Blueprint Section Every Month

RADIO AGE

The Magazine of the Hour

(See Story page 39)

December 1926

25¢

Death Ray Tube Rival of Radium ¶ Six Tube Shielded Receiver ¶ Parts Business is Not Dead

Complete Broadcast List

In Each Issue

Contrast the clumsy dials of only two years back . . . with the handsome illuminated controls MAR-CO *makes today. Here is another good reason for building your set yourself!*

Now dials give place to glowing spots of light

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. . . this is radio at its handsomest . . .

. . . this is the panel arrangement . the type of skillful tuning . that distinguishes the 1927 trend in set construction.

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RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 5 — *December, 1926* — *Number 12*

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Radio Age is published monthly by RADIO AGE, Inc.
Member: Audit Bureau of Circulations.
Publication Office, Mount Morris, Ill.
404 North Wesley Ave.,
Address all communications to RADIO AGE, Inc.
Executive, Editorial and Advertising Offices
500 N. Dearborn Street, Chicago, Ill.

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Pacific Coast Representative
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Final Advertising forms close on the 20th of the 2nd month preceding date of issue

Vol. 5, No. 12, Issued monthly. Subscription price $2.50 a year. December 1926. Entered as second-class matter at post office at Mount Morris, Illinois, under the Act of March 3, 1879.

Chats With the Editor

SCIENTISTS at large will welcome Dr. Coolidge's recent perfection of a cathode ray tube whose use in research will open many avenues heretofore closed. A diagram of the tube, together with a brief description of its functions, is presented for the benefit of our readers.

Armstrong Perry tells how to get started in radio at a very slight expense by use of the crystal receiver. This is one of a series of articles which Mr. Perry has prepared for the beginner and should be fine reading for the man who is just on the threshold of radio.

A combined short-long wave receiver, and a wavemeter of the resonance indicating type, has been prepared for the enthusiast who does not care to be limited to a single wave band for reception. The wavemeter is for the more advanced experimenter.

Another receiver of interest, available in kit form, is the six tuber which is completely shielded. It is described and illustrated in the blueprint section of this issue.

Kirk B. Morcross gives our readers an idea of why the wavelength allocations made by the government are figured in kilocycles instead of meters. Many a fan who has been puzzled by the kilocycle terminology will find the explanation a rational and simple one and much better suited to our needs than any other method.

Side band transmission is detailed by I. J. Karr who tells of some of the work being done by the General Electric with that type of transmission. Three advantages are listed for the side band transmission, the greatest one from the listeners' standpoint being the reduction of interference. The broadcasters might welcome it since greater efficiency is secured.

Frederick Smith

Editor of RADIO AGE.

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RADIO EDITORIALS

PROBABLY no other single comment on the radio situation has ever attracted the attention of so many citizens or produced as general a flurry of protest as did the recent assertion of Thomas A. Edison that radio is losing its popularity.

Mr. Edison, it will be remembered, also said that no radio dealers were making money, and that radio music was "terrible," or words to that general bitter effect, and that the people were going back to the phonograph.

One of the faults found with Mr. Edison's statement is that it lacked figures to confirm the sweeping survey he made of the industry. The United States Department of Commerce has just issued a report which does not at all agree with Mr. Edison.

More than ten times the number of tube-type radio receiving sets were manufactured in 1925 than in 1923 (the last preceding census), according to the government figures which give the production for 1925 as 2,180,622 sets —an increase of 1045 per cent over the 1923 output.

The production of radio speakers, 2,606,866 was more than four times that of 1923, when 623,146 radio speakers were produced, the census figures show. Five times the number of radio tubes were made in 1925, the report giving the value of the 23,934,658 tubes produced at $20,437,283.

This stupendous increase in production of radio apparatus brought the 1925 figure up to $170,390,572, more than three times that of 1923 when the total output was valued at $54,000,470.

The Government's figures are more than confirmed by reports from the industry. For example, one man, the largest producer of radio receiving sets and radio speakers planned months ago, under the most expert estimates, that his production for this year should be double that of last year. Yet even this increase has not been sufficient to meet the rapidly increasing demand and it has been found necessary to step up production still further to 5,200 sets a day, so that all orders may be filled.

The official fig res made public by the Department of Commerce show an increase of 215 per cent in the value of radio equipment produced in the country in the past two years.

* * *

PLANS are under consideration for a radio show for dealers and jobbers to be held in Chicago next June, or possibly later. The purpose of this exposition will be to afford the trade an early opportunity to see the season's new products and get an earlier start on distributions than has been possible heretofore.

One difficulty about such a plan is the apparent danger that manufacturers would be able to see the models displayed by their competitors at such a show and have time, as well as opportunity to readjust their own output to reproduce some of the excellent features which have been devised by their rivals.

To avert this possibility, the promoters of the early summer show are asking manufacturers to pledge themselves not to change their models before a certain date after the trade show. Several manufacturers with whom we have discussed the matter believe that the expense of preparing exhibits at such an early date would be so great that many manufacturers would be barred. It is probable, however, that the next few years will see the development of two classes of radio shows; one for the public and an earlier one for the jobbers and dealers who wish to get started on their way to distribution and sales before the Fall months.

It is argued by others that the early show would assist in destroying that annoying interval in which radio business is practically at a standstill, so far as sales are concerned. Anything that will administer a knockout to the well known summer slump would be welcome to the trade generally.

RADIO AGE
The Magazine of the Hour
M. B. Smith
Business Manager
A Monthly Publication
Devoted to Practical
Radio
Frederick A. Smith
Editor

Start Your Radio Work With a Crystal Receiver

By ARMSTRONG PERRY

RECEIVING radio entertainment is almost incredibly easy, yet four families out of five still are without the necessary apparatus.

Perhaps some are scared by the fact that the best receiving outfits on the market cost more money than the average family earns in a year. Even an ordinary five-tube broadcast receiver costs as much as the monthly incomes of many a man, and the money spent for upkeep would pay the milk bill.

But why should a family that is satisfied with a four-room apartment or a five-room bungalow wait for a radio set built for a millionaire's palace? Why not start with a crystal detector set? Let the neighbors talk if they want to—maybe their big set is not paid for!

The programs of any broadcasting station within five miles can be picked up easily with a crystal detector receiver, day or night. With an antenna well insulated at the points of support, and from thirty to sixty feet high, satisfactory results can be obtained up to twenty-five miles. So the bulk of our population is within easy reach of radio entertainment. Why not enjoy it? It's free!

Some folks pooh-pooh the crystal detector because it is cheap and less powerful than a tube set. The user of the crystal detector can double-pooh-pooh the average tube set because the quality of its music often is worse than that of

Hold the end of the aerial, and one phone cord tip, in one hand. In the other hand take the end of the ground wire and the other phone cord tip. You may be able to hear near-by stations without a detector as Armstrong Perry is doing in this picture

a fifteen-dollar phonograph, while the crystal detector never lowers the quality of the broadcast.

The crystal set is noiseless, except to those who are listening in with the phones. Loud speakers, on the other hand, are driving many involuntary listeners to distraction. The owners of a New York building secured a permanent injunction against a neighboring restaurant whose loud speaker—a superlatively good one—made so much noise that it interfered with the work of employes of other concerns. The crystal set requires almost nothing for upkeep, while the tube set always is running up bills for batteries, tubes or electricity.

These arguments are not directed against the tube sets. Properly installed and operated, they are worth all they cost and more. It pays to buy the best one you can afford. But the man who sneers at a neighbor for installing a crystal detector set usually is the kind of a gink who does not know enough to operate any kind of a set. Don't let him keep you from enjoying radio.

Easy and Inexpensive

FEW persons realize how very easy and inexpensive it is to receive radio entertainment. Fasten one end of a wire to a branch high in a tree and bring the other end into your room. If it is bare, protect it so that the metal will touch nothing but insulators, which can be purchased for a few cents each. Fasten another piece of wire to a water pipe, first scraping the pipe and the wire to make them bright where they touch. Put a pair of phones on

Why deprive yourself of the joys of radio just because you cannot afford a set built for a millionaire's palace?

your head. Hold one tip of the phone cord in one hand, together with the end of the wire from the tree. Hold the other tip in the other hand, with the end of the wire that leads to the water pipe. The wires in the hand do not have to touch each other. If there is a broadcasting station near, you probably will hear what it is transmitting.

Now take a galena crystal such as is sold in radio shops and five-and-ten-cent stores for use in crystal detectors. Hold this in the left hand, between the thumb and fore finger. Do not touch the polished surface, or the oil from the skin may cover it so that it will not work. You have the wire from the water pipe, and the metal tip of the phone cord, in the palm of your hand held tightly by the last three fingers, and the crystal is between the thumb and first finger. The other tip of the phone cord is in the palm of the right hand, held by the last three fingers. Take the end of the wire that leads from the tree. Holding it between the thumb and first finger, touch it lightly to the polished surface of the crystal. You will hear the entertainment from the nearby-station as loudly and distinctly as you can hear the voice of a friend on the telephone.

It may be too much trouble to climb a tree and put up an aerial wire. Never mind! For a dollar or less you can buy an antenna plug that will fit into any electric light socket. There is a thumb screw on it to which you can attach a short length of wire to use instead of the wire in the tree. There is no danger of being shocked by the current. The plug lets only the radio waves through; the lighting current cannot pass, provided your wiring is not in conduit or BX. Holding the wire from the plug just as you would one from the tree, touch the crystal. The concert comes in perfectly, except as the hand may tremble and break the contact between wire and crystal.

The antenna plug is in two parts. One part screws into the socket, and there is only one way to put it in. The other has two prongs that go into holes in the screw plug. There are two ways to put that in, and either one may be correct. Usually there are two thumb screws to which the wire may be attached, one on each side. If you do not hear well with the wire on one, try the other. There are seven ways to use the plug, with one or two wires. Try them all.

The Arrester

FOR less than four dollars you can buy everything you need for hearing the radio entertainments. Having the essentials, including antenna or antenna plug, phones, crystal and a little wire, you can install them to suit your convenience. If you use an outside aerial, any permanent connection between the wire and the house must be made according to the regulations of fire insurance companies and city departments. There is little danger from lightning but there must be protection against it. In case the few dollars required for a lightning switch or arrester are not available, the wire can be brought in when the set is to be used and the end kept at a safe distance from the side of the house at all other times.

The first improvement is to rid yourself of the necessity for holding wires in your hands. This requires some device for keeping the crystal, wires and phones in contact. The crystal probably is embedded in metal; usually they are sold that way. Whether it is or not, it can be placed in a metal cup. Cups can be purchased, but it is easy to make one with a small piece of tin and a pair of shears. A thimble can be used, held open end up by nails or screws in a block of wood. If the crystal does not fit tightly, and if there are no set screws for holding it, pack it in with tinfoil, leaving the polished surface of the galena exposed. Most radio crystals are of galena, that mineral being the easiest to handle and most satisfactory in gen-

Wind the inductance coil on any round or square box having a diameter of about three inches

Attach a wire to a limb high up in a tree and bring the other end into the house

eral. A lump of coal sometimes will serve as a detector crystal.

Galena requires very light contact with the antenna wire. It is better to bring the antenna to a screw or binding post on the block that holds the crystal and, from the same post, to run a finer wire to the galena. Usually this wire is coiled for a part of its length, making a coil spring that will take up the slight vibrations that might move the tip that is in contact with the crystal. At the other end of the detector also it is well to provide a binding post, to hold the ground wire that runs to the water pipe. This wire should be at least as large as the antenna wire and there is no need to insulate it or keep it from touching things. It should be held firmly in contact with the cup holding the crystal. If it can be soldered to the cup, so much the better. Soldering no longer requires the hiring of a union tinsmith. The metal can be purchased in tubes, like tooth paste, smeared on a joint and melted with a match.

Make Tight Connections

ONE of the first principles, which many ignore with the result that they lose half the energy that they might pull in from the radio waves, is that all connections should be electrically tight. That means that wherever metal touches metal, the surfaces should be bright, free from oil or dirt, and soldered if possible. A little wood alcohol on a rag or brush quickly removes dirt. A piece of emery paper or a file will remove a corroded surface and cut down to bright metal. Connections should be made bright at the start and kept bright by frequent inspections and cleaning.

Another important principle is that all metal, from the aerial to the point where the ground wire connects with the set, should touch nothing outside the set that is a conductor of electricity. Where wood is used it should be perfectly dry.

Endless ingenuity has been exercised in designing devices for holding the crystal and the wires that connect it with other apparatus. Some assembled crystal detectors, supposedly dust proof, cost several dollars. Good little ones can be bought for fifty cents. A Boy Scout brought me one that he made himself for twenty-one cents. The galena rested on a paper clip and a safety pin served as a "cat whisker" to touch the crystal. It brought in stations that I could not hear with a twenty-five dollar outfit manufactured by the largest radio concern in the country.

One little trick that ship operators use is worth copying. Vibrations are likely to move the point of the "cat whisker" that rests on the crystal. Galena is not equally sensitive at all points, and it is necessary to have the contact as steady as possible. So a ship operator sometimes hangs his crystal detector up by a string where it can swing without bumping anything as the ship rolls and the engines shake her. Once adjusted, the "cat whisker" will stay in place indefinitely.

The limited range of the crystal detector frees the listener from most of the interference that troubles his neighbor with the high-power set. Women who can hear and repeat everything that is said around half a dozen whist tables while they themselves are holding up their own end of a conversation will be actually lonesome with only three or four stations at most coming in at one time. But some folks cultivate a different attitude toward radio, and insist on tuning out all but one station if possible. It is easier to eliminate interference from a crystal detector set than from a tube set, because there is so much less of it to eliminate. Two things are necessary: an inductance coil and a condenser.

An inductance coil, or tuning coil, may be wound on an oatmeal box or any other round or square form having a diameter of about three inches. Bell wire, or smaller sizes of insulated wire are used, and the turns are wound as closely as they will lie. The number of turns depends upon the tuning range desired. The more turns, the longer the wavelengths that can be received.

To avoid studying technical details, a beginner may as well experiment. Start with a large number, say fifty to seventy-five, If the desired stations can be brought in loudly enough, the number of turns is practically correct. If not, cut off the turns one at a time until the desired result is obtained. Directions that are correct in theory for

(Please turn to page 63)

A water tank makes a convenient anchorage for the far end of the aerial, and a short mast will give additional height

Difference Shown Between Baseboard and Chassis Construction

By H. MELCHIOR BISHOP

PRACTICALLY all amateur built radio sets, that is, about ninety per cent of them, are of baseboard construction. There are many reasons for this.

One reason is that the average designer in presenting his circuit to his readers, builds a set in this form and photographs it for the illustration of his article. This has many advantages. In the first place, every instrument is in the same horizontal plane, and by means of a plan or top view the general layout of the instruments can be clearly and unmistakably shown. Secondly, the same thing is true of the wiring. Thirdly, when the average human being has an instrument which must be fastened in a particular place, his "fancy lightly turns," so to speak, to a board. The board is the standard, everyday, utility fastening down place.

Although the baseboard method of construction is the one most commonly used by the novice when constructing his set, almost all manufacturers and a large proportion of the more advanced amateur experimenters use the panel mounting or chassis type of construction exclusively. This method consists, in general, of supporting all instruments by the panel itself, or by brackets and shelves fastened to the panel, and thus doing away entirely with the baseboard.

Let us see why this method, which offhand seems to be more complicated and difficult without in any way adding to the efficiency of the set, should be so universally adopted.

In the first place, we shall see, if we look further into the matter, that this chassis method of construction allows us to place our instruments in the most favorable positions for shortening the wiring without reducing the distance between these instruments to a point where unfavorable reactions in the form of feedback and confliction of magnetic fields takes place.

Shortening Leads

THIS is so, due to the fact that associated instruments may be placed in exactly the most suitable positions with respect to each other by merely supporting them by suitable brackets. For instance, a tube socket may be placed directly over its associated radio or audio frequency transformer, shortening the grid and plate leads to a fraction of an inch in length.

The second advantage of this type of construction is the greater ease of wiring it affords, due principally to the fact that the set can be reached from the bottom and sides as readily from the back.

This also means that in case of any trouble, the various component parts of the set will be much more accessible for examination and repair or replacement, as the case may be.

Thirdly, the chassis form of construction is much more rigid than is the baseboard type. Due to this greater rigidity, there is less chance for rough handling (especially the rigors of shipping) to cause breaks and defects in the wiring of the set.

The fourth advantage of the chassis built set is its greater compactness, which makes for a smaller and more portable set. This compactness is due chiefly to the fact that the instruments can be placed more advantageously in this form of set than in the baseboard type.

Fifth and last among the advantages of the chassis type of set is its appearance, which is far more neat and workmanlike than that of the baseboard mounted set.

In spite of the above mentioned numerous advantages of the chassis mounted set, there are certain cases where the baseboard set still is, and probably always will be, supreme.

Fine For Testing

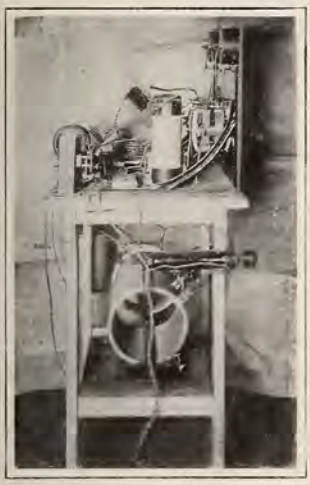
FIRST of these is the experimental set. In this type, to allow extreme flexibility, a large baseboard (often referred to as a bread board) is used and the various instruments are mounted thereon with wood screws. This breadboard set is very flexible in its general adaptability due to the fact that instruments may be moved or entirely replaced by others by the mere twist of a screwdriver.

