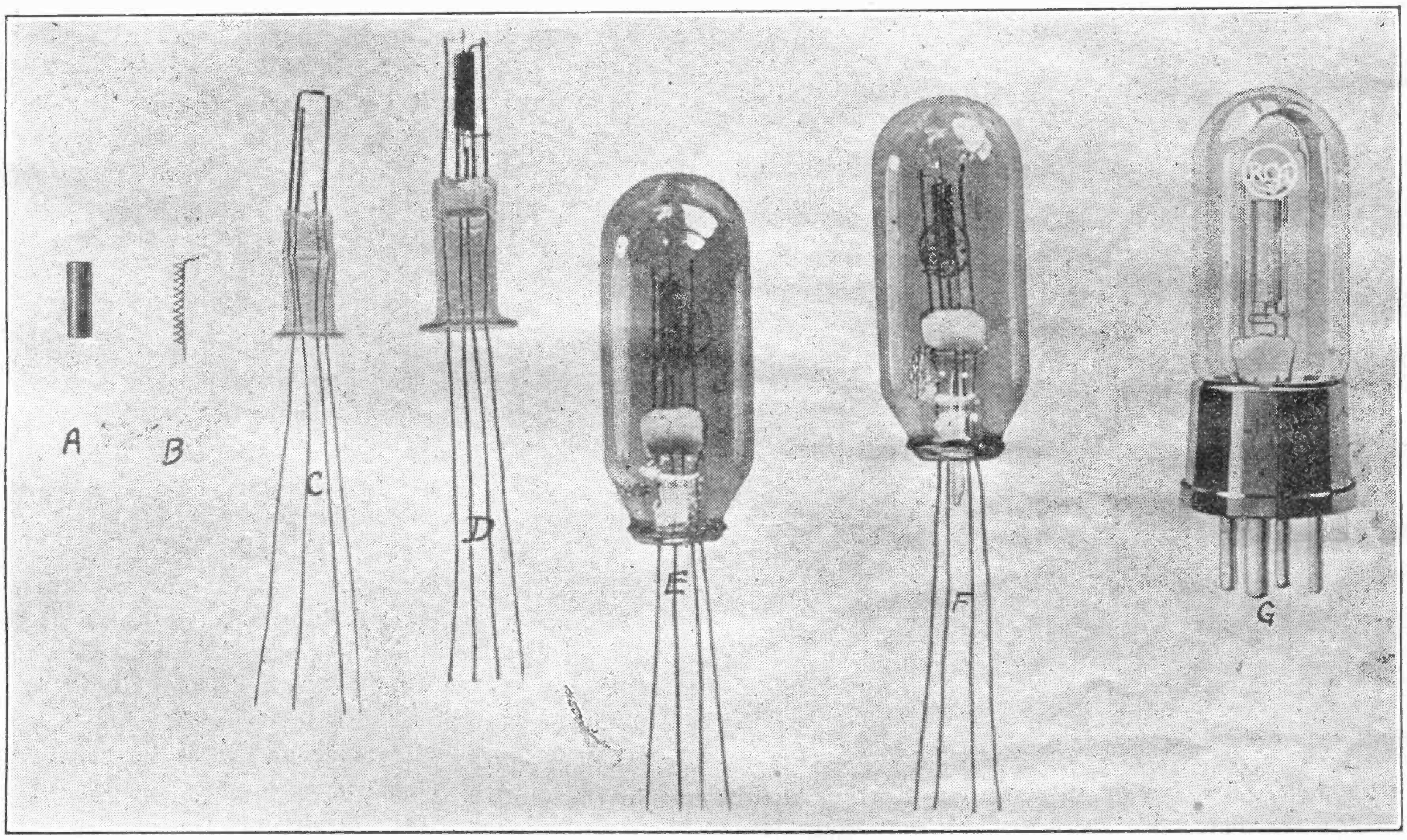

Fig. 3. This Illustrates Making a WD-11 Bulb. WD-12 is Same Except Base

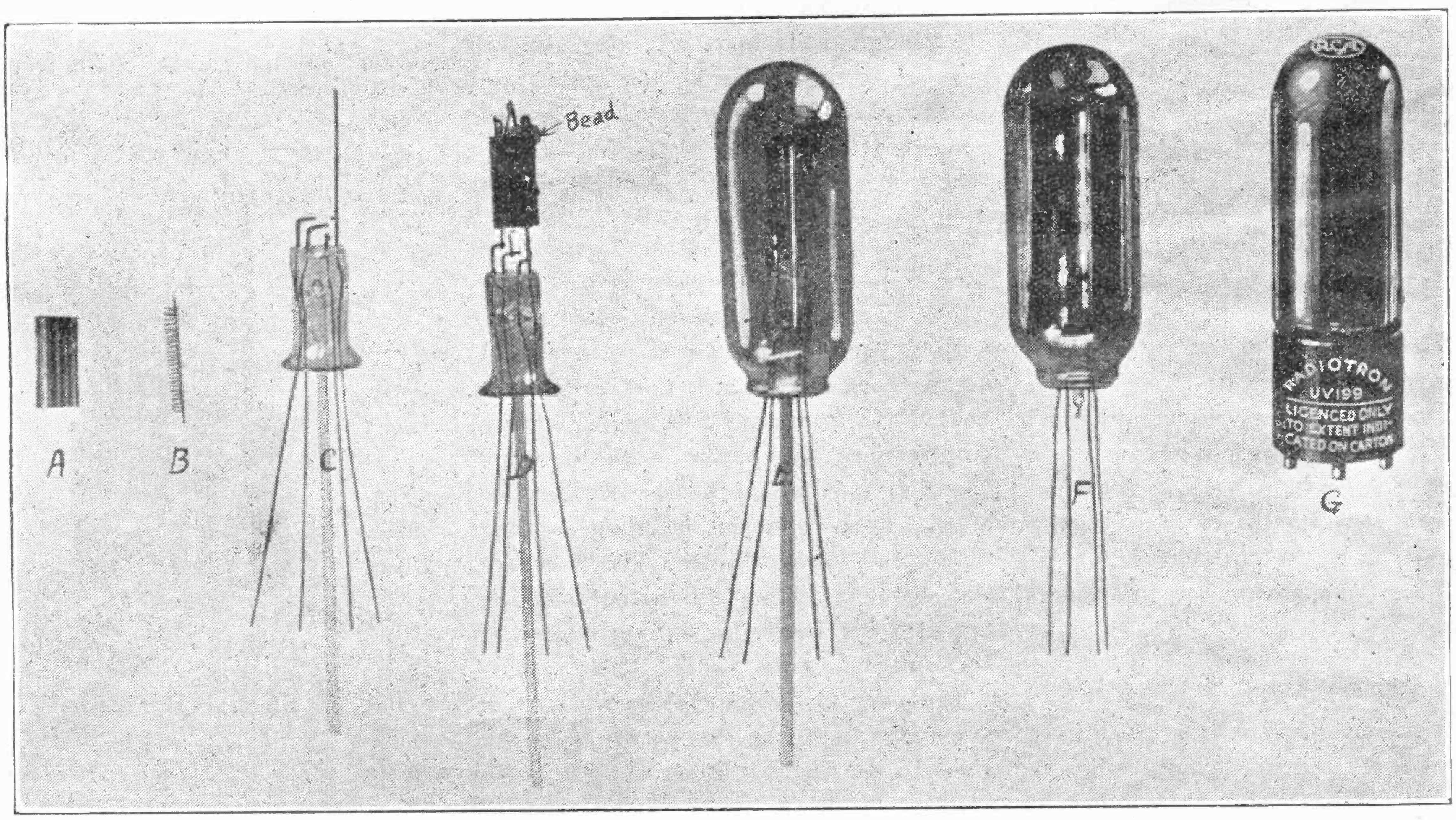

Fig. 4. The UV-199 is Put Together Like This. It Uses an Alloy Filament

Making a Mount

A short piece of glass tubing is heated at one end and when soft is flared out. This flared tube is then heated at the other end, the necessary leading-in wires and extra supports for the elements having been inserted in the tube. When the glass is soft, the tube is pinched together forming the seal, the wires becoming imbedded in the glass. The various wires are then bent the proper shape and cut to the right length, the stem appearing as at "C". The stems are then tested for open circuits, crosses and short circuits.

The exhaust tube, through which the air is sucked out, is at present welded to the stem, thus making a "tipless" tube. Formerly it was fastened to the

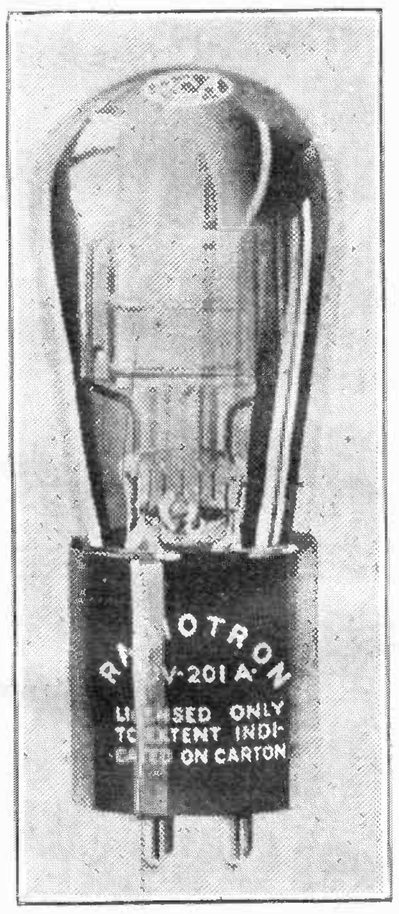

Fig. 5. Complete 201-A

end of the bulb. The tipless tube has its "tip," the sealed end of the exhaust tube, covered by the base, whereas formerly it was exposed on the end of the bulb. The exhaust tube, in the tipless construction, is inserted in the stem tube at the same time the wires are inserted. When the end of the stem tube is pinched together, the exhaust tube is welded to it at the same time. This end of the exhaust tube then unavoidably becomes closed, and is opened up again at the pinched seal by a slight air pressure being put on the open (lower) end of the exhaust tube while the glass is still red hot. The tipless tube is a great advance over the previous one as it prevents damage by breaking the exposed tip. For forty years lamp manufacturers have tried to produce a tipless lamp, but heretofore the expense has prevented its general use.