Another use of the baseboard set which is closely akin to the above use is the temporary set. By this I mean a set which has passed the breadboard development stage, and is ready for a try-out of a month or so to test its efficiency. It is useless in a case of this kind to go to the trouble of designing a suitable chassis, and the old reliable baseboard will serve here with most admirable adequacy. It has, for this use, the added advantage of a certain ease in changing connections due to the instruments being all in one place, which is not afforded by the less flexible chassis built set.

Still another use of the baseboard set is the one which is mentioned near the beginning of this article—that of the illustrative set. Its use here is due chiefly to the clearness and openness of this type of construction, which lends itself admirably to clear photographing, and is in addition easily built.

To summarize, it has been shown by the preceding exposition that the baseboard type of set construction is best and handiest for the more temporary and experimental type of sets. On the other hand, for a permanent and workmanlike receiver, the chassis type of construction is king, and rightly so, due to its greater rigidity, strength, neatness, and general efficiency due to short wiring and advantageous instrument placing.

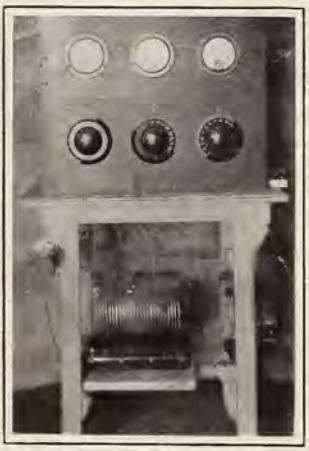
A Double Wave Remote Controlled Transmitter



Side view of the short wave transmitter described

Scheme Fine for Straddling Amateur Bands

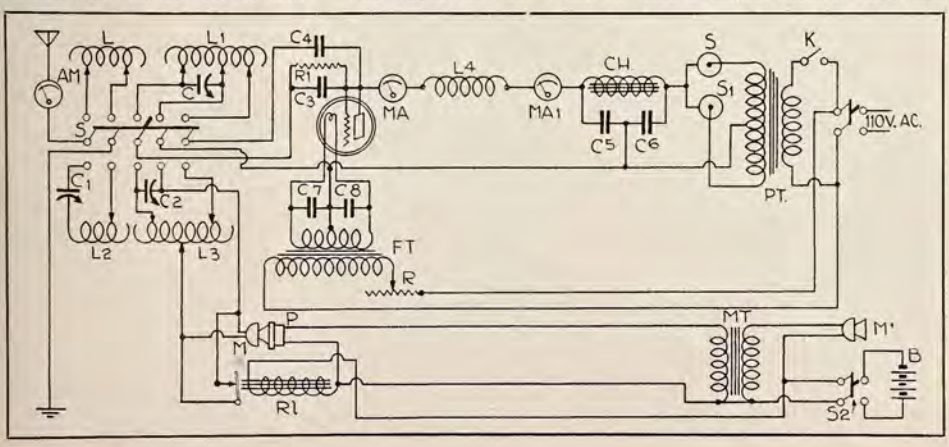
By
A. P. PECK
(Radio 3MO)



Front panel view showing meters and dials, while helix is shown on lower shelf

WITH four main operating bands available for the amateur in the United States today, which one of that clan wants to operate on only one of the bands, or wants to change the tuning of his set in order to reach one of the others? Ham traffic is now being handled on the 20, 40, 80 and 150 to 200 meter bands. There are only two practical ways of achieving good operation on more than one of these bands, and the first one is out of the question. That is the one which calls for two or more complete transmitters, each one tuned to a different band.

The writer did not want to operate on only one wave-length band, but desired to keep in touch with ham activities by working on the two bands that carry most of the traffic. Therefore, he followed the second course which necessitates the construction of a transmitter using two complete tuning units and a single vacuum tube and



power supply. Just how the double wave feature and the remote control of the transmitter were accomplished will be outlined below. The photographs show the rough layout of the original set which gave excellent results, and the circuit diagram shows all of the connections in detail.

A five-pole, double-throw switch was secured for use in changing from one wave band to another. This was hooked up as shown, as can readily be seen, changing the position of the switch, throws one or the other of the two tuning units into the circuit. As shown, this installation calls for three variable condensers and two sets of tuning inductance. If it is impossible to tune the antenna circuit to resonance on one of the required working wave lengths, a fourth variable condenser will be necessary. This is to be connected in series with the antenna coil of the circuit where no condenser is shown. This is only one possibility. The other is that the wire wave antenna circuit may not be large enough, and therefore, a parallel antenna tuning condenser will be necessary. This, however, will be determined by the characteristics of your antenna and counterpoise system.

Two Highest Bands

TUNING units used in transmitters are too well known to merit discussion here. The writer used some old inductances that happened to be on hand and had no trouble at all. His set, as shown, has been made to work on the 40, 80 or 150 to 200 meter bands. Obviously only two of these can be used interchangeably, and when the third is required one of the circuits must be re-tuned. The set is now in operation on the 80 and 150 to 200 meter bands.

Practically all of the apparatus used in this circuit is standard. "S" tubes are used for rectification, while a "brute force" filter insures a perfect DC note, and also gives an oscillatory current that is suitable for phone modulation. There are a good many amateurs who have to resort to remote controlling of transmitters in order to get the best of results, and the writer is one of them. The problem of installing phone modulation in remote controlling is a serious one unless the amateur happens to be wealthy enough to install the Heising method which, of course, lends itself admirably to remote control.

There are three other systems of modulation that are available for the average poorly financed ham. One of them is merely a modification or refinement of one of the others. The first that we will consider is the old stand-by, the loop system. The writer used this very satisfactorily with 30 foot leads between the loop and the microphone when operating on 180 meters. For 85 meter work, however, this system is not practical, probably because of the long leads. The other main system is the placement of the microphone in the center tap lead from the inductance to the filament circuit. Here again, the long leads are quite satisfactory for 180 meter phone transmission, but on 85 meter work the long leads give trouble. Therefore, the system shown in the diagram was worked out with the aid of 2 QS, and it proved quite satisfactory. True, it requires a little more apparatus, but still is not as expensive as the Heising system, and has practically no upkeep other than the battery. This method consists of placing the microphone in the center tap lead just as described above, but having the microphone located at the transmitter instead of at the control end. Placed up against this microphone, and strapped to it with ordinary friction tape, is a low resistance telephone receiver. This, in turn, is connected through an ordinary telephone repeating coil, to a microphone and battery. Speaking into the microphone causes the diaphragm of the receiver to vibrate, and this action vibrates the diaphragm of the microphone in the center tap circuit.

A further refinement can be added in the form of a relay which short circuits the actual transmitting microphone when the circuit of the other microphone is opened. This allows the use of CW transmission at all times without any further operation than the opening of the microphone switch.

Controls Near Operator

AS will be noted in the diagram, the power supply rectifier, filter and key are located at the control end. A milli-ammeter is also placed near the operator so that a constant check may be kept on the operation of the set. A second ammeter placed with the transmitting apparatus is of inestimable assistance when tuning the transmitter.

The antenna system the writer used for working on two waves will undoubtedly be of interest. When one of the oscillatory circuits was tuned to operation on 40 meters, the antenna circuit was tuned to its third harmonic and excellent results were obtained. For 80 meter work, the antenna circuit was tuned in the usual manner with a series condenser. For operation on the 150 to 200 meter band, the pick-up coil in the antenna circuit was connected in series with the loading coil in order to boost the wave length of the antenna circuit. If a comparatively large pick-up coil is employed, it can be shunted by a variable condenser, and the antenna circuit can be tuned to the required high wave. However, about the best results obtained were observed when only a small loading coil was used, and this was shunted by a tuning condenser. This is to be preferred to the placement of the tuning condenser in parallel with the pick-up coil itself.

The above description and the photographs and diagram should give some hams a few good ideas for the remodelling of their transmitters. The apparatus shown in the photographs should not be taken as a criterion, however, as it was merely assembled in order to test the efficiency of the remote control modulation methods, and the practicability of the two wave transmitter.

Death Ray Tube Turns Gases Into Solids

Vacuum Tube Produces More Electrons Than Radium

A VACUUM tube which produces as many electrons per second as a ton of radium—and there is only a pound of that rare substance in the world—was announced by Dr. W. D. Coolidge of the research laboratory of the General Electric Company at a meeting of the Franklin Institute of Philadelphia, on the occasion of the award to him of the Howard N. Potts gold medal of the Institute for his outstanding work in the development of x-ray tubes.

Radium is constantly disintegrating, and in so doing is bombarding electrons—infinitely small particles of matter or electricity—into space at very high velocities. The rate at which radium distintegrates is beyond human control; nothing that man can do seems to affect the rate at which the element breaks down. The cathode ray tube likewise bombards high speed electrons into space, but at a rate that can be controlled by man, and in quantities far greater than by all the radium in the world. The electrons given off by radium are of higher average velocity than those so far produced with the cathode ray tube, but otherwise the two are alike.

So much more concentrated are the rays from the tube that many startling experiments have been conducted with the new device. Crystals of the mineral calcite apparently become red hot coals when exposed for a moment to the rays, but they are glowing with cold light; ordinary salt is turned brown, and considerable time elapses before it again becomes the colorless substance it usually is; bacteria and small flies are almost instantly killed by exposure to the rays; ordinarily colorless acetylene gas is transformed into a yellow solid which cannot be dissolved; and a rabbit's gray hair has been destroyed, to be replaced later by a profuse growth of longer, snow-white hair.

Cathode rays have been known to some extent for many years. At first, however, they were known only within vacuum tubes, but about 30 years ago a European scientist, Lenard, succeeded in making the electrons pass through a tiny piece of extremely thin aluminum foil cemented to the glass wall of the tube. Improvements have been numerous since then, but with previous tubes the metal "windows" were much smaller and the operating voltages much lower than with the new tube.

Unusual Features

SEVERAL unusual features have been incorporated in the new tube. There is a "window" three inches in diameter, of nickel foil the thickness of which is measured in thousandths of an inch and which is capabe of withstanding a total atmospheric pressure of more than 100 pounds. A heated tungsten fila-

Dr. W. D. Coolidge, famous X-ray tube scientist, is given the Potts medal of the Franklin Institute for work on new wonder electron producer

ment, originally used by Dr. Coolidge in the x-ray tube and now known to all as an essential part of radio tubes, furnishes the supply of electrons. The glass tube has been shielded with a copper tube so that the stream of electrons cannot strike the glass and cause punctures, thereby permitting operation of the tube at voltages far higher than any previously attained, and the tube is also the first which it has been possible to seal off from an evacuating system; the tube thereby has been made as portable and as easy to use as an x-ray tube.

Electrons are released by the heated tungsten filament, or cathode, at relatively low velocity —a matter of a mile or two per second. Between the cathode and the anode—the "window" and the copper tube which serves as a shield—there is impressed upwards to 350,000 volts of direct current. This causes the electrons given off by the filament to speed up to an average velocity of 150,000 miles per second or more, depending upon the voltage, within the short space of about one inch between the cathode and the copper tube shield. Having attained this high velocity, the electrons coast the rest

This photograph shows ball of purplish glow surrounding window of tube

of the way through the highly evacuated tube and pass through the anode, or window and into the atmosphere with but slight diminution in velocity.

The nickel window is soldered to a disk of invar, an alloy which expands the same amount as does glass when heated. The invar disk, in turn, is fused to the glass tube, thereby making the seal air tight. The thin piece of nickel itself could not withstand the atmospheric pressure of 100 pounds—the difference between the outside air and the almost perfect vacuum within the tube —so it is reinforced with a honeycomb structure of molybdenum metal, a design that affords a maximum of strength with a minimum of cross-section area.

If the tube is operated in a darkened room, a hum is heard and the window of the tube is seen to be surrounded by a ball of purplish haze, about two feet in diameter with 350,000 volts and more or less depending upon the voltage. This glow, which shows the penetration of the cathode rays in air, results from the air being ionized or broken up by the

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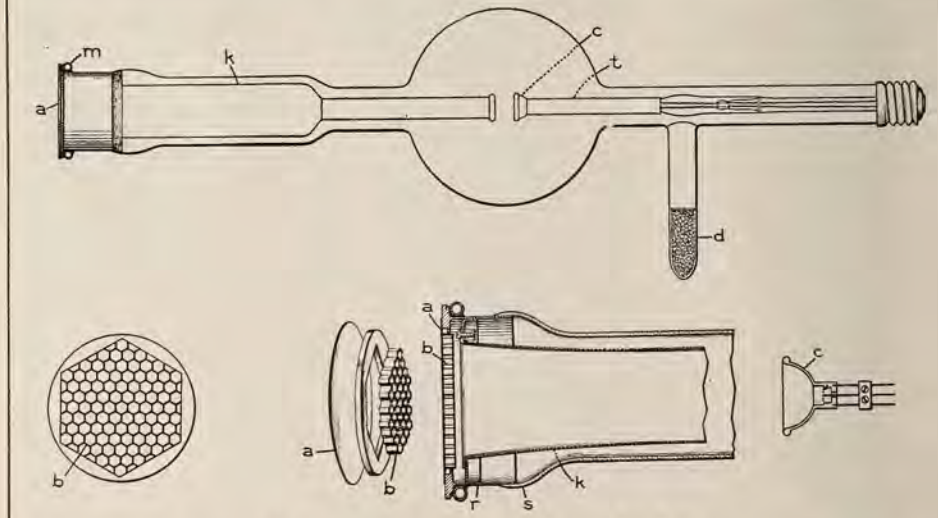

Explanation of diagram of the Cathode Ray Tube

Upper—Diagram of tube. Lower left—Construction of window. Lower center—Details of window, shield and seal. Lower right—Section of cathode. *a.* Anode window, a very thin piece of nickel foil, through which the electrons pass into the air. *b.* Window support, a molybdenum hexagonal grid, to reinforce the window against the pressure of the atmosphere. *c.* Hemispherical cathode cup, focusing the electrons released by the tungsten filament within the cup. *d.* Charcoal trap for residual gases. When immersed in liquid air, the charcoal removes all traces of gas within tube. *k.* Copper shield, preventing the electrons from striking the glass tube. *m.* Water-cooling tube, to prevent the window from becoming heated. *r.* Sleeve of invar, an alloy with about the same expansion as glass upon being heated, to which the anode is soldered. *s.* Glass-to-invar seal. *t.* Cathode shield

High Lights on Wavelengths and Frequencies Used

By KIRK B. MORCROSS

LIKE the story of the empty bucket, there being nothing in it, the subject of wavelengths and frequencies may not strike a responsive cord of interest in many of us. Why should we care about these apparently non-essential things in the background of the varied and colorful field of radio? We admit of course that meters, representing wavelengths, and kilocycles, representing frequencies, or rather, meters, or kilocycles are a necessary evil incident to the performance of the radio drama but after this fact has become ensconced in our minds why worry any more about the matter? The wavelength is there or the frequency if you prefer, and that settles it. Radio will go forward just as well without our delving further into the idiosyncrasies of these phenomena.

But after all, are wavelengths and frequencies in the background; can we be content without giving them a little "worry" and will the art of radio go forward just as well without some study on our part of these terms? The answer to these questions is decidedly in the negative. You probably don't agree with this now, but wait, and I will try to convince you. If I fail then you will have the satisfaction of knowing I am mistaken; if I succeed, why then, we are all going to receive some benefit.

First of all we will admit that waves are in the background, very much so. But what is a background? The dictionary defines it as a "subordinate position" or "that part of a picture behind the principal objects." Radio is a panoramic picture and in the background of that picture, giving it depth, setting and naturalness come wavelengths and frequencies. But here is something that must be proved. Let us do so.

The very earliest investigators of electromagnetic waves measured the lengths of those waves. It was an important and natural thing to do in order to further the progress of the art. Investigations in those pristine days of radio were marked by attempts to make better wavemeters. The old spark transmitting sets employed highly damped waves which required a measurement of decrement to determine the "spread" of the waves. The instrument used was a "decremeter" which was also a wavemeter. As the number of radio stations increased the measurement of their wavelengths became a matter of prime importance. The more stations the more interference and the more interference, the more necessary it was to measure wavelengths accurately.

So down through the corridors of radio progress have come wavelengths and at the dawn of broadcasting we recall that broadcasting stations were assigned waves in two bands, 360 and 400 meters. Then as the need of space in ether became acute a great many bands were made available for broadcasting. The 360-and 400-meter bands corresponded to 833 and 750 kilocycles.

Multiples of Ten

GRADUALLY the 833-kilocycle stations were allocated to other bands and at the present time the majority of broadcasting stations are assigned frequencies in kilocycles which are all even multiples of ten. Right here we begin to get suspicious that something is the matter with wavelengths else why this changing of the designations to kilocycles? Thereby hangs a tale which, incidentally, will occupy a deal of space in this article—later. Unfortunately Congress has failed to pass legislation giving the necessary authority to the Secretary of Commerce to specify frequencies to be used by broadcasting stations and a recent ruling of Attorney General Sargent disclosed that a station may legally select its own frequency. As a result, some stations have reverted to the 833-kilocycle wave while other stations have chosen some other frequencies which are not multiples of ten. That this may result in serious inter-

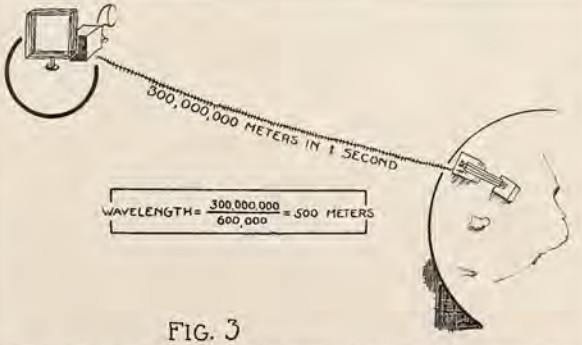

FIG. 3

Simple sketch showing speed of radio waves. At the right is the transmitting antenna and at the left your radio receiver

ference will be understood by a later explanation in this article. It is hoped that the next session of Congress will see the enactment of an authoritative radio law which among other things will ensure the use of proper kilocycle values by broadcasting stations.