Welding the Wires

The filament is next put inside the grid, both of which elements then go inside the plate. The three elements are electrically welded to the proper supports and leading in wires. This welding is an interesting process. The two wires to be welded, the lead-in and the filament, are squeezed together between the jaws of a press. A heavy current is sent through from one jaw to the other at the instant of pressing the wires together. This current is large enough to bring them up to white heat in an instant. The pressure drives the two together in such a way that they become practically a single piece.

In the UV-200 and UV-201A, in addition to the leading-in wires supporting each element, there is an additional support, or anchor, for the filament, another for the grid and still another for the plate. Thus in these Radiotrons there are seven wires imbedded in the seal, only four of which go through it to connect with the base.

In the UV-199 there are no other supports inserted in the seal, the upper end of the grid and plate being fastened to wires imbedded in a glass bead which is fastened to the leading-in wire connected to the upper end of the filament. This is shown at "D" Fig. 4. In the WD there is one extra support for the plate.

Sealing the Mount in the Bulb

The mount is inserted in the bulb and gas flames heat its neck. When the glass is white hot and soft, the neck of the tube welds to the flare on the stem of the mount which has also become heated. This makes an air tight joint as the glass has been fused. The only opening to the inside of the bulb is now through the exhaust tube which has been welded on as described.

Exhausting the Air

The air is next pumped out of the bulb. The exhaust tube is connected to a vacuum pump, the bulb being heated in an oven. The high temperature assists the pump in drawing out the air and moisture, the final traces of air being removed by chemicals put inside the glass. In the UV-200, after the unit has been exhausted, a slight trace of an inert gas is purposely put back into the tube.

The oven in which the tubes are exhausted raises the temperature of the glass to red heat. It must not get hotter than that or it will soften so much that the vacuum inside and the atmospheric pressure outside will collapse the walls in. This temperature is high enough to drive practically all of the air out of the glass walls. The metal plate and grid inside are not heated enough by the oven to eliminate all air from them. Remember that the filaments has two leads and so a current can be run through it, but both plate and grid have only one terminal apiece. Then as they do not touch each other there is no chance of a circuit through either. This prevents both these elements from being heated by a direct current as is done with the filament.

Fooling the Plate

If the plate thinks that because it has only one lead we cannot heat it by electric current it is much mistaken. To be sure direct current cannot be used as just mentioned. But a large coil is placed around the outside of the entire tube. By running a high frequency alternating current through this coil we may induce eddy currents (at the same high frequency) in any metal lying inside the coil. The plate is located so that these powerful eddy currents circulate around in it and heat it so hot that it raises the temperature of the grid inside it. In this way the metal is brought up to a heat high enough to clean out all the air. The action is similiar to a short circuit secondary coil of the transformer. In this case the coil outside the bulb is the primary

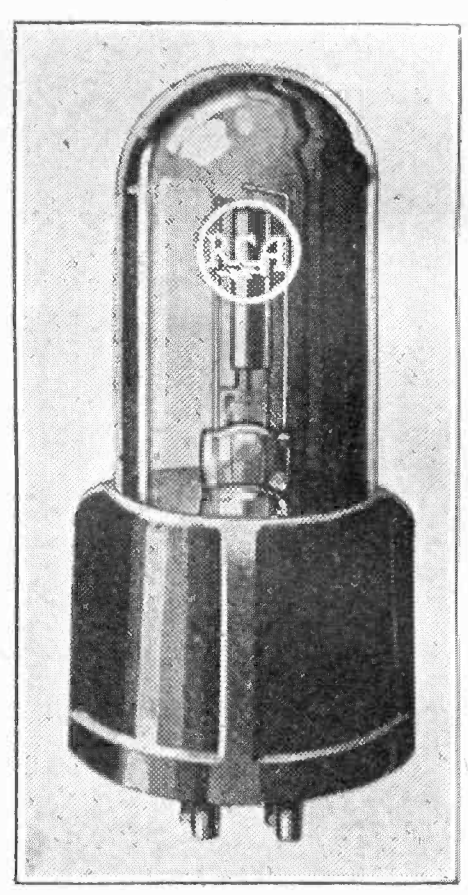

Fig. 6. Special Base of WD-12

and the plate the shorted secondary.

The heat produced vaporizes the chemicals, which condense on the cooler surface of the bulb, coating the inside of the bulb in the case of the UV-201A and UV-199 with a mirror

Continued on Page 21

Remarks Received from Readers

EDITOR, RADIO PROGRESS,

Dear Sir:

The radio public is accustomed to the use of condensers, which are rated in microfarads capacity. When two are put in parallel, the values add, as for instance, a 2 + a 1 mfd. capacity equals 3 mfd. Being familiar with this usage, makes it hard to get the idea of the megohm rating of grid leaks. For here, if we have a 2 in parallel with a 1 megohm leak, the answer is not 3 megohms, but a value even less than the smaller.

For this reason, when one speaks of "adding more leak" it is impossible to know whether he means more resistance or a bigger leak for current. One naturally thinks that a big leak would pass more current than a small one, but as the megohms go up, the current drops off. As an example, some people call a ten megohm leak a large one, because the figure is big. Others call one-quarter megohm a big leak because it lets the current leak away very fast. Which way is the proper one?

To get around this difficulty, there is a unit for the amount of current which a leak will conduct. I refer to the terms "Mho," which is the word "Ohm" spelt backwards. This is the unit of conductance, and a wire with a large resistance in ohms has a small conductance in mhos. One million ohms (1 megohm) has a conductance of 1/1,000,000 mho (1 micromho). In the same way a two megohm resistance is a leak of one-half micromho.

Using this system if we add a 2 and 1 micromho in parallel, the answer is 3 micromhos. Also a big leak is one of several micromhos, and will pass a big current, while a small leak, which lets only a small current through, would be rated as ¼ or 1/10 micro ohm.

I do not advocate the substitution of conductance units for ohms in rheostats, because the term "cutting out resistance" is familiar and quite to the point.

Richard E. Connet,
Cambridge, Mass.

WAIL OF A RADIO EXPERIMENTER

To the Editor,
RADIO PROGRESS

I am sure that I pay more monthly for house fuses than any fellow this side of the River Jordan. My electric light bill breaks my back. My experiments break my pocketbook, and my dear wife —bless her soul—breaks my head. Radio and women don't mix worth a cent.

She never can see the point for the reason that electricity is so mixed up in foreign terms that it is impossible to make a woman understand just what you are trying to accomplish. All they can see is the muss and dirt of it. But, my dear Ed, this is family affairs, and does not interest you in the least, as you have enough of your own without reading about the other fellows.

Life is a great thing, and it is the same over and over. During the evenings I start to putter on some apparatus.

"What in the name of heavens are you doing now? says my wife.

"Making a complexoplex."

"What's that?"

"It's so and so—etc—etc."

"What are you going to do with it?"

"Sell it."

"For how much?"

"About $1500 for all rights—etc—etc."

Two Weeks Later

"Where is that thing you had last week?"

"In the drawer."

"Why, it's all broken up."

"Yes."

"What happened."

"It wouldn't work."

"Hum, time wasted. Can't you think of something more profitable. Can't you spend your evenings with me—blah! blah!

My dear Ed, it would have been all different if I had brought home that $1500. But—well, women never understand.

Respectfully,
C. W.

HOW VACUUM TUBES ARE MADE

Continued from Page 20

like deposit. The chemicals used in the UV-200, WD-12 (and WD-11) do not discolor the bulb. The exhaust tube is then melted off, the exhausted bulbs then appearing as at "F".

Taking its Base

The exhausted bulbs are then based. Some cement is smeared on the outside edge of the base, the four leading-in wires being threaded through the holes in the base contacts as the base is put on the neck of the bulb. The tubes are then passed through a heater which hardens the cement. This done, the excess length of leading-in wires is cut off and the ends soldered to the base contacts.

The manufacture of the radiotron is now completed and it appears as at "G". Each Radiotron, however, has to pass through several tests before it is packed for shipment to insure that the product is up to standard.

As already explained the 201A is built like the 200 except that the filament is made of an alloy so that it gives off enough plate output with only ¼ ampere filament current. Fig. 5 shows this tube completed. Fig. 6 is a picture of the WD-12. Notice that the base is much bigger than that of the WD-11.

Testing the Tubes

Each Radiotron is first tested to see if the filament lights up and that there are no short circuits, open circuits or cross between any of the elements. The current and voltage of the filament are read.

Each tube is then tested for its degree of vacuum. Unless the tube has the proper amount, it is rejected asd scrapped. Each tube then is measured for electron emission, or plate current. Again, unless the tube has a certain minimum electron emission it is destroyed.

The final test is an intricate electrical one. The amplification factor and impedance of each tube is measured to see that they come within certain prescribed limits. In this test the tube is put into actual operation as in a radio receiving set.