We see that wavelengths and frequencies are in the background of radio sure enough but what an important background it is! A little "worrying" about them is certainly going to be worth while especially when it is mentioned that by so doing a little bit of the subject is going to be carved out of that background and placed right in the broadcasting stations and the receiving set. This discussion includes the experimenter, the amateur and the broadcast listener alike and without these members of the radio fraternity where would radio be today? Certainly if it can be shown that this subject is worth while to those people we are safe in saying that radio is going forward.

Tuning Fork Simile

CONSIDER a tuning fork—the kind we used in physics laboratory—which has, say, a period of vibration of 500 times per second. That may be a little too fast for easy comprehension and yet some sort of idea of it may be obtained by imagining a freqeuncy of 10 vibrations per second and gradually increasing the number. One of these complete vibrations of the tuning fork is represented by the "still movie" in Figure 1. At A the fork is struck and bends to the left; at B it passes through its normal position and then springs to the right as at C; at D it again passes through the normal position and then comes to E, the position from which it started. The fork has made one complete vibration in one five-hundredth of a second. Of course other vibrations follow and as each one is completed an air wave is sent out. These striking the ear drum 500 times each second, produce a musical note of rather high pitch. (No, I am not going to take up the old, old controversy of whether or not that sound is there when you don't hear it!)

Now sound travels, in ordinary air at the rate of 1090 feet per second, for simplicity let us say 1100 feet. Place yourself at that distance from the fork and have some one hit it with a hammer (see Fig. 2). One second later the first air wave will strike your ear. In the meantime 500 waves have been sent out and they are evenly distributed over the intervening space. The distance between these waves (in other words, their wavelength) is $\frac{1100}{500} = 2.2$ feet.

The simple explanation just given may be a little removed from radio; nevertheless it leads naturally to a consideration of what transpires in the antenna of a broadcast station. Consider such an antenna as shown in Figure 3. Let us assume that this antenna is so tuned that the alternating currents set up in it have a frequency of 600,000 cycles per second. Try to count them! At any rate that frequency is in the broadcast band and before proceeding further let us thoroughly understand the meaning of one cycle making up this frequency.

Beginning with a zero valve the current flows through the antenna circuit in one direction, then reverses and flows through the circuit in the opposite direction. This completes one cycle. Note the analogy to the tuning fork explanation. This all takes place in one six-hundred-thousandth of a second; 600,000 complete reversals of the current occur each second. This phenomena occurs right in the antenna of the broadcasting station because the antenna has capacity to earth and this forms a complete path for radio currents just as a loop of copper wire forms a complete circuit for a direct current. (This explanation concerns the carrier frequency of the broadcasting station; the effect of modulation can be neglected).

As each cycle is completed in the antenna a wave is shot out into space. Again, as in the case of the tuning fork place yourself at a distance. This time you will have to make it 300,000,000 meters or about 186,000 miles in order that we may follow out the analogy. Hence equip yourself with a receiving set out in space and see what happens. In just one second after the first cycle of current is completed in the antenna the first wave reaches your set. But during that time 600,000 waves will have been sent out and filling the intervening space, they will each be separated by a distance of $\frac{300,000,000}{600,000} = 500$ meters. Hence the wavelength of the broadcasting station is 500 meters.

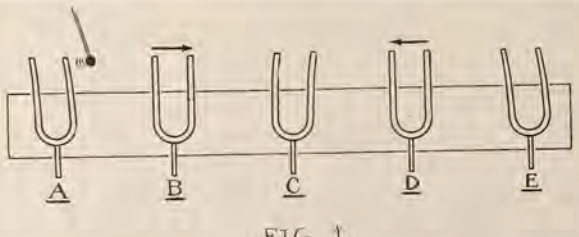

FIG. 1

This is the manner in which tuning fork vibrations pass through the air and are received by the ear as a musical sound

Speed of Radio Waves

WE CANNOT carry this comparison with the tuning fork too far. The waves from the fork travel very slowly—by comparison; they travel through air, not ether. The speed of the radio waves and likewise their frequency are entirely beyond comprehension. Parenthetically it may be mentioned that recent theories indicate that "ether" and "ether waves" are nonenti-

ties but that does not concern us here.

We have seen that dividing the velocity of radio waves in meters per second by the cycles per second gives the frequency. To save space and ink, frequency is expressed in kilocycles per second where each kilocycle represents one thousand cycles. Thus to obtain meters we divide 300,000 by the known number of kilocycles, or to obtain kilocycles we divide 300,000 by meters. The letter "f" is understood to mean frequency in kilocycles per second while the Greek letter λ (lambda) means wavelength in meters. For greater accuracy in computation the number 299,820 replaces 300,000.

You may become thoroughly up to date on this wavelength-frequency conversion business by investing the small sum of five cents. Send this amount to the Superintendent of Documents, Government Printing Office, Washington, D. C. and ask for "Miscellaneous Publications of the Bureau of Standards No. 67" and you will receive a large chart giving accurate conversions at a glance.

Have you noticed how of late the lists of broadcasting stations in newspapers and magazines are designating those stations in kilocycles as well as meters? The reason for this is, simply told, due to convenience. The distribution of broadcasting stations in the ether is determined fundamentally by kilocycles and as long as the kilocycle designations are all even multiples of ten it is an easy matter to learn the various frequency assignments.

Broadcasting stations were originally designated in meters and so it is not easy for us to become accustomed to kilocycles. We naturally agree that kilocycle designations represent a greatly simplified plan as compared to specifying stations in meters employing numbers which are generally expressed in decimals and which appear to have no special relationship whatever. Quite naturally the question arises: Why not assign wavelengths which are even multiples of ten? Such a procedure would be practical but the results would be ridiculous because while the ten-meter separation of the long wave broadcasting stations would be about right to prevent undue interference, that separation would be far more than necessary to prevent interference between the shorter wave stations. Result: a lot of waste space in the ether.

Very good so far, but what are the underlying reasons for the greater adaptability of kilocycles? They are two in number and they both relate to the carrier waves or frequencies radiated by broadcasting stations. It has been found that these carrier frequencies may have a certain minimum separation without undue interference and that this separation is the same regardless of the corresponding wavelengths. This required separation is determined by the width of side bands and by the beats produced between carrier frequencies.

Side bands are frequencies due to the modulation of the carrier which are somewhat higher or lower than the carrier frequency. Side bands normally occupy a space about five kilocycles each side of the carrier frequency. Thus we see that a broadcasting station requires more than a narrow streak through the ether. (Remember this fact when considering the adoption of a sharply tuned circuit: some of the side bands may be cut off and away goes the quality of received music). Since side bands extend out approximately five kilocycles each side of the carrier frequency a group of broadcasting stations spaced ten kilocycles apart must be very accurately fitted into the ether. It must not be assumed however, that these side bands always occupy this amount of space; they swell and shrink according to the modulation at the broadcasting station. Interference may occur between broadcasting stations even though a

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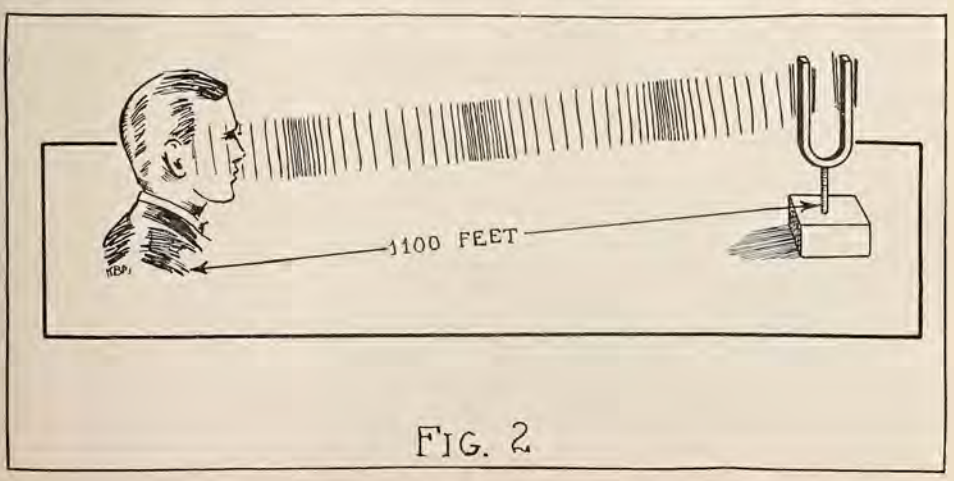

FIG. 2

Turning Soprano to Contralto is Feat *of* Single Side Band Set

By I. J. KARR*

RADIO broadcast signals whittled down to a single side band are now being put on the air by the newly developed transmitter at the South Schenectady laboratory of the General Electric Company. The usual signal consists of two side bands and a carrier. In the newly developed radio transmission system the carrier is eliminated and one side band is suppressed.

The single side-band system is used on license 2XAH and operates on 1400 meters. Programs of WGY have been broadcast on the higher wavelength and the stripped signal has been received by station WCAD of St. Lawrence University, Canton, N. Y., and rebroadcast on that station's wavelength.

There are three advantages fairly definitely established in the new system. First, it increases efficiency. The ordinary radio signal considered in three parts, consists of the energy at the carrier frequency, energy distributed in the frequency band extending from the carrier upward and energy in a band extending from the carrier downward. The power of the carrier frequency alone, makes up somewhat more than half of the total power even when the modulation is as complete as possible. With the same amount of power in the transmitter twice the signal strength may be obtained.

The second advantage of single-side-band transmission is a decrease in interference. A narrower frequency band from the transmitter permits the use of more selective circuits at the receiving end. This reduces the exposure to noise thus improving the signal-to-noise ratio.

Another and third advantage is the smaller frequency band, thereby conserving the available range for other radio transmission.

*Radio Engineer, General Electric Co.

Audible sounds by which broadcast material is classified consist of frequencies, or complex wave forms whose frequencies lie between about 30 and 15,000 cycles per second. Such frequencies when converted into electrical impulses, could not be radiated efficiently from an antenna so modulation is necessary. In other words, the low audio frequencies are combined with a higher frequency so the resultant may be radiated.

Frequency Combination

WHEN two frequencies are combined by a vacuum tube a very interesting phenomenon takes place. If a radio frequency carrier of frequency R cycles per second is modulated with a second frequency of A cycles per second, there will be four frequencies present in the resultant. These will be R, A, R plus A, and R minus A. The R plus A frequency is known as the "upper side-band" and R minus A, as the "lower side-band." It should be noted that any of these frequencies may be discriminated against or entirely eliminated by suitable means. The audio frequency seldom appears to any appreciable extent in the output, its frequency being so far removed from the tuned frequency of the output circuit. Thus, there are three frequencies present in the output of the conventional transmitter. These are: R, the "carrier" frequency, R plus A, the "upper side-band" frequency and R minus A, the "lower side-band" frequency.

In a conventional receiver these same frequencies appear and from them the original audio frequency A is reproduced by the phenomenon of modulation. The lower side-band" may be caused to combine again or "uncombine" thus giving back the original A frequency. Similarly the "upper side-band" gives back the audio frequency. These two components add to give the reproduced signal.

It is practically impossible to build a single transmitter or receiver to accommodate the band of audible frequencies between 30 and 15,000 cycles and the engineer is pleased if his transmitter handles the band from 30 to 7000 cycles. Incidentally, this band would give excellent quality.

To illustrate the preceding explanation, suppose a carrier of 1000 kilocycles is produced and modulated by the audio band reaching from 30 to 7000 cycles. For every audio frequency there will be two resulting frequencies and these will divide into two bands, the "carrier plus" band and the "carrier minus" band. Specifically, the "lower side-band" will reach from 993 kilocycles to 999.97 kilocycles. The "upper side-band" will lie between 1000.03 kilocycles, and 1007 kilocycles. These questions may now be asked: Since the carrier beating with the frequencies held in either side-band will give the original audio back again at the receiver, why is it necessary to radiate both side bands? Also, why not supply the carrier itself at the receiver and avoid the waste of energy from the transmitter which lies in the carrier? The "single side-band" system is based on these principles.

Since no carrier is transmitted, it is essential that one be supplied at the receiver. In the case of the example above, if the "lower side-band" is radiated, 993 to 999.97 kilocycles, and a receiver heterodyne frequency of 1000 kilocycles is supplied then the original 30 to 7000 cycle band is reproduced.

Change Singer's Voice

A VERY interesting phenomenon is observed in receiving single side-band signals. If the receiver heterodyne frequency is

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What Do We Get From Boston?

By DOROTHY BRISTER STAFFORD

IF we are to believe the reiterated statement dinned into our ears nightly by a multitude of radio entertainers last winter, it is "Beans, Beans, Beans," but those of us who think of Boston as "WBZ, Springfield," or "WBZ, New England," know that we are indebted to the home of the Cabots and the cod for vastly more than the succulent Saturday night supper dish.

When we first went adventuring in radio, and found that one of the oldest of the Westinghouse stations reared its antennæ in the environs of the historic seat of culture and tradition, we expected to be completely overwhelmed by Harvard accents and heavy programs of intensive education. We were agreeably surprised to find that while naturally the New England station was strong on its educational features, —as it should be, with almost unlimited material to draw upon,— there was a versatility in its broadcasts that ranged all the way from University extension lectures to snappy dance programs and hockey games. A couple of years ago—when radio was radio—and not a bedlam of heterodyning howls as this winter, we were in the habit of tuning to WBZ nightly, and usually were rewarded by some excellent feature just a little different from what was coming out of the general run of stations, such as the Nature League talks by Thornton W. Burgess (the Peter Rabbit man), or the singing McEnelleys, in those days a decided novelty. But last winter, much to our chagrin, it seemed that every time we set forth intent upon hearing some distinguished speaker from the New England station we wound up with a real estate ballyhoo down in Jacksonville. It is with much satisfaction we note this winter that right seems to be going to triumph over might, and WBZ get back in its proper place upon our dials.

Those of us who are wont to regard radio as an entertainment proposition pure and simple, are a little inclined to discount the value of the many educational features that pour forth upon the air nightly, and when we do run across them, listen vaguely for a moment or two and then go on to something requiring less concentration, possibly wondering if anyone does take the trouble to seriously follow the elaborate courses prepared for their enlightenment. On its face it seems a marvelous opportunity for the thousands who have been denied the benefits of higher education. Ordinarily one might wax exceedingly eloquent over the blessings of radio as a disseminator of knowledge, were it not for the fact that from the testimony of many a broadcaster, we had almost arrived at the conclusion that the radio audience is not only not thirsting for enlightenment, but is decidedly unappreciative of the efforts of earnest program directors to give it anything above the most ordinary run of entertainment. After all the tumult and the shouting about the betterment of radio, and the wonderful programs that have been coming to us this winter, it is rather discouraging to have to accept the assertion of many a sponsor of high-class entertainment that the general public is not interested in the better class of programs. These purveyors of good music and the like, of course have to gauge the results they are obtaining from the written responses they receive, and one wonders if possibly there aren't many thousands of listeners who do enjoy and appreciate the programs, but are not the kind of people who would think of writing a letter about it. And in the early days of broadcasting it is true that there were many who had unpleasant experiences from attempting to express their appreciation of something fostered by concerns with the wrong idea of radio publicity. We personally know of one case, where the name obtained from the listener's cordial little note, apparently was placed upon what is known in advertising parlance as a "sucker-list," and after his mail had been cluttered up for several weeks with all sorts of advertising matter, this listener naturally lost his original enthusiasm for radio entertainment. But we scarcely believe that such a condition could exist today even in regard

Leo Reisman and his Hotel Brunswick Orchestra broadcast by WBZ

Prof. Robert Emmons Rogers of M. I. T. who broadcasts courses in literature from WBZ

to publicity programs. We had just worked out this little argument to refute the theory of a program director friend of ours that we of the radio audience are dead from the neck up, when we happened upon an instance in our own immediate circle that almost led us to believe he was right, and that the yearning for culture was just what he called it—"a lot of bunk."

We drifted into a home where one always hears a lot about the finer things in music and art—in fact the hostess prides herself upon her patronage of the symphony, her frequent trips to the metropolis in the opera season and a general disdain for anything proletarian. To our astonishment the house was filled with the raucous yowlings of a station, which we, broadminded though we are, have long considered impossible.

"Good gracious, Ann," we said, "why are you listening to that trash? The Philharmonic is coming in splendidly tonight." Our friend was quick on the retort.

"It's the children's night to stay up," she said. "And they don't understand the better music."

At this moment a leather-lunged quartette broke the tension with a stirring rendition of "Keep Your Skirts Down, Mary Ann."

"Do you mean to say they understand that?" we asked her.