Thus each Radiotron is thoroughly tested before it is shipped to the consumer to insure its giving proper service.

ADVENTURES OF SPEAKER

Continued from Page 16

announcer nearly collapsed.

Having heard so many thin, puerile voices over the radio, I resolved, during my first broadcast, to make my voice unusually loud and clear. After I had, with an air of satisfaction, finished my broadside, one of the operators said to me: "Sure, you were all right; bellow all you want to, for we can tone you down upstairs!"

I got a genuine fright in another studio by listening to a speaker coming before me, as his talk came through a loudspeaker out in the outer studio. Such frog-like croaking and sputtering I had never heard before. I wondered if I was going to sound like that!

Talking in Bunches

Any radio speaker should keep in mind the fans with loudspeakers. After one of my talks, I passed by a radio store where people were listening to broadcasts from a large street loudspeaker. A man was talking, and his rapid words were hoarse jumbles. I learned a lesson, then and there, to talk more slowly and distinctly.

I can now recall several occasions when I found, only too late, that foolish errors had crept into the final copy of my talk. I had to stumble on, regardless of how I felt about it. On another occasion I was unusually bothered by the fear that a thought I had just expressed was utterly senseless. This haunting fear made me skip lines and pages, mispronounce, and have a generally miserable time.

200 Years Apart

Radio speakers do not realize until too late how awkward and impossible to enunciate clearly over the radio, are some of the phrases and words they attempt. Every speaker ought to read out loud carefully his radio speech, before he considers delivering it. From experience, I know that dates are easily misread—such as saying 1719 for 1917.

I shall remember the night at a studio when a terrible orchestra was playing. The announcer left the studio holding his nose, and exclaiming: " How on earth shall I get them off the air?"

This Was a Free Blow

Desiring to make the best possible impression, I took down to a nearby island my copy of a talk to be delivered the next day. I sat on the rocks overhanging water about six feet deep. The tide was going out, and a brisk off-shore breeze was blowing. I began revising my talk, when suddenly it flew out of my hand and landed far out in the water! And the talk was due the next evening! To make up the loss I spent one very busy evening.

In another studio, I was directed to sit down in a cramped position at a very low table. My arms were in an awkward as well as uncomfortable position, and I had to lean over to get near the microphone. Besides, I had to keep my manuscript out of the way, so that no crackling of the leaves would be transmitted. I was, moreover, cheerfully advised by the announcer to watch the signal board, so as to tell how my talk was going out. In looking at my paper, the microphone, and the signal board, I had quite a task. Besides, the paper and the "mike" were just right, so as to make me become slightly cross-eyed. Try putting yourself in a similar situation! I really believe there is exercise in these contortions of sufficient value to warrant their inclusion by Mr. Camp in his "Daily Dozen!"

Never mind, the radio speaker must stand "pat" before the "mike"! Radio artists must continue to provide the wherewithal which permits radio enthusiasm to be all "het up" over a heterodyne, or crystallized in a crystal set.

BUILDING THE NEW DERESNADYNE

Continued from Page 14

Tuning the Set

Before trying to operate the set, it will be well to read over carefully the following points on tuning the set.

1. Turn the stage control switch knob 5 to the LOUD position; if during the tuning the volume is too loud, it can be shifted to the SOFT position. When in the LOUD position the rheostat knob 6 will have to be advanced more as one more tube is connected in the filament circuit.

2. This rheostat knob should be turned to about a horizontal position pointing to the right. With knob 5 in the LOUD position all five tubes should light, but in the SOFT position only the first four will be lit. Don't turn knob 6 (rheostat) any further than necessary. Why use more battery current than is necessary to operate the set? In addition economical operation will also increase the life of the tubes.

3. This plate balance knob 4 should be retarded (turned to the left) for low wavelengths, near the zero end of the large dials and advanced to the right for high wavelengths near the 100 end of the large dials. This is indicated by the arrow arrangement shown in the panel layout Fig. 4. Advancing this knob 4 increases the strength of reception, and retarding it clears up signals and eliminates undesired noises.

Aerial Length Changes Dial

4. To locate stations, turn dials 1, 2, and 3, slowly, keeping approximately the same number on each dial in line with the indicator line on the panel. This can be done by setting dials 2 and 3, say at 60, then turning dial 1 slowly from 55 to 65. If no station is heard set dials 2 and 3 at 57 and repeat the operation with dial going from five points below the setting to five points above. This is done because different antennas slightly effect the setting of dial 1. Proceed with this operation until a station is heard, but don't forget the relative position of knob 4 on different wavelengths.

5. After a station is heard, carefully adjust each of the three dials for best position. Then adjust knob 4 for maximum clearness and volume. Make a record of the dial setting for each station that you tune in and keep it for reference when you want that station again. This will also provide a guide of the approximate setting for any particular wavelength you may wish to tune in for.

6. As was explained before, for greatest selectivity put the antenna plug in "selector" position, normally use the "medium," but when interference doesn't bother you use the "volume."

WHY WAVE LENGTHS CHANGE

Continued from Page 15

wave to each broadcasting station, as a frequency and wave length is found from it by dividing 300,000 by the figure representing the kc. Every ten kilocycles

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THOSE SPITEFUL CALL LETTERS

Has this happened to you? You sit up until 'steen o'clock to pick up that far away station and finally you catch the coast. You are sure that it must be at least as far away as that and the music is quite clear although very soft. Unfortunately, the announcer seems to have forgotten where he lives, since he goes on and on without giving his call letters. Suddenly as the music stops he says, "the station you have just been listening to is Umpty Squeal Squeak." There is fifteen minutes of your time wasted as you will now have to listen for another quarter of an hour until the spirit moves him to give his name again.

Why is it that station which seems to be quite clear and easily understood so often can not be heard when the call letters are announced? There are several reasons for it. In the first place it is perhaps partly a trick of our own minds. If we pick up three calls in succession and then miss the fourth, we are more disappointed at the single failure than we are pleased at the three successes. It is always the biggest fish which drops off the line into the water.

And then another thing is the matter of context. If you hear some one reciting a poem and he gets to the line, that sounds like, "You're a better fan than I am, Hunk-of-Tin," you can probably recognize it as one of Kipling's poems. That is why in testing a telephone line Edison recommended using a chemical catalogue to read from, because the listener at the other end could not guess what was coming from the context. When the call letters and city are mentioned, there is no context at all to help you out, and you must rely on hearing the exact words at that instant to be able to recognize them.

Blame the Announcers

Part of the blame should be put on the announcers themselves. After saying the same station over every few minutes for the last two or three years, they naturally get rather tired of the constant repetition and so they are apt to say the mystic words as seldom as possible. When they do repeat them there is a tendency to get an unpleasant business over as soon as possible and so some of them slur over the sylables in a way which makes it difficult to understand. Those who do it are certainly wrong, since they are not paid to please themselves, but to help the thousands of waiting fans who are hanging breathless on their announcements. If you find that any particular station is at fault in this way, by all means drop them a line, complaining of it. A few jolts from the public will let such careless announcers see the light.

But lastly, you are somewhat to blame yourself, you and your friends. After being contented with a good, reasonable adjustment on your set while the piece has been played, haven't you often starting jiggling your controls at the instant when you expect the call? Lots of others around you have done this too. Since every one who is listening to that particular station is naturally on the same wavelength, it means that so many slight adjustments and increases in feedback from the regenerative sets will unavoidably distort the faint radio waves coming in from far across the Continent. The only remedy for this condition is to make the best adjustment on that wave during the playing of the music and then when the announcement is about to be made *hands off the set.* If you will do this and get your neighbors to do the same you will find that the elusive call letters will come in better than they are now doing.

A TAX ON TUBES

The question of money is again being raised. It is strange how much people are interested in money, isn't it? This time it is in connection with radio artists again. As a matter of fact, there is no doubt but what their compensation could be doubled without overpaying them, since at present they are receiving nothing at all. Even John McCormack, at the top of the list, recently reported that he received no financial return for broadcasting recently in one of the Victor Concerts. Perhaps this may have unconsciously influenced him in his decision not to repeat the performance.

Who should pay for broadcasting? This is an old question. In a recent issue of the *Radio and Phonograph Dealer* a contributor proposed that funds for this purpose should be raised by a tax on parts of radio sets. If a coil or condenser were to be taxed, it would be paid once and for all, and then no more revenue would come from that particular set unless some accident happened to destroy the part in question. Tubes must be renewed, however, and if the tax were placed on this important part it would be collected every once in so often as long as the set was being used.

If we wish to tax a radio roughly in proportion to the amount of its use, a tube tax would perhaps be fairer than other way of assessment. While two bulbs working together will have unequal life, one, perhaps, lasting twice as long as the other, still in general the life of this unit is a fairly fixed quantity when taken on the average. In the same way electric light bulbs in your house have variable life. One of the lamps in the dining room burned out in three months, while one bedroom lamp has been there since the house was built. But still, you know that the number of lamps which you buy during a year is about the same from one year to another. And the number of tubes which are bought per set depends very largely on the use you make of them.

Furthermore, if we believe that it is fair to charge in proportion to the service received, then a five-tube set should pay a lot more than a one-lunger. It is able to receive from much farther distances, and pulls in the music a great deal louder. If the assessment were to be made as so much per tube, then it would bear its proportional share of the burden.

Although the proposal to tax the crystal of a crystal set does not seem quite so well adjusted to the needs of fairness, still the whole scheme appears to be more equitable than any we have run across, *provided* that radio must be taxed.