The fact was that the two small boys, absorbed in some important children's business, weren't paying the slightest attention to the radio, while their pedantic mother was, for once in her life, indulging her inhibitions and listening to the sort of thing she really liked. Since then we have had a good deal of respect for the broadcasters who, probably without a great deal of encouragement, continue to give us the best there is to be had in the way of entertainment and instruction.

Which dissertation on the seeming ingratitude of that portion of the radio audience which should know better brings us to

Prof. William C. Monohan, Massachusetts Agricultural College, conducts farm courses over WBZ

the pleasing counter testimony of WBZ, as to the returns from the educational features, which form a prominent part of this station's programs. For, as you probably know, WBZ was the pioneer in broadcasting educational courses, the first experiments being conducted as far back as 1923. Prior to that time Columbia had put out a course in Browning, the theory being, as one of WBZ's instructors phrased it, "if radio listeners could stand Browning they could stand anything." The Springfield station seriously took up the business of dispensing knowledge in the Fall of '24 with courses in Contemporary American Literature, Conversational French and Appreciation of Music. The lectures were presented by instructors of recognized prestige, and that these representative teachers might know if their efforts were being wasted upon desert air, the unique experiment of asking those taking the courses to pay an enrollment fee of one dollar was launched, with the surprising result that more than 2,500 enrolled the first season. This proved that there were quite a number of people, who not only were willing to listen to educational radio, but were willing to pay for it. An interesting angle is that these listeners were not confined to stern New England, where one might expect to find a serious-minded audience, but represented all parts of this country and Canada.

Professor Robert E. Rogers of the Massachusetts Institute of Technology, who gave the experimental course in Literature, has collected many interesting statistics from the letters which came to him that first winter from listeners in far distant sections—many with a wistful touch—but all teeming with appreciation of the opportunity afforded those who are privileged in no other way to hear the things, that, to quote the instructor, "they have at some time been accustomed to and lost, or have always thirsted for and never attained." Extracts such as the following from letters that came in countless numbers convinced those sponsoring the programs that they were engaged in something quite worth while.

This was from a small town in North Carolina:

James E. Murley, sports announcer and press representative of station WBZ

"This is my first opportunity to attend college lectures anywhere, much less in historic Boston. I feel like saying Thank God for radio."

Another wrote:

"This town is forty miles from a public library, but I am going to try so hard to get the books you suggest."

All the way from Georgia came this sincere tribute:

"This course is of estimable value to students living in villages far removed from those things which make life worth while to them, and for me, literally starving for such, it is a God-sent message."

The letter that contributed most to Professor Rogers' happiness was written from an R. F. D. route in Ohio, and he calls it "a real Iliad of the fight of an American family not merely to exist, but to keep alive mentally." An extract runs:

"Until Cousin Frank bought us our radio we had not heard a lecture for twelve years, nor a good play since the first few months of our marriage when we went to Chicago and saw The Garden of Allah, and Maude Adams and Sothern and Marlowe. Now we have orchestras and organ recitals every evening. I want to enroll in your course and I hope I can complete it. It is such a fine, generous offer for folks like me who can't get away from home."

Thousands more enrolled last winter and the season of 1926 finds WBZ with its educational broadcasts as an established feature, with standard courses ranging all the way from French and Agricultural subjects to Applied Psychology. Since its inauguration in Boston, educational radio has spread in the past two years to every part of the country, the excellent intensive courses provided by several western universities being too well known to require further comment.

The most important addition to WBZ's varied activities this winter is the complete series of the Boston Symphony Orchestra concerts, which are being put on the air in their entirety for the first time. The real music lovers of the country are overjoyed at the opportunity of hearing this great organization, and together with the Victor and Brunswick programs which comes from WJZ, the Boston station is well supplied with music of the highest class.

To the dancing element of the radio audience WBZ means McEnelly's and Reisman's, for these two sterling dance orchestras are known the length and breadth of the land. The former, led by Edwin J. McEnelly, records for Victor, and the latter, with Leo Reisman at its head plays at the Hotel Brunswick, and the newcomer who tunes into the New England

George H. Jaspert, Director of Westinghouse station WBZ

station in one of its more serious moments will get the surprise of his life if he happens along when one of these lively aggregations is on the air. There are further dance programs by Bill Boyle's Copley Plaza Orchestra, and the Hotel Westminster group, which add to the gaiety of the station. One of the unique features of this broadcaster's popular programs is the Alleppo Temple Band, something which never fails to appeal to the masculine part of the radio audience. This huge organization of 218 pieces, has a standard far above that of the average amateur band, and anyone who has listened in on the regular weekly concerts given by these be-fezzed gentlemen, is likely to have his dials set in the same position the following week.

WBZ has a number of alert young announcers, and we don't believe there is a genuine Harvard accent in the crowd. Those who have daylight reception are familiar with the expert handling of football games from Princeton, Brown, Harvard and Holy Cross, by "Jim" Murley, sports announcer, who also takes care of WBZ's publicity, when he isn't at the microphone; and the uproarious hockey games which come from the Boston Arena one night each week during the winter are breathlessly described by Frank Ryan.

In fact it seems that WBZ has overlooked no type of radio listener in preparing its programs, and one might wish that its example could be followed by several middle-west and western stations that seem to operate on the theory that their audiences will listen to anything that happens to come to the studio doors, and that it is a waste of time to prepare programs with a special class of listener in mind.

And since we have been talking about the question of the appreciation of the radio public, and to just what extent we are to regard broadcasting as an established form of entertainment, we might quote from a letter we received the other day, which we believe illustrates the attitud of the average intelligent listener.

"Your article on radio programs came along on a busy day, and I laid it aside with a vague wonder as to what on earth you could find in this subject to interest you much less to write about. That night I had expensive tickets for a concert. It poured rain—the taxi slid around in the traffic until I arrived at the concert hall a nervous wreck. The auditorium was stifling hot, the man in front of us was suffering from an acute sinus, the flapper and the boy friend back of us were afflicted with giggles, the artiste of the evening apparently had an attack of temperament and behaved like a bear, and Sam growled all the way home over the injustice of dragging a tired business man forth to such an exhibition under the guise of pleasurable entertainment.

"The next evening the new novel I had been looking forward

(Please turn to page 69)

Design and Manufacture of Resistance Units

By JOSEPH MORGAN*

IN the design of radio apparatus, whether for transmitting or receiving, we must always consider three quantities; inductance, capacity and resistance. Inductance and capacity are utilized chiefly in apparatus used for obtaining resonance at certain frequencies (tuning). Much valuable experimentation has been made on inductance coils and condensers so that for the last few years we have had coils and condensers having extraordinary good electrical and mechanical properties. Unfortunately the development of resistance units has not kept pace with coils and condensers. This is not because the resistance unit is any less important, but chiefly because the problem is a much more difficult one.

Before tracing briefly the history of the design of high resistance units, it may be advantageous to list some of the more important applications of such units to present day radio. In radio, chief uses for high resistance units are for grid leaks, amplifier, coupler units, potentiometers, and for A and B eliminators. A good high resistance unit must be constant in value, noiseless, free of appreciable inductance or capacity, compact, durable, and have sufficient carrying capacity.

Naturally the first type of resistance unit was a coil of resistance wire. The limitations of this type of unit are many. In the first place, such a unit is very bulky if the resistance exceeds 100,000 ohms. Second, they are incapable of carrying much current without undue heating. Third, it is impossible to construct high resistance wire-wound units which have inductance and capacity sufficiently low for grid leaks and coupling units.

In order to overcome certain of these disadvantages, some years ago a unit was devised which consisted of two metal electrodes dipped in ink. The resistance was controlled by the distance between the two electrodes and the concentration of the ink. This unit was in many ways very imperfect. It was not compact; it was not portable; it was not permanent; and the resistance could not be adjusted within ten per cent of the desired value.

Shortly after this, the very familiar unit consisting of a piece of paper dipped in India ink and clamped between two copper contacts was developed. There was scarcely any virtue outside of cheapness and compactness which was possessed by this type of resistor. It could not be made within 20 per cent of the desired value; it changed from day to day; was entirely unable to carry currents even of the order of a few milliamperes, without breaking down. Its chief merit was that of a humidity indicator, but unfortunately it does not seem to have been employed for this purpose.

An improvement upon the aforementioned type was made by enclosing the carbon paper and contacts in a small glass tube. Even with this protection, these units were erratic in behavior.

It was at this point in the development of high resistance units that the International Resistance Company engineers began experimenting with a view to the development of a strictly scientific product. After many months of patient research, a method was found for coating the inside of glass tubes with a thin layer of metal. The glass tube was provided with brass caps and the caps were in metallic contact with the metal coating through the medium of low melting point alloy. While this type of resistor was an improvement over previous units, the film of metal was necessarily so thin in order to obtain the desired high resistance that it was impossible to make a perfect contact with the alloy in the brass caps. Further the heat due to carrying the largest currents required for coupling units, made permanent changes in the resistance of these microscopically thin metallic films. This type of resistor frequently showed excellent characteristics immediately after manufacture. However, after several months of use these units deteriorated rapidly due to crystallization of the conducting film. Almost every conceivable type of substance was deposited on the inside of these glass tubes. Every known kind of glass and countless alloys for sealing in were tried. Each new specimen was subjected to the most rigorous scientific tests. Literally thousands of specimens were constructed.

Metallized Resistor

OUT of all this experimentation, there was finally evolved the present type of metallized resistor with the glass core which fulfills the most exacting requirements which could be placed upon a high resistance unit. The glass tube, internally coated with a thin film, was abandoned. In its place a fine glass filament is used. This filament is spun on a very ingenious and efficient machine in lengths of five hundred feet and is entirely uniform in diameter. The glass fibre is then passed through a conducting solution, and then into a high temperature furnace through which a steady flow of gas is maintained. This process results in the production of a perfectly homogeneous conducting surface, thoroughly hardened upon one of the finest insulators known. The coated filament has many advantages over the internally coated tube. First, due to the much smaller area of the filament it is possible to have quite a thick coating of conducting material and at the same time produce a very high resistance.

(Please turn to page 44)

*Engineering Dept., International Resistance Co., Philadelphia.

Versatility *and* Simplicity Are Features *of* This Set

Wavemeter Added For Benefit of Experimenters

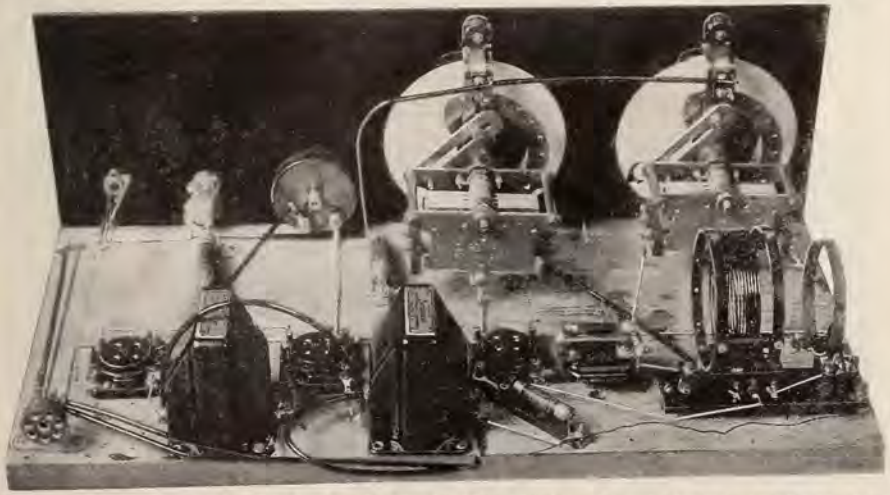
MANY broadcast listeners, as well as experimenters, have often expressed a desire for a receiver in which versatility and simplicity of arrangement have been combined. In answer to these requests the set described herein has been constructed and thoroughly tested in the laboratory, as well as under actual operating conditions from the highest to the lowest wavelength which it covers. All of this has been accomplished with extreme satisfaction.

Plug-in coils, five in all, allow easy transition from one band to the next in the broadcast spectrum. The Aero coils used, when in conjunction with a variable condenser of 140 micro-microfarads (.00014 mfd) cover the following ranges: Coil 1, 15 to 33.5 meters; Coil 2, 31.5 to 68 meters; Coil 3, 57 to 133 meters; Coil 4, 125 to 250 meters and Coil 5 from 235 to 550 meters. These coils, designed by F. J. Marco, a well-known amateur of Chicago, who is engaged in consultation work at present, have an overlap on all coils so there is no possibility of a lapse in covering the entire range of broadcast frequencies. Thus the broadcast listener may select programs from WGY, KDKA and others whose wavelengths are shown in our Short Wave Broadcasting section in every issue. He may also take in the ordinary broadcast programs from 200 to 550 meters. For the amateur the set is ideal because he may skip at will in the 20, 40, 80 and 150 meter bands.

For the advanced experimenter a wavemeter of the resonance indicator type (for transmission) has been included, the coils being the standard Aero coils with the tickler windings stripped off, leaving only the secondary. The range covered by the meter is the same range as that of the receiver. The meter may be used either as the resonance type, or as a straight wavemeter in connection with the grid meter driver described by Hoffman on page 7 of the September RADIO AGE.

Martin Copeland's new illuminated controls have been used on both the receiver and the wavemeter, as will be seen from an inspection of the pictures on these pages.

Reference to the schematic circuit on page 24 will give the builder an idea of the electrical connections. The coil marked A and G in the diagram is a fixed tune primary which serves as an energizer for all of the



Rear view of the completed short-long wave receiver showing Marco illuminated controls, Aero plug-in coils as well as other units mentioned in the text of the accompanying article

Front panel view of the resonance type wavemeter. The Marco dial is shown in the foreground. The knob shown at the right is the control on the Carborundum detector unit. The larger coil on the top is the Aero plug-in coil, while the smaller one is the home-made pickup coil

plug-in coils. While its tuning is fixed, nevertheless its inductive relationship to the various secondaries may be altered at will.

Condenser C1 is a Cardwell taper plate type 167-E having a maximum capacity of .00015 mfd (150 mmf) for spanning the secondary. The regenerative condenser C2 is another Cardwell taper plate, type 168-E of .00025 mfd (250 mmf). The grid condenser is a Sangamo .00001 mfd with a Durham grid-leak whose value may be from 3 to 7 megohms.

FILAMENT control is fixed. The detector, as used in our tests, consisted of a 199 tube. The resistance for that particular tube was an Amperite 199 which allows proper operation of a 199 from a six volt source. This is shown as R1 in the diagram. R2 is a 10,000 ohm Allen-Bradley fixed resistance (cartridge type) used as a choke in the plate circuit of the detector tube. Since it is non-inductive it can have neither a fundamental nor harmonics and this on occasions has helped in preventing blind spots in short wave receiver tuning. (Blind spots are those which occur when in tuning across a given band the tube stops oscillating, and excessive regenerative coupling is necessary to again induce oscillation.) R3 is an

This front view of the receiver shows the Marco controls, Centralab variable resistor across the first audio grid circuit for volume control, then the Yaxley switch and the phone or loudspeaker jack. The little knobs above the Marco controls are for turning on and off the lights back of the celluloid dials, current being taken from the same source as for the filaments

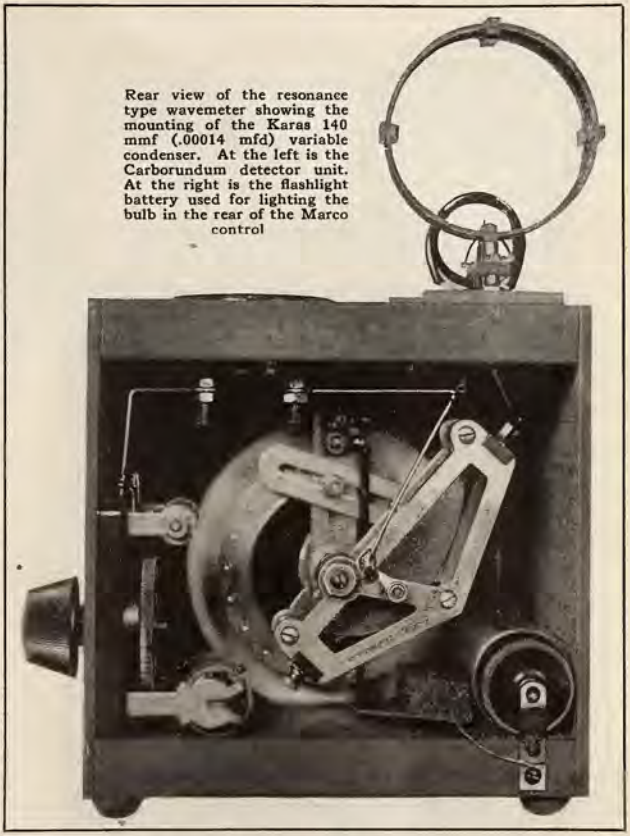
Amperite type 201-A while R4 may be an Amperite 112 for use with a 112 power tube. If quarter ampere tubes are used throughout, the last two may be put on a single 112 resistor instead of 2 single 201A resistors.

Audio transformers are the Samson 3 to 1 ratio, this kind having been used for good results on broadcast frequencies where quality is desirable. On the amateur bands, with code, quality is not especially desired, but rather volume.