Is a Tax Needed?

Notice that we say, "Provided that radio must be taxed." We are not all convinced that it is necessary to raise money in any such way. As long as there are so many broadcasters who are willing—even eager—to run their stations themselves without any outside contributions, why is it necessary to make such a hue and cry over financing?

Remember that the Department of Commerce had worked out a complete scheme for assigning wave lengths to the stations then in existence. This plan was to have gone into effect the first of the year. However, it was finally cancelled because so many new applications were received for opening additional broadcasting stations that there were altogether too many of them to fit in with the plan.

They Like to Talk

With all these concerns which are willing to supply the public with programs for nothing, it seems a little beside the mark to offer to subsidize broadcasting. The claim is made that by doing so we could have better programs. This is doubtful. The numbers put out by the large companies like General Electric, Westinghouse, Crosley, and the large newspapers, to name only a few, are now so good that it is hard to think how they could be made better.

Of course, there are many small stations now on the air which put out ready-made programs by running off a series of phonograph records, but such stations would not receive any of the subsidy anyway. The taxing plan contemplates giving the money only to a few superstations and letting the small fry feed themselves. Small locals would therefore not be helped at all to raise the quality of their offerings.

In view of this situation, we recommend that any such tax be postponed until the time when the radio stations show a pronounced trend to smaller numbers. It will be time enough to raise money for the few struggling stations when said stations begin to struggle.

GRINDING THOSE AXES

It is surprising how much radio literature these days is a kind of advertising. Look over the various publications and notice that each chap is writing in praise of his own article. One recent issue of a popular radio magazine was given over almost entirely to the three or four associate editors, each of whom described in detail the product of his company.

While there is no doubt that the sets and parts put out by each of the manufacturers are quite reliable and good, still it gets a bit tiresome to hear a person continually praising himself and his works, particularly if it is written up in the body of the magazine and not labelled "Advertisement." Many readers will rely more on an editorial comment than they they will on an advertisement about the same thing.

That is, we feel that the editor of a magazine should not keep praising his own apparatus unless he makes it plain to the reader that it is an advertisement that is being written. Oftentimes the editors as well as the readers are fooled.

We know of a case where a radio magazine was paying a certain writer for regular contributions each issue. They began to get stronger and stronger in advertising flavor, and finally the author was looked up. He was found to be the publicity manager on the payroll of the company whose products he was boosting. Of course, the contract was immediately cancelled, but that same author continued to send it articles without pay in the hope that they would be published as free advertisements.

Caught with the Goods

As an editorial policy, RADIO PROGRESS is trying to keep away from such a course. Naturally, we have a great many articles describing certain devices which are on the market. This is necessary since, if we are to be "Abreast of the Times," we must keep you informed as to all the latest improvements which are being made. But if you should happen to find that we have unintentionally fallen into the mistake of disguising advertisements as regular articles we hope you will let us know immediately.

The "A"---"B" Charger

This New Device Needs No Battery Switch to Disconnect

By OLIVER D. ARNOLD

THERE are a great many different kinds of battery chargers on the market. Most of these take care of the "A" battery only, and a few of the "B". Besides these there are some which are designed primarily for six volt output but can be made to charge up to 22 or 45 volts by use of a special attachment.

Practically all such charges have required a battery switch to disconnect battery and charger while the set was being used. This was necessary for this reason. The electric light system which furnishes the power to the unit has one side ground. This is the almost uniersal custom throughout the United States. Also one side of the "A" battery is likewise grounded in the usual radio set. As there is a connection between the input and output sides of most chargers it would sometimes occur that the grounds on the two systems would happen to come together. In such a case no trouble would be experienced.

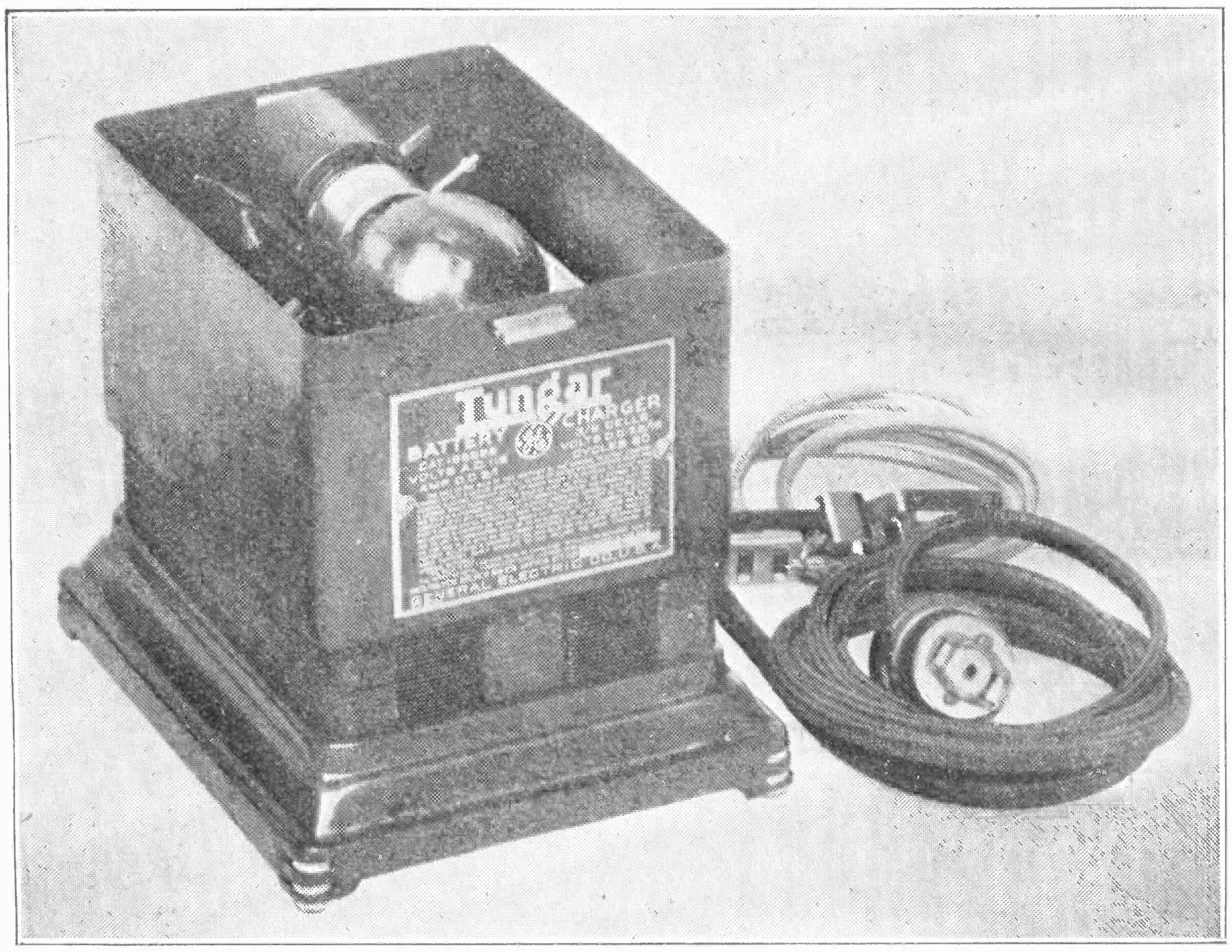


Fig. 1. Rectifier Which Charges "A" and "B" Batteries

Burning Out the Tubes

But sometimes in plugging in on the alternating current (AC) the user might happen to get the connection made so that the two grounds were on opposite sides of the 110 volt line. In such a case there would be a short circuit, which might include the tubes in which event three of four new bulbs would be sold by some radio dealer. The only way to prevent such a catastrophe was either to open a switch connecting the battery to the set or else what amounted to the same thing, to disconnect the battery by taking off its clips.

Fool Proof for Polarity

Besides the trouble of short circuit, it is true that most of the vibrating types of rectifier use a small amount of current from the battery to get the right polarity for the charge. The bulb type represented by the Tungar must be connected with the plus of the battery to the red wire, or else it will be discharged instead of boosted. These vibrating types have the advantage that you can hook-up the battery with the positive running to either of the leads. In this respect it is trouble proof, but to pay for this very slight advantage a certain small amount of current drain from the battery is needed.

This is another reason why this style of unit can not be left connected to the battery all the time. The amount of current wasted by this requirement is so small that it is lost in the shuffle while the battery is being charged. But if it were to run twenty-four hours a day,

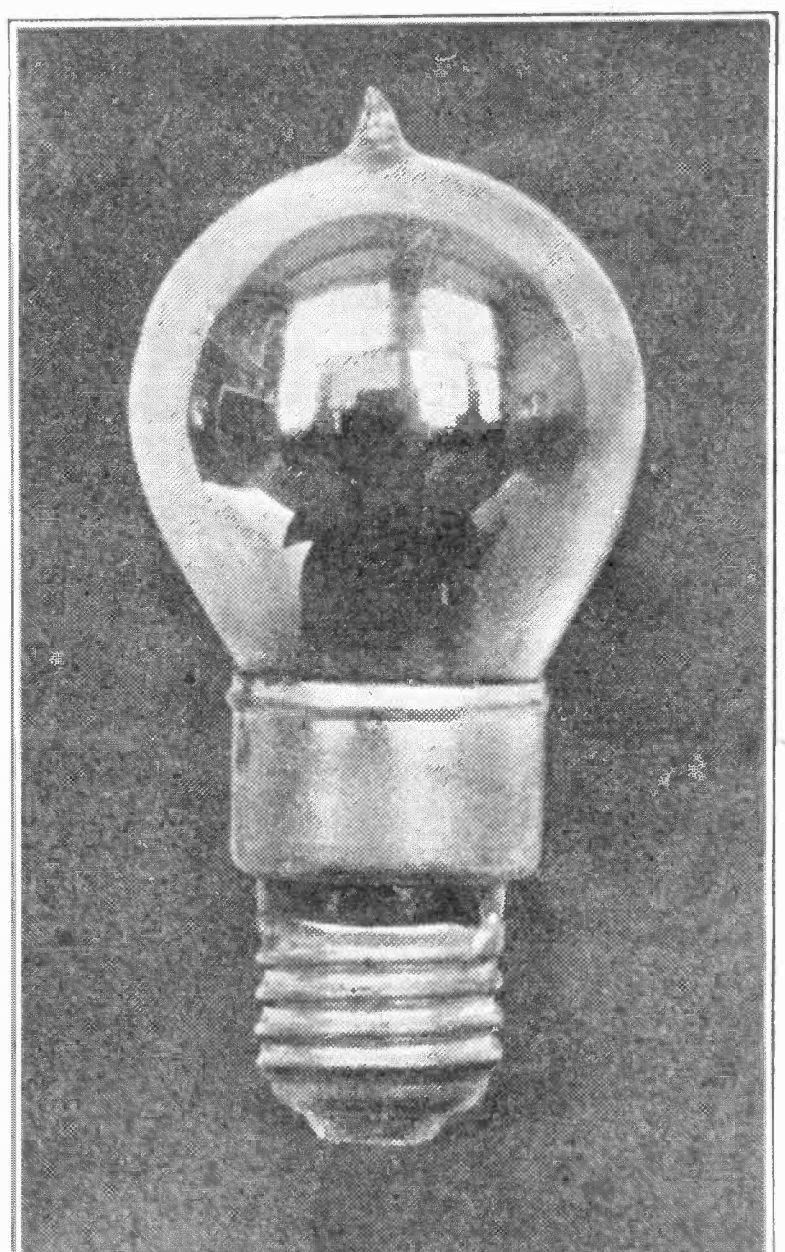


Fig. 2. New Tungar Bulb

seven days a week, it would reduce the life of the charge in the battery quite considerably so it is not practical to leave battery and charger hooked together all the time.

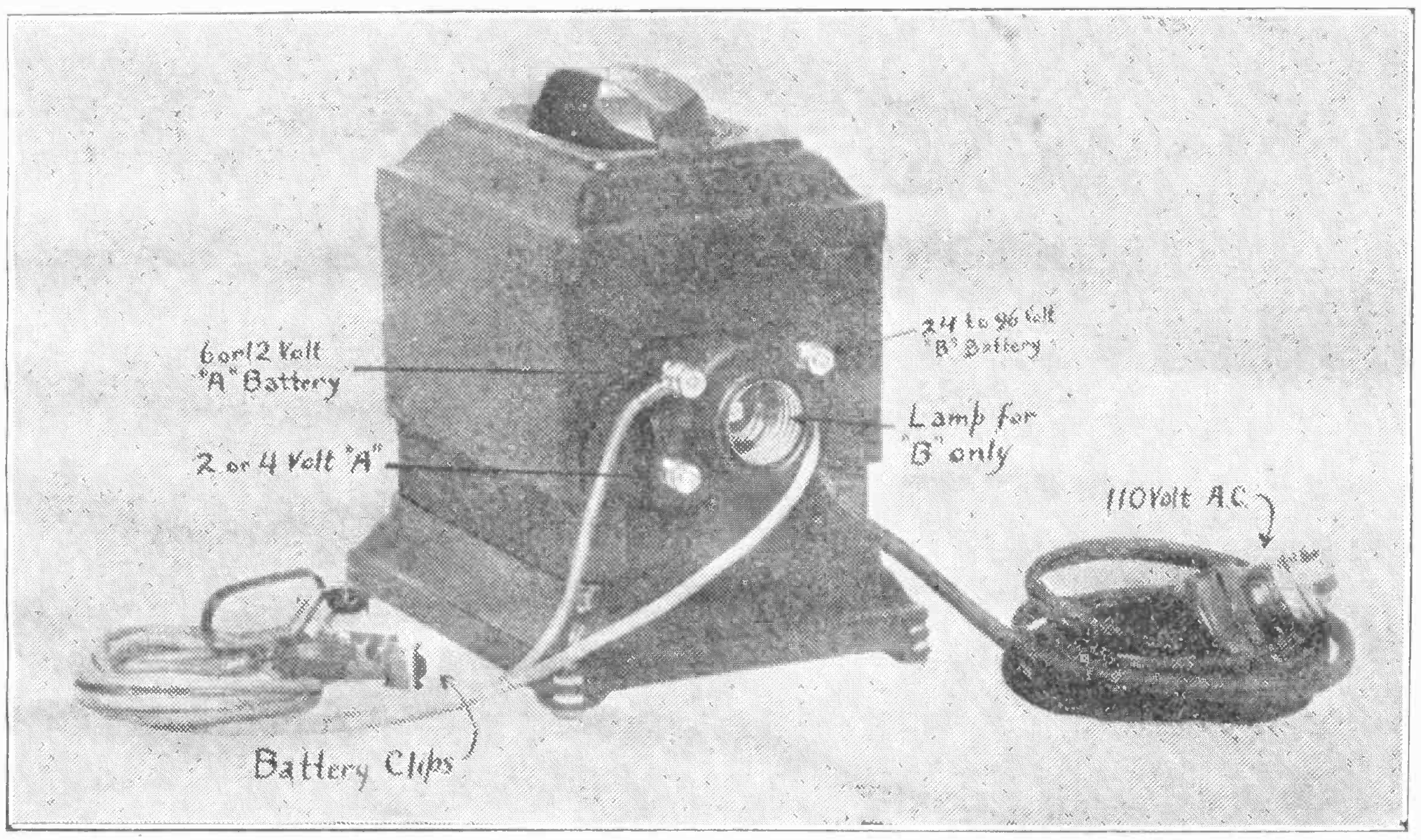


Fig. 3. Rear View Showing Adjusting Lamp Socket

These Troubles Overcome

The new Tungar rectifier, which is just being put out, gets rid of the disadvantages just mentioned. To be sure the output is polarized—the plus of the battery must still be connected to the red line. But since this connection may be made once for all and never disturbed again, this need can not be regarded as a drawback.

Fig 1, shows the appearance of the new device. It is changed quite a lot both inside and out from the old form of Tungar. The first difference that catches your eye is the new mounting and kind of bulb. Of course, it is the bulb itself which really is the rectifier. The windings on the transformer are needed to change to the proper voltage and also to light the filament. But it is the bulb which acts like a valve and allows the current to flow in one direction, but not to reverse.

Top Connection Omitted

The old style of unit had two terminals at the base, just like an electric light, and also one wire sticking out through the top of the glass. This was hooked up to a flexible wire with a clip on the end of it which came out from the transformer winding. To make this extra contact was something of a nuisance, and also there was some danger of breaking it off.

Fig. 2, shows the appearance of the new unit. Notice that the plate connection no longer comes through the glass but is made to the metal rim around the base. To connect this bulb all that is needed is to screw it into the base like an electric light. All these connections (two for the filament and the plate) are made at the same time.