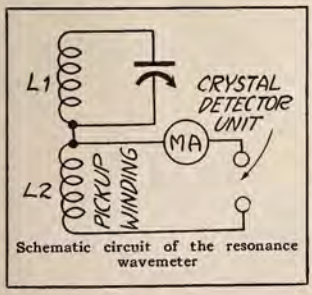
Sockets used were those made by Bremer-Tully which are cushioned. For short waves cushioning is not a bad idea to cut down tube jarring. Filament and plate connections terminate in a Jones base mounting. A Centralab O-200,000 ohm variable resistor placed across the grid circuit of the first audio, serves to control volume. The set is turned on and off by means of the Yaxley filament switch. A phone jack of the same make is provided for headphones or loud speaker.

Properly built this receiver is perhaps the most selective one we have yet used. It is especially desirable when tuning on the broadcast band to split the band into two sections by the use of Coils 4 and 5, the former covering from 125 to 250 meters, and the latter from 235 to 550 meters. Biasing of the two audio grids is accomplished by means of a C battery which may either be placed in the rear of the baseboard, or kept separate on the table.

PLACEMENT of the parts is illustrated in the photograph of the rear view of the receiver at the bottom of page 21. The front panel picture is shown at the bottom of page 22, while the schematic is shown at the bottom of page 24. By following these views the construction of the receiver is a simple matter. The panel length is 7 by 26 inches. It can be made shorter if desired.



Rear view of the resonance type wavemeter showing the mounting of the Karas 140 mmf (.00014 mfd) variable condenser. At the left is the Carborundum detector unit. At the right is the flashlight battery used for lighting the bulb in the rear of the Marco control



Schematic circuit of the resonance wavemeter

By means of metal template furnished with the Marco illuminated controls, the drilling of the panel for the bezel is quite simple. Drill the top and bottom holes of the template first; then affix the template tightly against the panel and follow the drilling course for the bezel. Since the template is held tight against the panel, the holes for the bezel will be accurately placed. When all holes are drilled, remove the template and chip or knock out the window.

Construction of the wavemeter is also a simple proposition. The panel used is a 7 by 7 piece of Insuline. It is prepared for the insertion of the Marco illuminated control as previously described.

Two coils are used, as shown in the schematic diagram on page 23. The smaller coil (L2) is a pickup winding consisting of about five turns of busbar wire (round) wound on a form 1½ inches in diameter. Spaghetti is first placed on a length of busbar wire, then it is coiled tightly around a form 1½ inches in diameter and then removed. The pickup coil will be self-supporting and have good insulation between. This coil is

Another view showing the front and top of the wavemeter. The Weston O-1 DC milliammeter is shown at the right, top

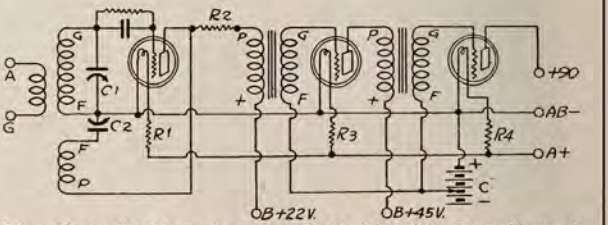
equipped with General Radio plugs while the G. R. jacks are placed on top of the meter housing. The coil L1 is any one of the five Aero coils, which are already equipped with General Radio plugs. The tickler winding is stripped out of the coils so these windings will not affect the wavemeter inductance. A Karas .00014 mfd (140 mmf) condenser is connected across L1 from one end to the other. Coil L2 is coupled to L1 at the rotor of the condenser. As shown in the schematic the Weston O-1 DC milliammeter is in series with coil L2 and the crystal detector which is one of the Carborundum stabilizing crystal detector units which have been found admirable for this purpose. The schematic shows the manner in which the connections are made.

When the wavemeter is placed near a transmitter and the variable condenser rotated, at the point of resonance the milliammeter will begin registering. When the needle reaches its highest point on the scale, the resonant frequency of the transmitter will have been found. By properly calibrating each of the coils against a standard, the wavelength of any transmitter within the band may be ascertained. For use in determining the fundamental of coils, etc., the grid meter driver described by Hoffman in the September RADIO AGE should be carefully studied.

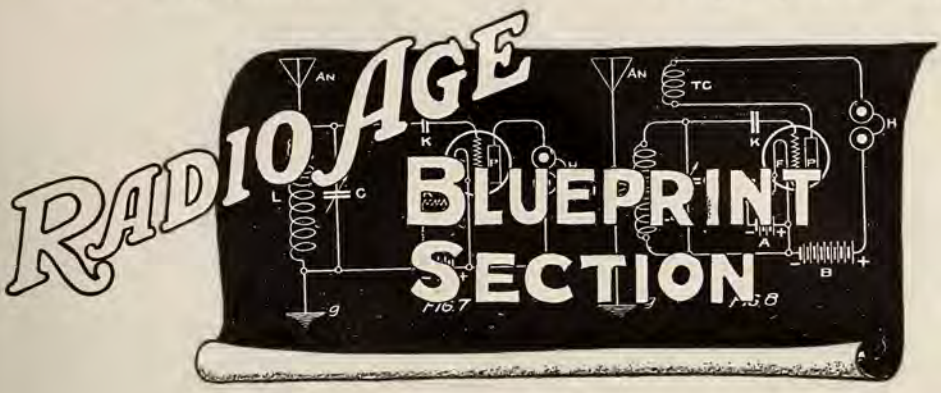
A small 3 cell flashlight battery is shown in the housing for lighting the bulb in the rear of the Marco control. The Carborundum stabilizing unit also makes use of a small single cell flashlight battery for applying a potential to the fixed crystal.

This receiver has been in use in the laboratory for the past sixty days on both code and voice work covering the entire broadcast and amateur range. Its selectivity on the broadcast band is excellent and good quality of reproduction secured.

It has also been used with A and B elimination with fine results. The recent A eliminator made by Briggs and Stratton, Inc., known as the Radi-A, was utilized in securing filament supply, while the Majestic B eliminator was connected up for the plate potential. Both of these devices operated without any hum when head phones were used on the receiver. The same held true for loud speaker operation.



Schematic circuit of the receiver as described in this article. From this sketch the set may be easily assembled



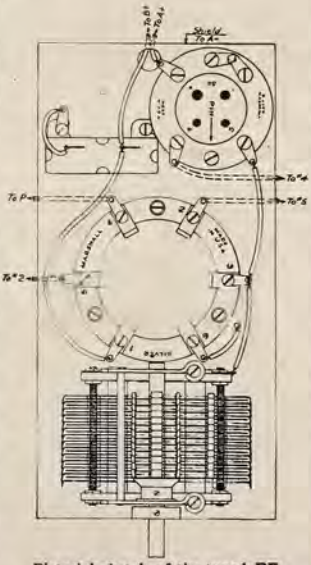
New Six Tube Receiver Kit Is Completely Shielded

By McMURDO SILVER

INSPECTION of this season's receivers indicates that practically all are of the tuned RF variety and that though in this respect they certainly are not new or radical, yet certain new features are evident which make them more than interesting. Among these features may be mentioned simplicity of tuning control, quality of reproduction, the use of complete shielding, and, possibly more important, there is evident a very persistent endeavor to equalize amplification throughout the entire wavelength range to be covered—a feature woefully absent in previous designs.

The receiver to be described in this article may well be selected as an example by means of which the outstanding engineering advances of the season may be explained inasmuch as they are practically all contained in this single design. Not only those of an electrical nature are evident but the more important mechanical advances tending to mechanical strength and longer life of receivers are excellently exemplified in the Shielded Six, the name by which the outfit illustrated, which is available in kit form, is known.

Radio frequency amplification employed in the receiver is extremely interesting and is remarkably efficient, for RF transformers employing an extremely high value of coupling between primary and secondary are used. This high value of magnetic coupling is obtained without detrimental capacitative coupling between windings by spacing the primary turns over the full length of the secondary winding and further by locating them on a tube which is one-quarter of an inch away at all points from the secondary winding. This feature of maximum inductive coupling with the lowest possible value of primary inductance is one which does not appear to have been properly appreciated in previous years though it is extremely important, as can be shown very simply. It is known that the larger the inductance in the plate circuit of a vacuum tube, be it either detector or RF amplifier, the greater will be the tendency of the circuit to oscillate up to a limiting critical point which is approximately the point at which the plate circuit becomes resonant with the grid circuit. In an RF amplifier oscillation is absolutely



Pictorial sketch of the tuned RF unit inside the shield

(Please turn to page 28)

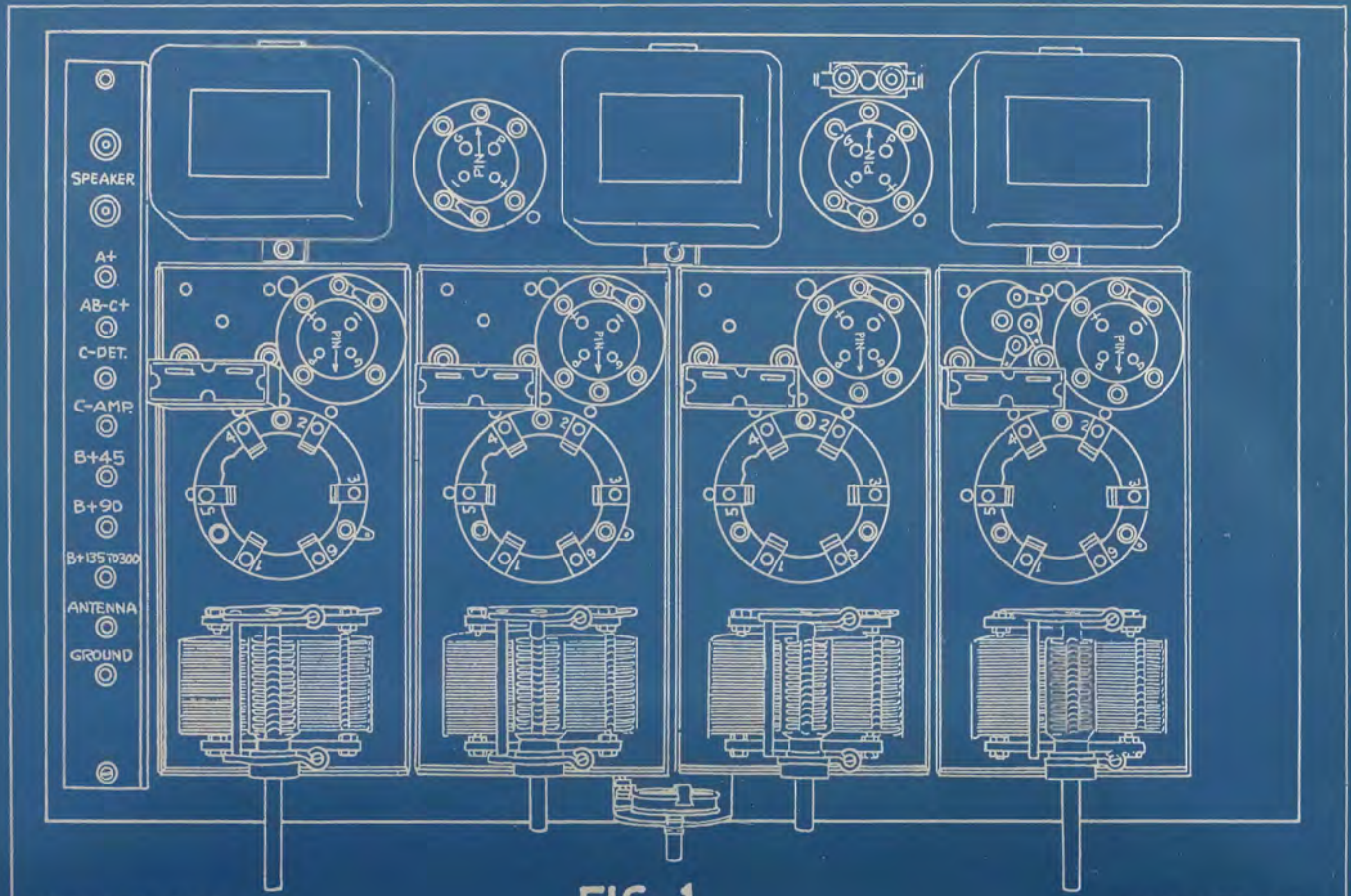


FIG. 1

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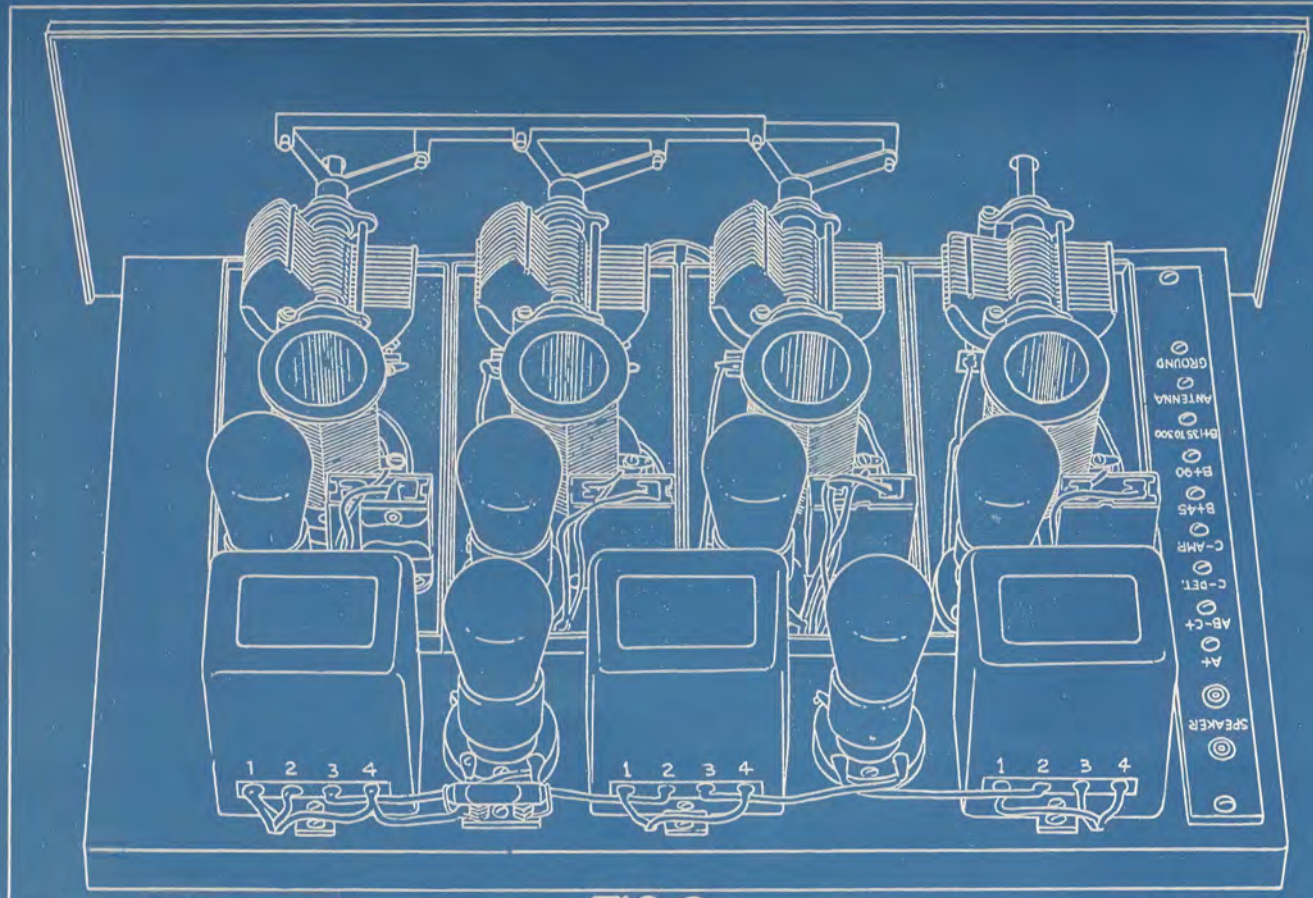


FIG. 2

RADIO AGE INC.

undesirable and is the limiting factor in the efficiency of practically all designs. For this reason it is evident that the primary inductance of an RF transformer should be kept as low as possible, yet the primary should be so placed with relation to the secondary that maximum inductive coupling results with a minimum of primary inductance. This theory, capable of mathematical substantiation, and evident in the product of the best engineers, is in direct contradiction to the older belief that the primary with turns bunched closely together and located at the filament end of the RF transformer secondary represented the peak of efficiency.

Coupling co-efficient between primary and secondary of the RF transformers is such that the tuning of each stage is slightly broader than would be allowable in a two stage tuned RF amplifier. This is a vital necessity for with three stages of RF amplification employed the side-bands of received signals would be cut were the RF stages too selective. Further, the possibility of effective gang control would become increasingly remote as the selectivity of the RF stages was increased. This matter of gang control is an important one for it would be practically an impossibility to handle a four control receiver, particularly when it is borne in mind that the average man often has difficulty in handling the conventional three-dial outfit.

In the Shielded Six the antenna stage is separately tuned by means of a variable condenser shunting the RF transformer secondary. Thus variations in antenna characteristics which affect the tuning of the first RF stage are not allowed to react unfavorably upon the operation of the receiver inasmuch as this stage is independently manually controlled. In order to minimize the effect, however, and to allow accommodation of the receiver to varying lengths of antennas, a switch is provided on the primary of the antenna transformer which permits the inclusion of a part or the whole of the primary winding in the antenna circuit.

The completed receiver described by the author is shown above

Inasmuch as the input and output characteristics of the second, third, and detector stages are practically identical, and as the coils and condensers are manufactured with more than the required degree of uniformity, these three circuits are tuned by a single control dial which, through the agency of a mechanical link motion, actuates the three variable condensers required for the tuning of the different RF transformers.

It will be noticed that all of the RF circuits are completely shielded by aluminum housings which enclose completely all parts of each stage. Aside from an extremely important function of this shielding which will be considered later, one of its most important purposes is to prevent the pick-up of signal energy directly by the coils, wiring, or other parts of the different RF circuits. The importance of this will be appreciated if it is realized that the various tuned circuits in this receiver, or in any tuned RF receiver, are intended to operate in the fashion of a filter. Thus the incoming signal flows to the first tuned stage from the antenna and is amplified by this section which serves at the same time to eliminate unwanted signals picked up indiscriminately by the antenna. The second and all successive stages serve to enhance this filtering effect with the result that in a properly designed receiver under ordinary conditions only one station at a time can be heard, all others being filtered out by the action of the tuning circuits. In the case of very strong powerful stations enough energy is frequently picked on the various coils of a receiver to operate the set with the result that the desired filtering action is entirely absent since the signal is not forced to progress through the various circuits from the antenna but is picked up in part by the detector circuit coil, as well as other coils and instruments. The obvious condition is that selectivity may not be obtained in congested areas with a tuned RF receiver, the circuits of which are not thoroughly shielded.

The other purpose which complete shielding serves is to equalize the amplification of the RF amplifier over the entire wavelength range. Inasmuch as shielding represents only one method employed to obtain this end and as this is a feature in which practically all of the older receivers are sadly deficient, it might be well to explain why it is necessary to employ special methods to obtain it.

In an ordinary RF amplifier, or tuned RF receiver, it is a well known fact that the tendency to oscillate is greatest at the shorter wavelengths and that the amplification is least at the long wavelengths. This trouble may be, for purposes of explanation, attributed to the increasing efficiency of RF transformers with increasing frequency or decreasing wavelength. This is an inherent characteristic of all RF

transformers and inasmuch as they are necessary in tuned RF receivers some means must be found to compensate for this deficiency if satisfactory uniform amplification is to be obtained at both long and short wavelengths in a receiver.

Another angle of considering the matter is that as the transformer efficiency increases or as the frequency increases the tendency of the circuit to oscillate becomes greater and greater, and not in direct proportion to the increase in frequency. It is therefore necessary if uniform amplification is to be obtained to provide some means which will counteract oscillation as the frequency increases at a rate almost exactly proportional to the increase in oscillation tendency. No one single method is adequate to accomplish this, though a number of individual methods will be found in different receivers, one of the most popular ones being the use of an adjustable primary inductance in the RF transformer in which the primary winding takes the form of a variometer or a coupling coil, the position of which is adjusted as the receiver is tuned.

In the Shielded Six five individual methods are used, the cumulative effect of all of which is to oppose oscillation in a very slightly greater effect than the tendency is manifest at all wavelengths. These methods are: (a) Interstage shielding; (b) placement of coils upon shielding; (c) reversed tickler; (d) series grid resistances; (e) manual control on first stage with loading on successive stages.

The first feature, that of interstage shielding, needs little explanation for it is generally accepted that coupling between circuits is extremely detrimental in an RF amplifier, or, for that matter, in any other type of amplifier, and may only satisfactorily be eliminated by complete shielding or isolation of each individual stage circuit.

Method "B" takes advantage of the increase in resistance of the RF transformer coils which may be effected by their relation to the shielding. Normally, the resistance at long wavelengths remains practically uniform with the shielding positioned as it is in the Six. As the frequency increases, however, due to the effect of the metal upon the coils, the resistance goes up quite rapidly which is the exact effect desired to compensate for the increasing tendency toward oscillation. However, the resistance increase cannot be made sufficiently rapid by the use of shielding to effectively compensate for the tendency toward oscillation and, as a result, allow of uniform amplification. Therefore a reversed tickler is employed in each stage, coupling energy from the plate circuit of each vacuum tube back to its grid circuit in a direction intended to oppose oscillation. For reasons well known to the art, the efficiency of this coupling increases as the frequency increases which is exactly what is desired to compensate for the oscillation tendency. Like the increase in coil resistance due to shield placement, however, this method alone does not increase rapidly enough in its effect with increases in frequency to provide uniform amplification. Therefore still another method is employed.

This method takes the form of series resistances located between the grid of each radio frequency amplifier and its tuned secondary circuit. These resistances tend to slightly oppose oscillation at long wavelengths, but, due to inductive effects, their alternating current resistance goes up as the frequency increases and they therefore operate to increasingly oppose oscillation with frequency increase.

All of these methods are used to render uniform the amplification of the second and third RF stages throughout the entire wavelength range of the receiver and to keep them in an extremely sensitive condition throughout this range. Inasmuch as the characteristics of antennas with which the Six would be used are bound to vary and cannot be predetermined, it will be realized that the amplification of the first RF stage will vary with variations in antenna resistance and that, as a result, no methods of automatic sensitivity control may be adequately employed. Therefore a manual control in the form of a resistance is used to regulate the sensitivity and amplification of the first RF stage. This resistance is unique in its application as it is arranged in such a fashion that a load is always kept on the primary in the second stage RF transformer. Were this not done, and were the control of the first tube effected through the agency of a filament rheostat or a series plate resistance, the load on the second RF stage would vary and, as a result, the amplification of the balance of the RF amplifier would not remain uniform.

In the methods employed a series plate resistance is used in the first RF stage which is so arranged that as more resistance is included in the plate circuit and the load automatically lessens on the second RF transformer. At the same time a portion of the resistance in shunt with the RF transformer primary decreases serving to increase the load in a directly opposite fashion. Thus the first RF stage can be pushed up to the point of oscillation and the sensitivity of the receiver in the hands of an experienced operator rendered practically unlimited. This resistance, one portion of which is in shunt with the primary winding of the second RF transformer and the tickler winding with the first RF transformer, is, by virtue of this fact, an excellent volume control, for, by means of it, the volume of a receiver may be cut to practically nothing or may be increased to a roar at will.

The audio frequency amplifier employs two stages of very heavy transformers which have a frequency characteristic in which the amplification increases as the frequency decreases. (It is a well-known fact that practically all commercial loud speakers will respond very poorly to frequencies below 100 cycles, if at all in many cases. This effect is further enhanced by the output transformer which prevents saturation of the loud speaker before its signal handling capacity is reached by the direct plate current of this last power tube.

(Please turn to page 32)

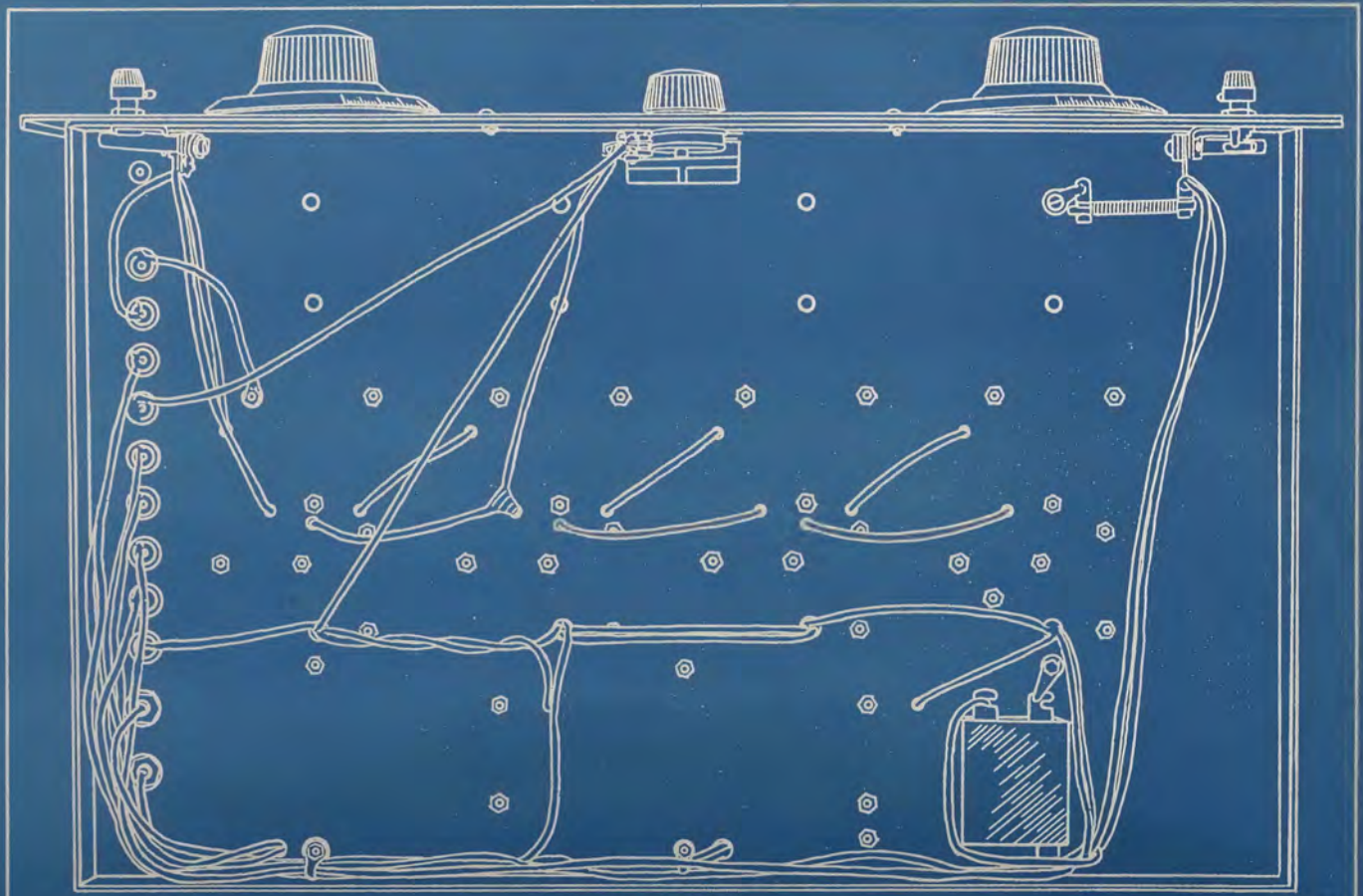


FIG.3

RADIO AGE INC.

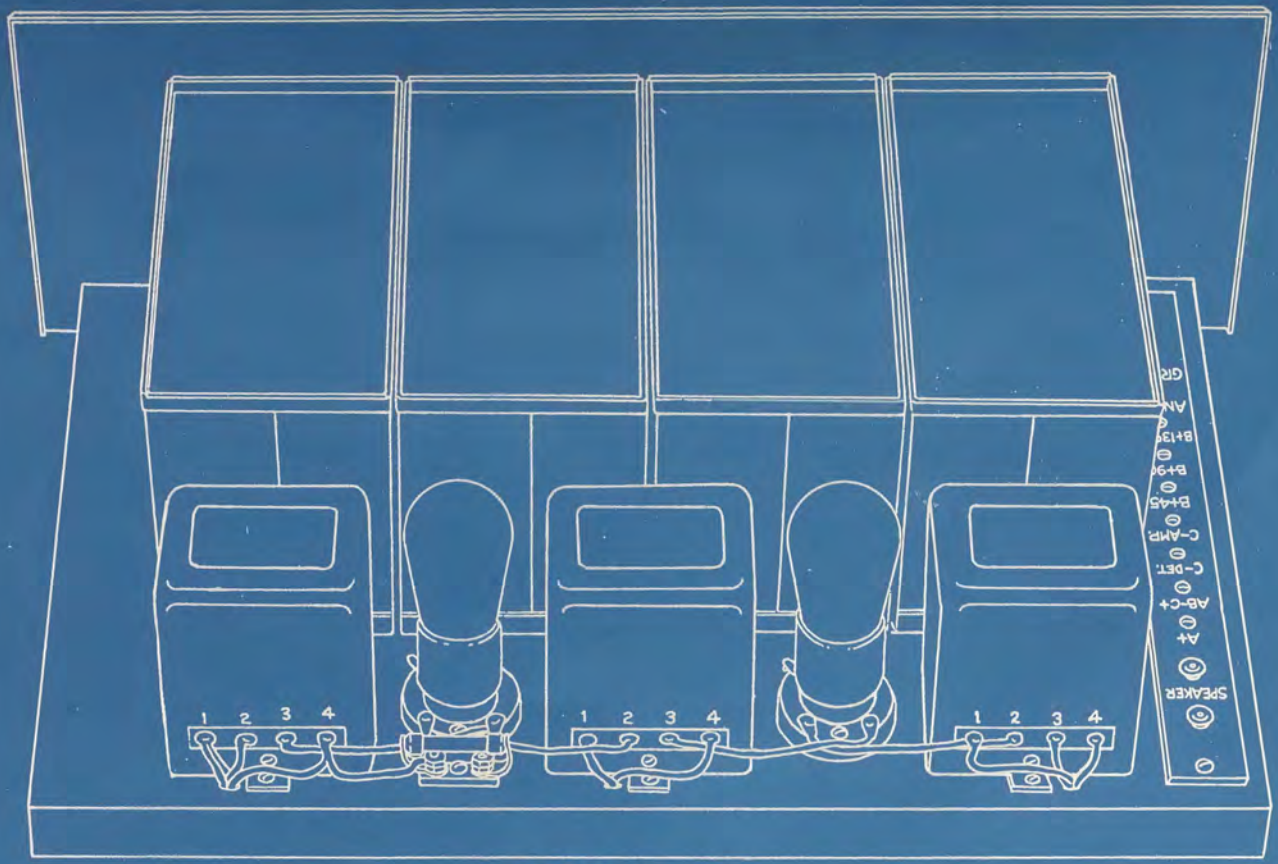


FIG. 4

The C bias on the first AF amplifier is rather interesting in that it is only one volt. This low value is selected as it has been determined that the grid voltage of this tube will never reach this value and consequently the grid of the tube may never run positive, which would cause distortion. An important effect realized by the use of the low C voltage is a decrease in the effective plate impedance of the first amplifier tube which allows of better low frequency reproduction.

Mechanically the receiver is particularly interesting inasmuch as it is available in kit form and, as a kit, represents the first all-metal construction ever available to the home-builder. The photograph of the front panel illustrates the simplicity of the assembly. On this panel will be found the antenna tuning dial together with a second dial controlling the second, third, and detector stage tuning. In the lower center of the panel is the volume control resistance while in the lower right-hand corner is the on-off switch. No filament rheostat is used, a fixed resistance providing automatic control of the non-critical amplifier tubes. At the left hand end of the panel will be seen the antenna switch allowing the use of either long or short antenna.

In one of the rear view photographs the entire assembly is clearly revealed to the eye. A terminal strip will be seen carrying all battery, antenna, ground, and speaker binding posts. This terminal strip is fastened upon a steel chassis which in turn carries the walnut finish brass front panel. Located directly behind this panel are the four individual aluminum stage shields which contain all the RF apparatus of each amplifier circuit. Directly behind this shield assembly is seen the audio amplifier consisting of three transformers between which are located the two audio amplifying tubes.

In one photograph the link motion serving to connect the three condensers which are tuned together is clearly visible. This is a mechanical motion practically entirely without play and serves the purpose of ganging the individually measured and surprisingly uniform condensers in a most satisfactory fashion.

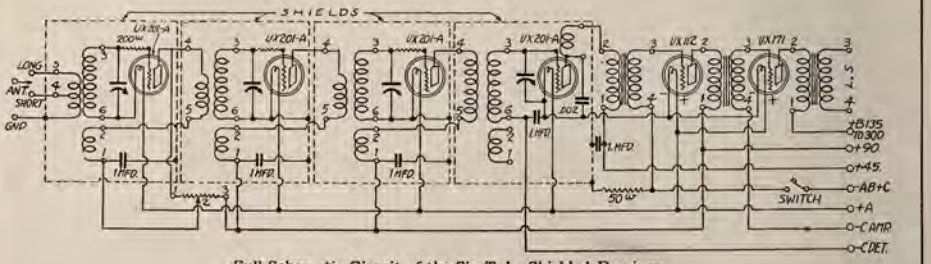
Five UX201A or CX301A tubes are used, with a UX171 or CX371 power tube in the last audio stage.

The construction of this receiver is extremely simple for every step is clearly illustrated in the photographs and in the wiring diagram. It is practically impossible to make a mistake for all of the parts are standard and available upon the market. Thus with the proper parts procured, they can hardly be mounted in any other than the correct fashion upon the pierced steel chassis which is also a standard item. The testing of the receiver once finished is simplicity itself for there is practically no error to be made in the assembly and nothing can go wrong. Thus with the receiver once connected up there remains no problem unsolved and the builder can enjoy the pleasure of tuning in station after station by means of the two control dials—a pleasure which it is difficult to fully appreciate unless one has tuned an extremely sensitive, selective receiver producing more than ample volume with a tone quality which is startling in its fidelity.

In our next issue we hope to have complete constructional data on the building of a superheterodyne with no repeat positions on the oscillator dial—the set is now in the final stages and awaiting operation tests. We believe the receiver will be ready for readers in the January issue.

Robert J. Casey, nationally known radio humorist, unravels a corkingly funny yarn on the subject of broadcast conditions as we find them at this time. Be sure to get your January issue and laugh with Mr. Casey.

—Editor.



Full Schematic Circuit of the Six Tube Shielded Receiver.

Who Said the Parts Business Is Dead?