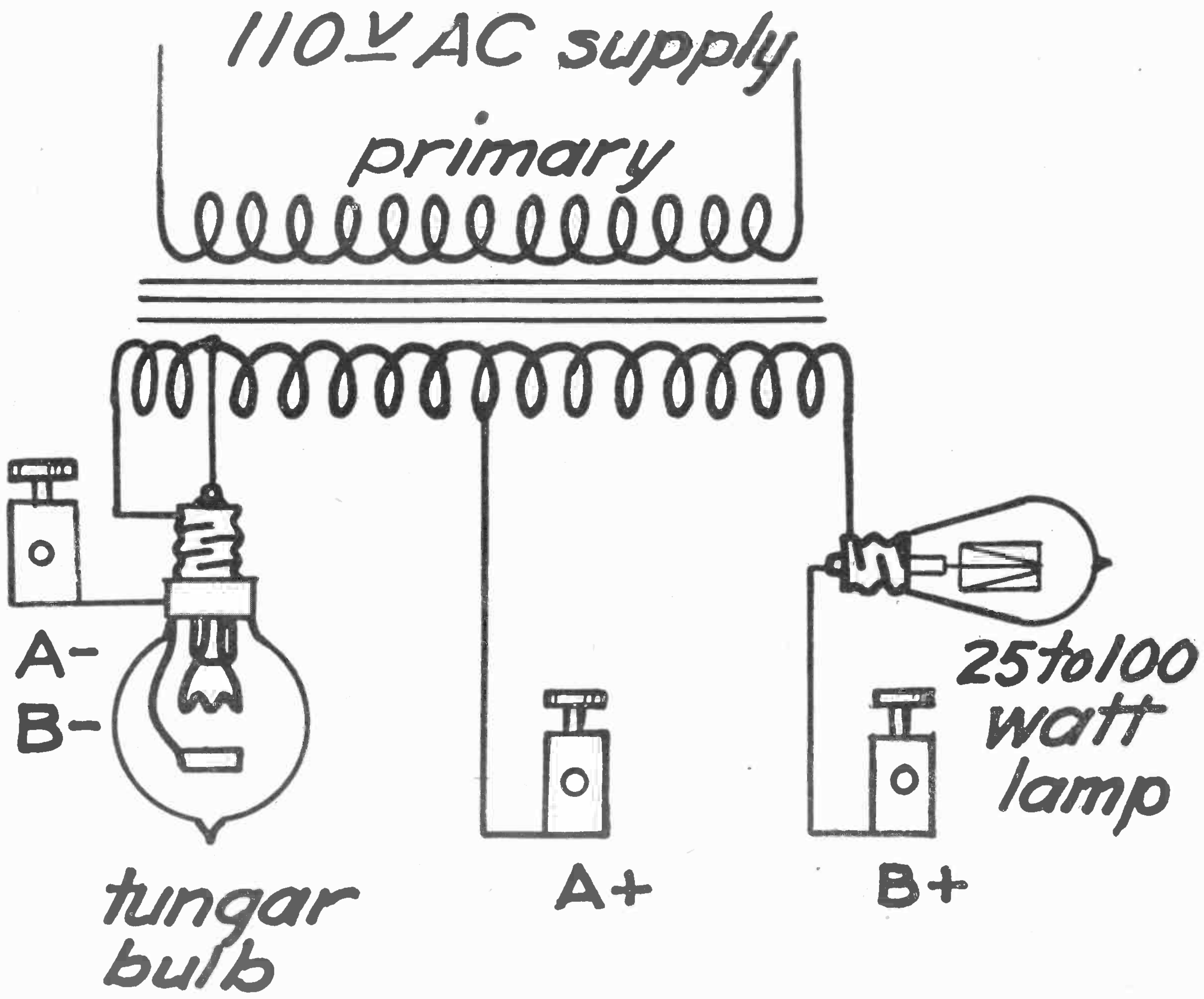


Fig. 4. Hook-Up of Charger. Note Bulb and Lamp.

The operation of the device is the same as before.

The current consumption of the filament is low. Twelve amperes at 2½ volts are required for the small size and 18 amperes at 2½ volts by the large rectifier. The right current and voltage are automatically given by the transformer windings, and of course this energy is supplied by the 110 volt source.

Charging the "B" Battery

To fill up your storage "B" battery no extra attachment is needed at all. Fig. 3 is a near view of the instrument. Notice the socket in the middle of the back. This is not used at all while the "A" battery is on the line. For the "B" a 110 volt electric light is screwed into this socket. The size of this depends on the "B" battery you are charging. For a small one a 25 watt light is correct, while a large capacity "B" or a 90 volt outfit can be charged all in series with a 100 watt lamp.

The terminals are marked in Fig. 3. With this equipment you can charge any amount of "B" battery at the same time in series up to 90 volts. However, a 22 volt "B" will not be overcharged and so damaged. To handle a six volt "A" battery the indicated terminal is used. This takes care of sets using 200 and 201-A tubes.

For Dry Cell Sets

The WD and 199 tubes are very popular at the present time. These are intended primarily to take 1 or 3 dry cells

Continued on Page 30

How the Eclipse Affected Radio

First Report on the Results from Transmitting Tests

By R. H. G. MATHEWS

THE biggest free spectacle shown in northeastern United States in a century not only effected the spectators but also disturbed radio conditions to some extent. This was one of the things looked for by the scientists. It will probably be a year or more before the results will be known completely since the amount of data gathered by the various observers is very large. This is a first report which is interesting since it verifies the ideas of radio which we have all believed in the past few years.

There has always been a question as to what causes the big increase in range of radio transmitters during the night compared with the day time. It was thought that this was due to the fact that by day the powerful sunlight ionized the air while at night this action was absent. The powerful rays of the sun particularly the short wave lengths beyond the violet—the so-called ultra violet light are much stronger way above the earth than they are after being filtered through 10 or 20 miles of air. At these high altitudes they are so powerful that they sometimes knock an electron out of some of the air molecules and this ionization disturbs the radio waves passing by.

Listening in at 4:00 A. M.

It has been noticed for years that the range of radio stations is about ten times at night what it is during the day time. This is fortunate for those of us who have to work during the day and use the evening to annihilate space with our radio. A somewhat unexplained fact has been the increase in range during a momentary period at the breaking of dawn. Just before daylight for a few moments tremendous ranges can be covered greater than even during the darkness. Most people are willing to take the engineer's word for it, as this is a distinctly unpopular time for listening to radio.

Foreseeing the possibility of testing this sunlight absorption theory during the period of artificial darkness produced by a solar eclipse, the Zenith Radio Corporation established its 100-watt Portable Broadcasting Station WJAZ mounted on a one ton truck in Escanaba, Michigan, in the exact center of the path of totality of the solar eclipse of January 24th.

The oscillator, modulator and five-watt amplifier on the truck were placed at the rear of a garage building with a 100-foot, four-wire copper braid antenna running almost straight up to a 75-foot mast. Two wires covered with tin foil (to shield them from interference) were run to the line amplifier, which in combination with the control board for the three microphones used, were placed in a temporary studio arranged in the front show window of the garage display room. Precautions were taken in draping and arranging the studio to avoid echos and other bad acoustic effects. A frequency of 1,120 kc., was used with a total power of 100 watts, the radiation current in the aerial being about three amperes.

Prizes for Distance

A three-hour musical program was given each evening for three nights preceding the morning of the eclipse. These performances ran from 10:00 P. M. until 1:00 A. M. Several Zenith receivers were awarded as prizes each night for telegrams received for the greatest distances covered, and also by the method of drawing from all the messages received. An average of 500 telegrams per night were brought in, and the longest distance covered during these evening programs was approximately 800 miles, various points in Nebraska, Missouri, Ohio, Indiana, Michigan, Wisconsin, and Illinois being reached with fair regularity. The normal range of the transmitter during the night period therefore would appear to be 800 miles as a maximum. This is good for a portable 100-watt station.

During the evening preceding the eclipse a program was rendered from 10:00 P. M. until 1:30 A. M., the farthest point reached being New York City. It was curious that practically no other distant telegrams were received, indicating that either the transmitter was not covering its normal range in all directions or that weather conditions were peculiarly unsatisfactory. (Maybe the confirmed listeners had gone to bed early so as to get a good start at the eclipse the next morning.)

At 3:00 A. M. a second program of music was started and this ran through until 9:00. The eclipse occurred at 8:02 A. M., Central Standard Time. No change was made in the apparatus from the time of the earlier evening program, and from 3:00 A. M. until 5:30, only ordinary normal results were obtained, a few telegrams coming in from Missouri, Kansas and Eastern Nebraska reporting reception. This is not surprising, considering the time of day.

Testing for Audibility

The engineers of the Zenith Radio Corporation in the Research Laboratory at Chicago reported fair reception at this time on their instruments with which they were carefully checking the loudness, the reading on the audibility meter at this time being about 30. This meant that the music was 30 times as loud as was necessary to be just heard by straining one's ears

At 5:30 A. M. the first faint flush of light appeared in the east as observed by the engineers with the broadcasting station. At this time, the familiar increase in range due to the dawn effect preiously mentioned, was looked for. We were not disappointed.

Uncanny Volume at Dawn

A telegram was received filed at 5:31 A. M., from Porum, Oklahoma, reporting reception. The signals apparently, however, instead of falling off nearly to nothing at these distant points, as is usual immediately after this dawn effect, continued steadily to increase or at least to hold this uncanny volume at extreme distance.

At the same time a peculiar thing was happening in a band or ring at distances of 25 to 80 miles. In this band we had listeners who were able to hear us with only slight volume at night, but at this time on the morning of the eclipse our signal strength was excellent. These receivers apparently were in what is known as the daylight range of the station and therefore our signals were louder in the daytime than at night. In the case of listeners inside of a 25-mile circle no change was noticed at this time.

While Sender Was in Shadow

This condition of extreme volume at extreme distance continued through the entire period of the eclipse and until the moon had passed completely from in front of the sun as far as the locality of the transmitting station was concerned. This is indicated by the filing time of the following telegrams:

Atkinson, Nebraska	5:35 A. M.
Lincolnton, N. C.	9:02 A. M.
Fond Du Lac, Wis.	8:34 A. M.
Pocahontas, Va.	7:25 A. M.
Traverse City, Mich.	9:11 A. M.
Gillett, Ark.	10:00 A. M.
Binghampton, Ont., Canada	5:42 A. M.
Piedmont, Okla.	9:08 A. M.
Wichita, Kansas	7:05 A. M.
New Sharon, Iowa	8:06 A. M.

Each of these telegrams reported no variation in signal strength up to the time of filing and from those filed after the eclipse, the information was noted that no variation in signal strength was evident during the period of totality. These receivers were of course all outside the eclipse band.

A different result was noted by observers in the band of from 25 to 80 miles. In this band the signals were very weak during our night broadcasts but very loud during the morning period and during totality again returned to the weak night time volume,immediately after totality coming up to the loud daylight signal strength again. In the band of 8 to 25 miles, a slight decrease in volume was noted during the totality, again coming up to normal after this period had passed.

Summary of Effects

Summing up these results we have the following three sets of conditions. In a ring running from 8 to 25 miles we have strong night time signals with no apparent decrease in daylight, but a slight decrease during totality. In the band of 25 to 80 miles strong daylight signals and a marked decrease during totality with restoration immediately thereafter. In the long distance band of over 100 miles, we have an average range of 800 miles at night with nothing in the daytime, with a very marked increase in range and volume during the daylight period preceding and following the eclipse until after the entire phenomenon has passed, the range being increased to about 1800 miles during the period from the normal average of 800. In this long distance band no change in volume was noted during the eclipse, the tremendous increase being evident during the entire morning.