By F. A. HILL
(Associate Editor)

MORTICIANS who may be lurking in the offing, awaiting the early demise of the parts business, are due for an indefinite vigil ending with keen disappointment at the failure of the said parts business to give up the ghost.

This much has been gleaned from interviews and letters secured from those members of the radio industry who are specializing in the manufacture of parts and accessories required in the building of radio sets. Every now and then a glib tongued individual will break forth with the pronunciamento that the parts business is dead; that radio is like the phonograph or the automobile, and that no one would ever conceive of the idea of making their own phonograph or automobile. This announcement, generally sponsored by an individual who is engaged in manufacturing a complete receiver (factory built) has so far gone unchallenged.

In an effort to get at the facts in the case recently this magazine interviewed a number of parts manufacturers who have been in the game for some time and who have established a reputation for honest, high quality products. Their reactions will be given as an indication of the virility of the parts business.

W. A. Ready, president of the National Company, Inc., engineers and manufacturers of many parts now used by home builders, sounds the keynote of the matter in this fashion: "Our business, which consists mainly of parts, shows an increase of 41 per cent during the month of September of this year over the same month of last year. It is the writer's humble opinion that the day the parts business dies will be the day the science of radio shall cease to progress. We are very far from that day, at present. The thrill of personal accomplishment is still very strong in the minds of every active, intelligent American."

Taking the example of another manufacturer whose viewpoint represents a different sphere of activity, we hear from Francis R. Ehle, president of the International Resistance Company, manufacturers of the Durham metallized resistors, who states: "While the majority of sales of our resistors are to manufacturers, a large percentage of them are to jobbers. From the number of jobber orders that have been received during the past month, we would certainly not say the parts business is 'dead.' There seems to be more interest in circuits this year than in previous years—that is, worth while circuits, and we look forward to a very successful season from the sale of Durham resistors to individual set builders through our jobbers and dealers."

Double the Business

MANUFACTURING a wide variety of parts used by home builders, Arthur Moss, treasurer of Electrad, Inc., throws further light on the subject in the following statement: "Decidedly, the parts business is not dead. Our organization is doing practically double the fan business it did a year ago, and three times as much fan business as it did three years ago. Quality parts will sell and a quality line will grow. The parts buyer is with us to stay as long as a radio is here because of the very nature of radio. A soldering iron to a fan is the same as a saw to a carpenter. Each would be lost unless he could actually do the job with his own hands. The parts business has become more concentrated—that is—the fan business is drifting into the hands of such parts manufacturers as put out reliable products. There may not be the same number of fans there were two years ago, but the successful parts manufacturer is today getting a greater share of this concentrated buying public."

E. Cornell Martin, vice-president of the Martin-Copeland Company, furnishes us with a pithy analysis of the parts business which is well worth remembering: "During this season there has been a very definite trend towards a greatly increased business in parts of the better type. Many owners of factory built sets have become interested in building their own receivers. This desire to do something constructive one's self is a very pronounced trait of the people of this country. Our business has shown a very substantial increase each of the five years we have been manufacturing radio parts. Parts have just as definite a place in the merchandising of radio as factory built receivers. Careful analysis of the business of stores handling both lines will show that no small part of their profit has been made on the parts. They are free from the necessity of giving service and bring customers to the store on many repeat occasions."

One organization had figured on confining their production to the needs of manufacturers of complete sets, but the jobber demand became so insistent it became necessary to alter the previous policy. We quote H. E. Osmun, sales manager of the Central Radio Laboratories: "We have been very optimistic about radio parts sales and find our optimism justified in every way by the early business. About this time last fall we felt it was scarcely worthwhile to push the sale of our products to jobbers, believing at the time we could interest others connected with the industry that the manufactured set was the thing and that we should concentrate our attention on sales to manufacturers. The jobbing business, however, came in with no effort on our part and with such steadily increasing vol-

ume it was forced on our attention. Since the first of the year we have devoted a great deal of time and thought in developing sales to the home set builder and the man who wishes to improve his present receiver. There can be no question about its success because our sales to jobbers have steadily increased every month since the first of the year with the exception of the two summer months of July and August, and even in these months our parts sales to jobbers were greater than they were a year ago in October."

Where Crowds Go

TACKLING the question from another viewpoint, E. Tyrman, president of the High Frequency Laboratories, states: "The question of the condition of the parts business can best be answered by looking into a responsible wholesaler's place of business. There is always a crowd, and this crowd represents the public that is really interested in radio. Despite the statement of many set manufacturers these home builders and experimenters are having much more satisfaction in listening to their own receiver. The confused broadcast conditions require extremely selective sets and the price of factory built receivers to meet this requirement, is prohibitive for many fans. I am convinced there is at present more interest in high class apparatus than during any previous season."

In many cases parts manufacturers have left that part of the business and gone into the complete set market. Here we have an organization that quit the set business to engage in parts. The opinion of Amsco Products, Inc., is voiced by Zeh Bouck in a recent letter: "We are at present exclusive manufacturers of parts, having made our exit from the set building field a year back. Making predictions justified by the extent of the present business, I should say we are anticipating through our advertising work a most successful season in the parts business. The parts business is a long way from suffering from senile dementia. As long as the patent situation makes it impossible for individual manufacturers to make the best possible equipment, the home made set must stand supreme. The average radio fan today has at his disposal a thousand and one patents and by tactfully infringing upon them he can make a set definitely superior to ninety-nine out of a hundred commercial receivers."

Tobe Deutschmann Company, speaking through F. D. Rankin, gives us the following insight into their business: "The condenser business is more or less riding on the crest of a wave at the present time. We find the activity in amateur building is on the increase. Circuits of B eliminators and power supply sets have been publicized continually and as a result there is an ever increasing demand for condensers and high current carrying capacity resistors. The sale of grid leaks, forming a vital part of set construction, has been increasing steadily and for this reason we are justified in saying at this time, the parts business is not on the wane by any means."

Concentrated Buying

THERE have been too many radio dealers in the field according to an analysis submitted for the Benjamin Electric Mfg. Co., through P. A. Powers, advertising manager, who has the following to say: "The radio parts business dead? Not as long as our sales are running twice as large as they were at this time last season. So far there has been more activity in the parts business than at any time since the advent of radio. I believe this experience is typical of most of the leading parts manufacturers. The reports that salesmen are sending in indicate many dealers are going out of the parts business, but we regard this as a desirable condition in many ways. There have always been too many dealers in the field. It now looks as if the sale of parts will be concentrated among the more capable dealers using sound merchandising policies and handling well known quality products. This should be an advantage both to manufacturers and consumers of radio products. We expect no great boom in parts sales at this time, but see no reason to believe otherwise than that there will be a satisfactory and growing demand for those products which meet market requirements."

Stating they have no reason whatever to complain of the condition of the parts business, the Allen-Bradley Co., through F. F. Loock, sales manager, gives the following brief statement covering their organization: "Speaking from our experience with our jobbers this Fall, we have no reason to assume the parts business is dead or, for that matter, is even dying. It is a fact some jobbers have given up the handling of parts but, on the other hand, this makes the parts business just as much more attractive for the remaining jobbers and dealers. In consequence we are enjoying a very healthy parts business. Frankly, we have no reason whatever to complain."

No Service on Parts

REAL activity in the set builders realm is discerned by M. Openshaw, sales promotion manager of the Radiall Company, who make the well known Amperite automatic current controls: "If the parts business is dead, or even dying, it is surely one of the liveliest corpses we have ever encountered. As a matter of fact we are in a particularly favorable position to deny such an altogether exaggerated rumor because as manufacturers of a self-adjusting rheostat specified as standard equipment in popular construction sets, we have an actual gauge of the real activity in the set builders realm. It is quite true that a year or so ago many of the jobbers were inclined to go out of the parts business and devote themselves to sets. What were the results? The jobber had to give service; he had to take back a large number of sets for repair and what not; in short there was nothing but grief. Since that time a remarkable business has developed in kits and jobbers were quick to realize the advantages which this

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Using Radio to See If Continents Drifting Apart

By S. R. WINTERS

IN order to test the theory that continents and islands of the earth are wandering or drifting apart, a network of longitude determinations are being made at strategic points around the world during October and November. Radio signals, sent from seven or eight powerful broadcasting stations, in the United States and other countries, will be used in checking the differences in longitude in various parts of the world and in testing the validity of the theory that the earth is unstable.

It is anticipated that these longitude determinations will be made with extreme accuracy—less than 0.02 of a second for the different longitude stations. This great accuracy would have been impossible under the old methods of using land telegraph lines and cables for sending time signals to longitude or astronomical parties. By means of radio, however, time signals transmitted from either Annapolis, Maryland, or Bellevue, District of Columbia, can be received in the astronomical observatories from Europe to Alaska and the Hawaiian Islands. Thus, it is anticipated by astronomers, that in one step the difference in longitude or time between London or Paris and San Francisco or Honolulu can be determined.

Capt. F. B. Littell, astronomer of the United States Naval Observatory, at the transit (or telescope) to be used at San Diego observing base in the world-wide longitude project

PRINCIPAL observing stations, selected because of their strategic locations inasmuch as they are at nearly the same latitude and spaced 8 hours apart in longitude, will be at San Diego, California; at the Algiers Observatory, Algeria; and at the Shanghai Observatory, China. The United States will make observations at four stations: Washington, D. C.; San Diego, Calif.; Honolulu, Territory of Hawaii; and Manila, Philippine Islands. The United States Naval Observatory will occupy the two first named observing stations and the U. S. Coast and Geodetic Survey will make observations at the other two stations.

Radio time signals will be sent three times daily during October and November from at least seven powerful transmitting stations, some of which will use both short and long waves. The participating stations and their assigned wavelengths are as follows: Arlington, Virginia, or Bellevue, District of Columbia, 74.7 and 24.9 meters; Annapolis, Maryland, 17,145 meters; Honolulu, Territory of Hawaii, 11,500 and 36.8 meters; Saigon, French-Indo China, 17,000 and 25 meters; Bordeaux, France, 18,900 meters; and d'Issy, near Paris, France, 32 meters.

The observing parties will be equipped with telescopes for reckoning time as the stars cross the meridian of the heavens and with radio receiving outfits for picking up the time signals from the transmitting stations. The Naval Observatory has designed a special radio recorder for the purpose, this equipment making an automatic graphic record of the time signals. The Coast and Geodetic Survey will also use an automatic radio receiving device, which records the time signals on a sheet of paper wound around the drum of a chronograph. In another instance, a photographic method will be employed in recording the radio signals. These radio signals will be compared with the local clocks or chronometers.

The Radio Storm Detector

Recent Radio Talk Given over WJZ by Arthur Williams, (Vice President, Commercial Relations, New York Edison Co.)

NEWSPAPERS throughout the country recently published the story of the French Government's official cloud painter, an artist who spends his days on the roof of the highest building in Paris gazing into the sky and recording what he sees, with paint and brush. Comparatively few people know that New York City for many years also had a professional sky-gazer, or that the unusual work to which he was assigned is now being done far more effectively by a simple little radio device—the first of its kind in the world. The purpose of our talk tonight is to describe the important part that this little device—known as the "storm detector"—plays in the work of insuring uninterrupted electric service for the largest city in the world.

Let us, for a moment, get back to New York's human sky-gazer and the reason for his job. This man's sole duty was to sit on the roof of the famous Waterside station with a telescope to his eye, looking for heavy clouds foreshadowing a storm or sudden darkness, and to get word concerning the oncoming storm to the man in charge of the generating equipment as quickly and as accurately as possible.

You may wonder why it is necessary to watch the skies so sharply for the first sign of an approaching storm. The answer is that electricity, in such great quantities as are required in New York City, cannot be stored, but must be generated as it is required; yet we must not use any more generating equipment than is really necessary if we are to operate with the high degree of efficiency and economy made imperative under present-day conditions. During a sudden storm in working hours in a city like New York, literally a million people may at the same moment press the button for electric light; our job—which is not always easy—is to see that they all get this light when it is needed.

The generating stations of The New York Edison system have a capacity of approximately a million horsepower, but it would not be efficient operation to generate so much power except when actually needed. That generating station is most efficient which can most accurately anticipate the minute-to-minute changes in the public's demand for current and thus at all times generate enough current to fill the needs of the community and yet avoid any waste of energy.

Demand May Be Doubled

DURING a heavy storm or sudden period of darkness in business hours the demand for current may be doubled within a few minutes. It has frequently been necessary during a storm to increase our service by 260,000 horsepower, and even more, within a few moments. During the total eclipse of the sun several months ago the increase in service demands caused by the turning on of additional lights throughout the city approximated one hundred thousand horsepower. It is not, however, possible to double the output of power in a few minutes. In fact, it takes nearly an hour to get one of our many huge turbo-generators—the machines in which steam energy is converted into electrical energy—warmed up and operating properly. That is why we must know that storm clouds are headed for New York City long before they get here.

The wireless storm detector on the roof of the Waterside station now gives us warning of an approaching storm when it is still fifty miles away, sometimes hours before the storm breaks over New York. Incidentally this little radio device, unlike other receiving sets, is helped, not hurt, by static, for the atmospheric conditions which cause static are the conditions which operate the storm detector. This detector consists of an ordinary radio aerial, a short-circuiting switch, a spark gap, a coherer, a relay and battery, a bell, and a condenser with a ground connection.

The nerve center of the entire New York Edison system is the System Operator's room at Waterside. Upon the System Operator rests the responsibility for the maintenance of electrical service throughout the city. He must anticipate every demand for service and give the orders which will enable the system to meet it. On the big board before his desk hundreds of little colored lights indicate the condition of every generator and every transmission line; meters show the capacity of the entire system and the current transmitted on the various feeders; a gauge shows the boiler pressure. Behind him is the radio storm detector which apprises him of approaching storms and their accompanying darkness long before a cloud is in sight from any point in New York City. At his desk the System Operator has direct telephone connection with 80 men. At his left a telegraphic system, similar to that used by our fire department, enables him to give any message simultaneously to any or to all of the forty sub and generating stations in the system.

Storm Rings Bell

WHEN a heavy storm headed for New York gets within fifty miles of the city, the wireless detector at Waterside begins to ring intermittently and rather quietly; the System Operator immediately passes word along to the boiler and generating rooms, so that they may get ready to put more generating equipment into use; as the storm gets closer and closer to the city, the radio detector rings louder

(Please turn to page 61)

Pick-ups and Hook-ups by our Readers

THE material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

A LARGE number of Washington radio fans are reporting the reception of HHK at Port au Prince, Haiti. The Department of Commerce states this is a government station opened recently, which operates on 361.2 meters and power 1080 watts.

THE Army radio net, which includes the Alaskan cable, has become a very speedy service, as the delivery of two recent messages will attest: A radiogram from Fort Sam Houston, Texas, to the Washington message center was delivered in forty-five minutes, while another transmitted from Anchorage, Alaska, to Seattle via cable, was relayed by radio through San Francisco, and Fort Leavenworth to Washington in one hour and thirty-five minutes.

FANS who tune in transoceanic stations, or try to do so, will be glad to know the power of those transmitters seems to be increasing rapidly so reception over here should be more practicable. Eighty-one foreign stations are now rated at 1000 watts or over, and twenty-two of them are of 1650 or more watts. The highest powered station listed is Daventry 5XX, rated at 16 KW. It is still on its long wave of 1600 meters but will change to a lower wave about December 1. The next powerful stations are Vienna, Austria, with 7000 watts on 517.2 meters, and the Moscow station of Russia supposed to be using about the same power but on a long wave.

AN UNKNOWN radio broadcasting station in Mexico is reported to be denouncing President Calles almost daily over the air, much to the disgust of his friends and followers. So far it has escaped identification and carries on its propaganda.

JAPANESE broadcasting interests have been combined and the Tokyo, Nogoya and Osaka stations will be operated by the Japanese Broadcasting Association. Each station, however, will continue to present individual programs.

"I didn't know Jones was a college man, did you?"

"Sure, I was listening in with him when he graduated."

THOMAS KILWIN, 2505 W. Dodier St., St. Louis, Mo., using a home made three tube set, furnishes a list of distant reception that belies the recent chaos which has been observed in the ether lanes.

REPORTS from England state that British broadcast listeners are urging the transmission of still pictures by radio, so that they may "look in" as well as "listen in" on important events.

A station in London, known as 2VT, has been licensed to project radio movies on 200 meters under the system invented by John L. Baird, but so far no radio prints or pictures have been offered the public. Two systems for broadcasting pictures are said to be in operation abroad, one in Vienna and another in Germany. Over here, C. F. Jenkins is working with the Navy in the broadcasting of weather maps, but no pictures are yet available.

A NEW public wireless circuit between Germany and Brazil has been opened, according to advices to the Department of Commerce. The German transmitter is in Nauen near Berlin, and the Brazilian receiving station is at Rio de Janeiro, but messages are accepted for any and every part of either country. Messages cost 2.75 reichsmarks per word. The opening of this line is expected to aid materially in developing German commercial prestige in South America.

AT LEAST two broadcasting stations, which have changed their wave lengths from their assigned channels, are now interfering with the weather reports broadcast by NAA, Arlington, Va., on 434.5

meters every morning, afternoon and night. The Navy Department points out the trouble is not so much that listeners ashore are deprived of this official information, but the interference is far more serious at sea where many small craft are not equipped except with ordinary broadcast receivers. Not having regular radio operators who read code, many coast-wise vessels such as tugs, towing barges and pleasure craft, utilize the radio-phone broadcasts from NAA for securing weather and time reports, as well as for picking up news and entertainment. Cooperating with the Department of Commerce, the Naval Communication Service is making an effort to persuade the broadcasters operating in the neighborhood of 435 meters to arrange their program so that they do not interfere with the weather reports transmitted by Arlington at 10:30 a. m., 3:15 p. m. and 10:05 p. m.