The first part of our theory, that the sun's rays have a marked effect on radio transmission is therefore proved absolutely. There is no longer any question but that sunlight has an extremely marked effect on radio transmission, and it is also evident that the mere presence of the moon's shadow neutralizes this interference of the sun's rays to a sufficient extent to equal or even exceed night time conditons.

Analyzing each of the three rings or sets of distances mentioned in the preceding, we have the following: In the local range—that is, to 8 miles, no variation of any kind is noticed because the power of the station is so great at that distance that the variations are not noticeable. In the ring of from 8 to 25 miles we are approaching our daylight range belt—in other words, that section of our range which is within our normal daytime transmitting radius. Therefore, during the period of totality, a reduction of volume might be expected, as our signal strength in this belt is normally slightly greater in the daytime than at night. In the ring running from 25 to 80 miles we have this daylight effect still more strongly shown. Here we are easily heard by day and only faintly audible at night; therefore during the period of totality, which is apparently artificial night and affects our radio wave in the same way as does night, our signals drop very nearly out, with a restoration when daylight again comes.

Dawn All Morning

Now we come to the extremely interesting phenomenon of the increased volume and range over long distances. As mentioned in the first paragraph the ordinary socalled "dawn effect" at which with the first flush of light in the east at the transmitting station the range is largely increased, is purely momentary phenomenon and ordinarily lasts but a few minutes. Apparently during the entire time of the passage of the moon across the sun, the moon's shadow has given us a second edition of this dawn effect, continuing this abnormal condition until the shadow has completely passed. As a result, during this artificial continuation of the dawn, we have more than doubled the range of the transmitting station. This being the case, there would certainly be no reduction of strength during the period of totality. It is even probable that the slight rise might take place during this period, but would be rather difficult to measure, especially because it would be over so quickly.

The eclipse of January 24th in some parts of the country was not a success from the standpoint of the astronomers. But it was a tremendous success along radio lines. It has proved conclusively that the theory of ionization and absorption of radio waves due to the sun's rays is no longer a theory only, but actually a fact. And we have in addition the interesting knowledge that the shadow of the moon has produced a continuation of the "dawn" effect by preventing this ionization until the moon has completely passed across the face of the sun. Knowing clearly the conditions with which transmission must contend, radio engineers will now be able to design their appartus more intelligently to meet and overcome these circumstances.

Our only regret in this matter is that the astronomers are not now arranging to have another eclipse until we are dead.

℞ 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. Is there any difference between radio and wireless?

Answer. In the theory of the thing there is no difference, since they both work by means of waves which travel through the ether. In general conversation, however, the terms are not the same. Radio has come to mean the radiophone, which sends out music, speeches, and the like, and can be easily understood by any one. Wireless, on the other hand, is restricted to the telegraph, which transmits only dots and dashes. To understand the latter you must know the code.

The instruments to receive the two are just alike, except that the wave band of radio broadcasting lies between the frequencies of 500 and 1500 kilocycles per second. (600 to 200 meters.) No code work is allowed between those wave lengths, and so the receiving sets to pick up the latter must have either smaller coils and condensers to bring in the faster vibrations, or larger ones to bring in the slower ones. From this you can see that if anyone insists on using radio and wireless interchangeably, you cannot say he is absolutely wrong, but he is not following the ordinary usage of the words.

Question. Why do various condenser manufacturers advertise that their rotor is grounded and so prevents body capacity?

Answer. They should not make any such claims, as they are not fulfilled as a general thing. If the condenser consists of two parts—the rotor and stator—which is the ordinary construction, then there is no way it can be connected to eliminate completely the effect of hand capacity. In such a case the stator should always run to the grid of the tube as this will reduce this unwanted capacity to as low an extent as possible. However, it will not be zero by any means. If a metal shield is fastened on the back of the panel and insulated from the condenser, but connected to ground, then such a combination with the condenser connected as just described, makes a set which is practically free from body capacity.

If the condenser is made of three separate parts, rotor, stator, and frame, and the latter is completely insulated from either of the others, then by grounding it and connecting the stator to the grid as described, a set nearly without hand capacity can be built.

Question. How can I find the polarity of a battery?

Answer. The easiest way to test for the polarity is with a volt meter which is built to indicate it. Ordinary meters are made in either one or two ways. Those that use no permanent magnet will read the voltage no matter what way the leads are connected up. Those which have a permanent magnet inside the case, will read forward when the connections are made one way to the battery, and then if these leads are reversed the needle reads backwards or below the zero of the scale.

To tell whether your meter will indicate polarity or not, hook it up to any battery and notice the reading. If it is forward then reverse the leads. If it is still forward, then it is evident that you cannot tell which is the plus and which the minus, but if it now goes off the scale backwards, you will know it is built with a magnet, and it can be used for this test. If it is this kind of meter, then try it out on a "B" battery or dry cell, of which you know the polarity. The lead which goes to the plus when the meter reads forward, should be marked with a "P" or a plus, and the wire connecting to it if you lead it on all the time, should have a knot tied in the end so as to tell it easily.

Question. When dipping two wires into water, which end gives out the bubbles, and why?

Answer. The negative pole is the one which shows most of the bubbles. The reason is that the water is composed of two parts of hydrogen and one of oxygen, and the hydrogen goes *with* the current, while the oxygen travels *against it.* Since there it twice as much hydrogen it shows up as so many more bubbles as it follows the electric current through the liquid, and deposits itself on the negative pole. Another reason why the hydrogen shows up so much more is because the water absorbs oxygen very easily. This is how fish breathe in the water as you probably know. If you have gold fish in a glass globe, you will find that after they have been in a quantity of water for some ten or twelve hours, they begin to gasp at the top of the water or "cluck" as it is called because they have used up all the oxygen absorbed by the water.

Fone Fun For Fans

Wise, Too

Dumb—"You certainly sling a terrible lingo. You ought to go to London and learn the King's English."

Dumber—"Oh, I know he's English."
—*Sour Owl.*

Famous Last Words

"Hold the wheel, Pete, while I open another bottle."—*Aetna.*

The Modest Minister

There was a young parson named Teedle,
Who wouldn't accept his degree;
He said, "It's enough to be Teedle,
Without being Teedle D. D."—*Dirge.*

Lucky Angler

Maud—"The dictionary says that a 'bob' is something used in angling."

Marie—"I suppose that's why you got yours, dear."—*Boston Transcript.*

He Trusted Her

Poker—"Won't your wife miss you?"

Chip—"No, she's a pretty fair shot."
—*Froth.*

Nobody

Aloysius—"Have you seen the new balloon tires?"

Dulcinia—"Why, who ever heard of a balloon needing tires?"—*Texas Ranger.*

"A"-"B" Charger

Continued from Page 26

respectively. However, many users have installed storage cells to take their place as with them the voltage is much steadier and a charge lasts a great deal longer than in a dry cell. For such use a single cell of storage is used with a WD tube, or two in series for the 199.

If such a battery were charged by the old style equipment, the current taken would be above the rating of the Tungar bulb and as a result its life would be very short. By using the extra terminal as marked in Fig. 3, either one or two cells of storage battery may be charged without danger of exceeding the rating of the tube. This gives long life (1000 to 2000 hours) of burning.

How Circuits Work

The hook-up of this equipment is shown in Fig. 4. At the top we have the primary winding, which is connected direct to 110 volts, 60 cycle electric light circuit. Since, as already explained, this is an insulating transformer, which keeps the power entirely off the battery circuit, it makes no difference which way the input is plugged into your lamp socket.

Below this is shown the secondary winding, with several taps. The first one gives 2½ volts at the terminals of the rectifier bulb. This lights the filament and makes it give off electrons in the same action as occurs in the vacuum tubes of your radio set. The next tap shown is the one which produces the current for charging a 6-volt "A" battery. There is an intermediate wire (not shown) for taking care of the two and four volt "A". At the end of the winding is a connection which gives 90 volts for filling up the "B" battery. However, the lamp socket is in series with this line and by using the proper electric light bulb, as already described, this pressure is dropped to either 45 or 22 volts, depending on what style of "B" you are using.

The negative terminal for charging all batteries is taken off from the plate in the Tungar bulb. It will be remembered by those who have studied the action of vacuum tubes, that current will run from the cold plate, through the vacuum of the tube itself to the hot filament. This is because negative particles or electrons are being shot out by the filament, but none are given off the cold plate.

How the Current Travels

As the AC vibrates back and forth through the primary coil at 110 volts, it induces similar oscillations in the secondary winding by transformer action. The pressure in the secondary is considerable lower, however, since there are much fewer turns than in the primary. This pressure starts out and induces current flowing from the "A" plus terminal through the battery back to the "A" minus. From there it jumps across from the plate to the grid of the bulb and so returns to the transformer winding again.

This puts a small charge into the plates of the battery. An instant later the current reverses in the primary and so a negative wave in the secondary tries to discharge the battery by the same amount which an instant before was left in it. However, when this impulse of current starts out from the transformer and attempts to go through the bulb from the filament to the plate it is held up as the bulb acts like the turnstile at the baseball ground exit. It is easy to get out, but when you try to get back again you find it can't be done. The small charge that was left in the battery by the positive half of the wave, is trapped there and the negative loop can not undo the good work.

Millions of Charges

This action occurs sixty times every second, since most electric light stations are sixty cycle current. This makes 3600 times every minute or 216,000 times an hour. You see that for an overnight charge there will be two or three million of these small impulses that have run into your battery and been prevented by the bulb from leaking out again. Thus your battery, either "A" or "B" is ready for another period of broadcast receiving.

WHY WAVE LENGTHS CHANGE

Continued from Page 22

there is now a wave assigned to some broadcasting station. As there are not enough waves to go among all the powerful transmitters some stations have to share their frequency with one or two others. But unless the stations happen to be separated by hundreds of miles they are not both allowed to be on the air at the same time. In this way interference is avoided.

Revised List of Stations

This list is the official one just released by the Department of Commerce. Notice that the stations are grouped by the sending kilocycles. This is a convenient arrangement for logging your dials. If you have a straight line condenser to tune with you will find that the various call letters are spaced evenly around the dial. If your condenser has not a straight line curve then the grouping of call leters will not be quite so even but will still be fairly well spaced. The *alphabetical* list of call letters will be found in our columns on page 31 as usual.

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
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	275	1090	500
KFBB—F. A. Buttrey & Co., Havre, Mont.	275	1090	100
KFBG—Search Light Publishing Co., Fort Worth, Tex.	254	1180	100
KFBK—Kimball-Upson Co., Sacramento, Cal.	283	1060	100
*KFCF—Frank A. Moore, Walla Walla, Wash.	256	1170	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	250	1200	100
KFFY—Louisiana College, Alexandria, La.	275	1090	100
*KFGC—Louisiana State Univ., Baton Rouge, La.	268	1120	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	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.	248	1210	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
*KFKU—Univ. of Kansas, Lawrence, Kansas	275	1090	500
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—Fayetteville, Ark	275	1090	500
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
KFOZ—Taft Radio Co., Hollywood, Cal.	240	1250	250
KFPG—Garretson & Dennis, Los Angeles, Cal.	238	1260	100
KFPL—C. C. Baxter, Dublin, Texas	252	1190	100
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
*KFQC—Kidd Brothers Radio Shop, Taft, Cal.	231	1300	100
KFQD—Chovin Supply Co., Anchorage, Alaska	280	1070	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
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
*KFUM—W. D. Corley, Colorado Springs, Col.	242	1240	100
*KFUO—Concordia Theological Seminary, St. Louis, Mo.	545	550	500
*KGO—General Electric Co., Oakland, Cal.	312	960	1500
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.	252	1190	500
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	1000
KOB—N. M. C. of Agri. & Mech. Arts, State Col., N. M.	360	833	500
*KOP—Detroit Police Dept., Detroit, Mich.	278	1090	500
KPO—Hale Bros., San Francisco, Cal.	422	710	500
KQV—Doubleday-Hill Electric Co., Pittsburgh, Pa.	275	1090	500
*KSAC—Kansas Agri. Col., Manhattan, Kansas	341	880	500
KSD—Post Dispatch, St. Louis, Mo.	545	550	500
*KTHS—New Arlington Hotel, Hot Springs, Ark.	375	800	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
*KZRQ—Far Eastern Radio, Inc., Manila, P. I.	222	1360	500
*KZUY—F. Johnson Elser, Manila, P. I.	370	812	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.	278	1080	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
*WABO—Rochester, N. Y.	278	1080	100
WABT—Holliday-Hall Elec. Engineers, Washington, Pa.	252	1190	100
WABU—Victor Talking Machine Co., Camden, N. J.	225	1330	100
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.	256	1170	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
*WBCN—Foster & McDonnell, Chicago, Ill.	266	1130	500
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.	327	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	266	1130	200
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	263	1140	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
*WCBI—Nicoll, Duncan & Rush, Bemis, Texas	226	1330	150
WCBN—Chicago, Ill.	266	....	500
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.	273	1100	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
*WDBE—Gilham, Schoen Electric Co., Atlanta, Ga.	278	1080	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.	441	-	500
WEAA—Frank D. Fallon, Flint, Mich.	234	1280	100

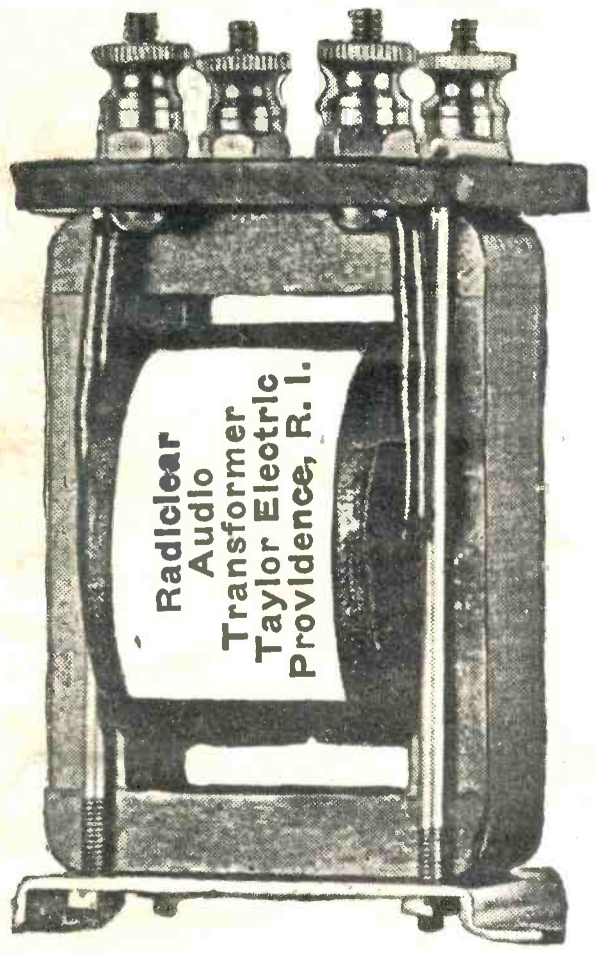
Station	W.L.	K.C.	W.P.
*WEAF—Amer. Tel. & Tel, Co., New York, N.	492	610	2000
*WEAH—Wichita Board of Trade, Wichita. Kas	268	1120	100
*WEAI—Cornell University, Ithaca. N. Y	254	1180	500
*WEAJ—Univ. of S. Dakota, Vermillion, S. Dakota	278	1080	100
WEAM—Borough of N. Plainfield, N. Plainfield, N. J	261	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	405	990	500
*WEMC—Emmanuel Missionary Col., Berrien Springs, Mich.	268	1120	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	278	1080	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	252	1190	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
*WFBY—U. S. Army, Fort Benj. Harrison, Ind	258	1160	100
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
*WGBB—Harry H. Carman, Freeport, N. Y	244	1240	100
*WGBG—Breitenbach's Radio Shop, Thrifton, Va	226	1330	100
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	1500
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	275	1090	500
WHAG—University of Cincinnati, Ohio	233	1290	100
*WHAM—University of Rochester, Rochester, N. Y	278	1080	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	353	850	500
*WJAG—Norfolk Daily News, Norfolk, Neb	270	1110	250
*WJAN—Peoria Star, Peoria, Ill	273	1100	100
WJAR—The Outlet Co., Providence, R. I	360	833	500
*WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa	275	1090	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	349	833	500
WMAH—General Supply Co., Lincoln, Neb	254	1180	100
*WMAK—Norton Laboratories, Lockport, N. Y	266	1130	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	280	1070	100
WNAD—University of Oklahoma, Norman. Okla	254	1180	100
*WNAP—Wittenberg College, Springfield, Ohio	248	1210	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
*WORD—Peoples' Pulpit Assoc., Batavia, Ill	278	1080	500
WOS—Mo. State Marketing Bureau, Jefferson City, Mo	441	680	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	275	1090	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	268	1120	100
*WPG—Municipality of Atlantic City, Atlantic City, N. J.	296	1010	500
*WPSC—Pennsylvania State College, State College, Pa	261	1150	500
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	252	1190	100
WQJ—Calument Rainbo Broadcasting Co., Chicago, Ill	448	670	500
*WRAA Rice Institute, Houston Tex	256	1170	100
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	263	1140	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
*WREO—Reo Motor Car Co., Lansing, Mich	286	1050	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
*WRR—Dallas, Texas	261	1150	200
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	209	1430	150
*WTAM—The Willard Storage Battery Co., Cleveland, O.	389	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.	250	1200	500
WTG—Kansas State Agri. Col., Manhattan, Kas	485	620	1000
*WTIC—Travelers Ins. Co., Hartford, Conn	349	860	500
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	266	1130	500
WWJ—Detroit News, Detroit, Mich	517	580	500
WWL—Loyola University, New Orleans, La	268	1120	100

* Alterations and corrections.

Why Joe Brownell Was Sore

Joe had just bought a new two-tube radio set. He was complaining to his friend, "I get the stations very clearly on the phones and the music is sweet on the detector, but when I plug in on the amplifier it sounds like a tin pan. What do you suppose is the trouble?"

His friend hastened to explain. "That's easy; you are using an audio transformer which doesn't let the low notes through and which censors the high notes, too. There are not many transformers on the market like the RADICLEAR, which treats them all alike."



"Would it be hard for me to change over my step of audio amplification to use the RADICLEAR?" "No; this transformer is very easy to install and will improve your results a great deal. It costs only $3.95, and if you like you can add a second step for $6.00, complete. The kit includes transformer, socket, rheostat, jack, binding post, and wire. Complete instructions tell you how to make the connections."

"Thank you," said Joe. "I will write for one immediately," and that is how we happened to add Joe Brownell to our list of satisfied customers.

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

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

Radiclear Audio Transformer @ $3.95
Amplifier Kit for........tube @ $6.00
Audion Crystal @ 25c.
Gold Plated Cat Whisker @ 15c.

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

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

Name...............................

Address...............................

TAYLOR ELECTRIC CO.

1206 Broad Street

Providence, R. I.