Biggest Flashlight

The biggest flashlight in the world was one of the exhibits at the Sesquicentennial Exposition, at Philadelphia, of the National Carbon Company, Incorporated, makers of "Eveready" flashlights and radio batteries.

This huge flashlight, measuring six and a half feet in length and two and a half feet in diameter, is an exact working reproduction, on a gigantic scale, of one of the popular models manufactured by the company. It is powered, however, from the electric lighting system of the exposition and has a 2,000-watt lamp.

Automatic Control

SINCE the advent of B eliminators, trickle chargers and other recent accessories to radio sets there has been a need for a simple automatic control. This demand has been met by the issue of the Yaxley automatic power control illustrated above. It is designed for sets using B eliminator and trickle charger. The power control automatically cuts out the trickle charger, cutting in the A battery and B eliminator when the filament control switch on the receiver is turned on. When the switch is cut off the automatic control switches back to the trickle charger after having taken off the A battery and B eliminator.

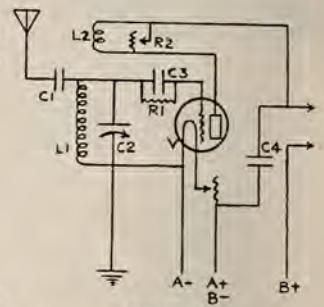
Resistance-Controlled Regeneration for Short Wave Receivers

By EDWARD T. HOWELL
(Radio 9 C V I)

EMBRYONIC hams whose purses are limited, as well as to others whose space is limited, may welcome the fact that oscillation of the detector can be controlled by a simple resistance device instead of by the more expensive variable condenser used in the Weagant and other types of circuits.

A movable tickler of course will control oscillation, but who wants to go back to the old rotating tickler, with which you could tune a station in and out nearly as well as with the tuning condenser, and which caused trouble with the shaft and pigtail connections? Modern plug-in coils also practically necessitate a different fixed tickler with each coil.

The diagram shows the lay-out of the new method. The writer claims no priority for the idea, but merely wishes to present it in a workable form.



Constants

V 201A tube.
L1 10 turns No. 18 wire spaced. 3 in. diam. (for 40 meter band.)
L2 3 turns 3 in. diam. 1 in. from L1. If L2 is wound in same direction as L1, the plate lead comes from top end of L2. (Just the opposite from that shown in figure.)
C1 25 mmf. or smaller. (2 pennies about ¼ in. apart.)
C2 100 mmf. variable.
C3 100 mmf.
C4 2000 mmf.
R1 5 megohms.
R2 50000 ohm Radiohm.

Advantages of this type of control are that the fixed by-pass condenser of rather large capacity enables a small tickler to be used; no r. f. choke is needed; on turning the Radiohm toward maximum resistance, the tube goes into oscillation with a gentle "plop," fully as smoothly as with the variable by-pass condenser control; there is a welcome freedom from capacity effects which are so noticeable with rotating ticklers; and finally, this particular device seems to make smooth contact at all positions of the lever.

The construction and mounting of the coils is left to the reader. In the receiver under discussion the wire was simply wound on a 3 inch cardboard tube, no particular effort being made toward "low loss" construction. 4's and 5's came in R5 and R6 on a hot afternoon in August with only a ten foot indoor antenna and no ground connection.

*Past President and former Chairman, Technical Committee, Milwaukee Amateurs' Radio Club.

New York and London Now Linked by the Speediest Cable in the World

THE New York end of the fastest cable in the world was laid recently at Hammels, Long Island. It links this country with England, by way of Bay Roberts, Newfoundland. The Newfoundland end was landed August 22 and the entire task occupied just three months, for the cable ship *Colonia* set out from Penzance, England, early in June.

This is the nineteenth trans-Atlantic cable and the eighth to be operated across the Atlantic by the Western Union. The cost of laying it was estimated at $1,000 a nautical mile. Its speed is 2,500 letters a minute, eight times faster than the ordinary cable. This speed is made possible by the fact that the copper conductor is sheathed in a wrapping of permalloy, an alloy of nickel and iron developed in the Bell Telephone Laboratories for the Western Electric Company and having a magnetic permeability many times that of any other known substance.

Uncoiling the sea-earth section of the new permalloy cable off Hammels Beach, near Rockaway. The cable weighs from 20 to 36 tons per mile and the men who handle it on the barge must show considerable dexterity to keep it from getting out of hand

In contrast to the landing at Newfoundland, when 150 fishermen hauled in the shore end through a heavy surf and during a driving rain storm, the landing of the New York end was accomplished under perfect weather conditions — brilliant sunlight and a quiet sea.

A barge took the shore end from the *Colonia* off Staten Island and brought it within about half a mile of Hammels Beach. A large crowd was on hand to watch the picturesque sight of the heavy cable, about three inches in diameter, being floated to the shore on barrels.

A rowboat first came ashore with stout rope to which the cable was attached by steel strands. The rope was wound on a winch set up on a truck about 300 yards up the beach. Then, one by one, the barrels to which the cable was lashed were lowered over the side of the barge. The winch wound away and the glistening black cable started on the last lap of its long journey.

Two deckhands, in trying to keep the bobbing barrels in line, fell out of their dory into the surf, but the water was shallow

(Please turn to page 57)

Bringing the shore end of the cable in from the barge by floating it on barrels

WITH THE MANUFACTURERS

Power Compact

ABOVE is shown Thordarson power foundation unit for B-elimination and power amplification. It contains a power supply transformer, two filter choke coils, a center tapped filament supply, and two buffer condensers all in one compound filled case. In two types; R-171 for Raytheon tube BH and power amplifying tube UX 171, and type R-210 for UX 216-B rectifying tube and UX 210 power amplifying tube.

Manufactured by the Thordarson Electric Manufacturing Co., Chicago, Illinois.

Eby's Vernier Dial

Above is the new shielded vernier dial made by Eby. It has dual range for rotation, and a hair line indicator. It is furnished in only one style as shown

Walker Promotes New Idea

George W. Walker, of Victoreen fame, has embarked in the manufacture and marketing of an entirely new line of radio products.

The new line will consist of individual units completely assembled and shielded, for use in all popular circuits.

Klosner Socket

Uniformly tight contact on both the old UV and the new UX type of prongs is claimed for the latest socket issued by the Klosner Radio Corporation, which may be used either on sub-base or base-board construction. Single hole mounting, eyelet assembly and spring grip terminal lugs are noted as features.

New Radio Company

The Electrophone Corporation, Chicago, manufacturers of Electrophone for the instruction of the deaf, have branched into the radio manufacturing business.

Their first product is a very compact, six tube, single dial control portable receiver, equipped with speaker, unit, loop aerial, tubes and batteries, with a total weight of 28½ lbs. This product is known as the *Hyatt* portable and is the result of years of experience by Ralph E. Hyatt.

E. A. Davenport, formerly Assistant Sales Manager of Jewett Radio Corp., of Pontiac, Mich., has been engaged as Sales Manager of the Radio Division.

Want Trade Show

JOBBERS of Chicago have united to put on a radio exposition for the trade during the summer of 1927.

A survey made among thousands of dealers to determine the logical time for this trade show disclosed the fact the dealer did not want the show held so far in advance of the season that the manufacturers would have time to copy the popular models of competitors, thus after the dealer had made his commitments he would be forced in the late summer to take on these additional models thereby creating a subsequently larger percentage of dead stock of the less popular cabinets. The majority of dealers prefer a show early enough to permit of selection and delivery in time for the opening of the season and yet late enough to prevent any radical changes being made in models by manufacturers after dealers have made their season's commitments.

Amsco's "Tom Thumb" rheostat is shown above. Efficient design has concentrated a full power rheostat into an inch and a quarter diameter extending less than three quarters of an inch in back of the panel. Single hole mounting.

Use Aurora Borealis For Line Batteries

THE RECENT mystery at Westinghouse Station WBZ of Springfield and WBZA of Boston which enabled the engineers to talk by telegraph to each other without battery current being supplied to the line has been disclosed.

The two stations operated in synchronism maintain a direct line connection between Boston and Springfield where studios and transmitters are located respectively. This line carries three different circuits as three distinct uses are made of this connection; one for broadcasting, a second for controlling the stations' assigned frequency and the third for telegraph intercommunication.

The telegraph system between WBZ and WBZA is operated by means of simplexing the line, and the battery current must be put on the line at either or both stations to use the telegraph. In the course of an evening's broadcast, the engineers at both stations are constantly in communication by means of the telegraph.

The evening of the mystery was no exception, but during the early part of the broadcast the telegraph instruments kept making signals which the operators could not read. The telegraph line had been receiving the necessary current for maintaining communication from the Springfield station and in order to trace the cause of the strange signals, Engineer Wolfe took the Springfield battery off the line. The meters showed, however, that the line was still receiving current and he signaled Engineer Robinson at Boston and asked if Boston was supplying current.

Engineer Robinson replied in the negative but it was still found that the telegraph system could be operated without current being supplied at either end of the line. At that time, approximately nine o'clock, the Northern Lights were at their greatest intensity and for more than one hour and a half the operators discovered the Aurora Borealis was supplying sufficient current to operate the WBZ telegraph system. With the disappearance of the Aurora Borealis about 10:30 p. m. the operators were forced to put back the batteries on the line to operate the telegraph.

Another interesting feature caused by the Aurora Borealis during the time this phenomenon of nature operated the WBZ telegraph was the change in the direction of the current which occurred every few minutes.

Radi-A Unit

RADIO AGE is showing above a new instrument that replaces both "A" battery and charger. It permits operation of any radio receiving set directly from 110-volt alternating current circuit of 50 or 60 cycles. Radi-"A" draws a maximum of about 75 watts from the power line and furnishes a constant, smooth 6-volt current directly to the set at all times, regardless of how long or how often it is used. This instrument operates without hum or distortion and maintains the radio receiver at peak reception at all times.

Radi-"A" is unique in that it is *not* a battery and charger combined in a single unit but is, to the contrary, a complete "A" power unit in itself. The entire operating mechanism consists of five simple units—transformer, Tungar rectifying bulb, electrolytic condenser, choke coil, and automatic switch. These parts are contained in a compact, neat, pressed steel cabinet which is finished in sepia diamond crystal.

The instrument requires very little attention and contains but one moving part—the automatic switch. The purpose of this switch is to provide automatic control of power within the Radi-"A" as the radio set switch is turned on and off. This automatic relay has a movement of only about 1/8 inch and every time it operated, it breaks only a maximum current of 7/10 of an ampere and it has double contact points of silver contact metal to prevent sticking and corrosion.

Unlike most other devices designed to serve the same purpose, Radi-"A" does not require a separate switch. Its automatic switch is controlled by the switch of the radio receiver itself. When the set switch is turned on, Radi-"A" is automatically placed in active operation and conversely, when the set switch is turned off, Radi-"A" is likewise shut off.

A further convenience in connection with Radi-"A" is the "B" eliminator plug receptacle, permitting connection of the "B" eliminator directly to Radi-"A" so that both the "B" eliminator and Radi-"A" are controlled at the same time by means of the radio receiver switch.

Radi-"A" is a product of Briggs and Stratton Corporation, Milwaukee, well known manufacturers of automotive electrical equipment. Radi-"A" received its initial introduction to the radio public at the Third Annual Radio World's Fair in New York in September.

It was also shown at the Chicago Radio Show where it met with considerable interest.

Vernier Dial

W. F. LOUGHMAN, INC., have designed a vernier dial without the use of a cheap material or poor workmanship to cut the price.

The "White Cross" Dialier is a 360 degree dial with a 6-1 ratio. It can be used for both clockwise and counter-clockwise rotating shafts since it is calibrated for 360 degrees.

Art of Television Not Far Off

Soon Will Attach Device to Set, to See Desired Events

By ALBERT W. FRANKLIN*

THE radio age is upon us. The electrical age, acknowledged by authorities to be still in its infancy, has been surpassed by the meteoric progress of the art of radio. This progress has in its scope the perfection of one most important invention to humanity—the art of television.

Like the development of the moving pictures, television will follow the perfect transmission of photographs. Just when can be only a matter of time.

At present there are several means of transmitting photographs from one point to another by wire, cable or radio. The various systems of themselves offer no solution to the problem of transmitting moving pictures. Nor has any one as yet proposed what appears to be a commercially feasible and practical solution. From a logical viewpoint just what is the seemingly impossible barrier? Let us consider the systems.

Caselli's 1856 Method

OUTSTANDING advantages of the Belin system, the Bartlane, Hanson, A. T. & T., Leishman, Korn, R. C. A. or Jenkins system as compared to one another, are evident from a brief resumé of their characteristics.

As early as 1856 Caselli sent various designs by telegraphy, using for the transmitter a tinfoil-covered cylinder on which the designs were drawn in insulating compound. A needle acting very much like the stylus of a phonograph served the purpose of a contact pin traveling spirally over the surface of the revolving cylinder. Thus the circuit was made and broken as the lines passed under the contact pin, while at the receiving end, by an electro-chemical action, a similar cylinder synchronized with the transmitter reproduced the designs directly.

Discovery of the effect of light on the electrical resistance of selenium became known in 1873 and shortly afterwards various schemes to substitute selenium for Caselli's process were attempted. The most noteworthy were those of Semlocq and Perosino in 1878. After quite a lengthy interval Korn (in 1904) employing Semlocq's plan with several modifications, succeeded in transmitting photographs a few hundred miles. The method now in use by the R. A. C. is to place a negative of the photo on a glass cylinder. On this is focused a very narrow beam of light used as a stylus. By reflecting the varying intensity of the light passing through the cylinder the registry is effected and then follows an amplifier system which then allows the photo to be reproduced in several ways: either by a tape recorder which records the photo as a continuous line of dots and dashes; by means of a relay which operates a special pen and reproduces a pen and ink sketch, or by means of photographic reproduction, a light shutter being controlled by the current variations and controlling the light from a lamp focused on a sensitized rotating cylinder.

Belin Full of Originality

WITH such a system successful photo transmission has been accomplished by radio transmission from London to New York.

The first photo which was transmitted over the Atlantic was sent by a system based upon the half-tone method of screening. The photo was automatically divided into a predetermined number of dots per square inch. A photo-electric cell then determined into which of eighteen groups a dot belonged, each group being given a distinguishing letter. By means of special relays, the letter was automatically transmitted and at the receiving station, the letter was converted into a dot and placed into its proper position in the photograph. Even though the photo was converted into 12,000 squares, much of its detail was lost. A more nearly perfect system is the Leishman process which employs a similar but modified principle and operates on trans-Atlantic cables.

Perhaps the most original scheme is that developed by Belin. His process resolves itself upon the fact that bichromated gelatin becomes insoluble under strong light—his own discovery. Thus he places a film of wet gelatin under a negative whereupon the portions of the film swell up more or less in proportion to the intensity of exposure. This forms a sort of relief map of the negative and is wound on a cylinder over which a stylus traces its path. A microphone attached to the stylus varies the resistance of a local circuit which is coupled to a transmitter. At the receiving station an oscillograph has its mirror deflected, altering the projection of a beam of light focused on a synchronized rotating cylinder having a sensitive photographic film on it.

How Jenkins Does It

JENKINS' method of analyzing is based on aberration by means of prismatic rings. These rings are of glass, the edges ground in such a manner that a beam of light passing through is given an oscillating motion. By means of two such rings geared at a predetermined ratio, a negative is explored in minute strips, and a photo-electric cell employed to convert light into electrical values.

The Bartlane system is a coding process which operates by a printing telegraph. Holes are punched into a tape and reproduced at the receiving end by passing the type in front of a beam of light. Synchronism is

*Chief Engineer, Chas. Freshman Co., Inc.

maintained by holes punched into the tape alongside the coding group.

By this time you may have noticed that there are two distinct classes into which we can place photo-transmission—the purely physical transmission, such as the Bartlane, Leishman and Korn systems, and the purely modulated electrical or radio transmission, such as the R. C. A., Jenkins, Belin and A. T. & T.

Of these the modulated systems stand the better change of development into practical television. It is, however, very doubtful that any one system will not be radically changed so this may be realized. Near perfection has been achieved in single photographic transmission. The average time it requires to transmit a good picture is about ten minutes. Since all the systems require that the photo be analyzed into minute strips—about 1/100" wide, this precludes the possibility of resolving the same procedure into a practical solution.

For motion pictures we need sixteen pictures per second. Our nearest approach to television is one picture every ten minutes, unless recent claims from London of ten every second are correct. There is such a wide gap that all methods proposed up until the present time have failed.

However, with such marvelous inventions as the photo-electric cell, the Thalofide cell (one converting the light energy into electrical energy, the other acting as a varying resistance controlling the current in the circuit), the Moore lamp capable of responding to very high frequencies and which may play an important part in future development work, and the prismatic rings of Jenkins, we may expect a swifter solution.

The present day receiver is so far advanced in engineering design, that it will not be obsolete for many years to come. Thus, it may be entirely possible to equip the set with a "televisor," as we can aptly call the device, and have at our leisure and pleasure, not only all the latest news and best entertainment, but also the very portrayal of the events as they transpire!

RADIO AGE SUBSCRIPTION BLANK

Radio Age, Inc.
500 North Dearborn Street
Chicago

$2.50 A YEAR

Gentlemen: Please enter my subscription for RADIO AGE, the Magazine of the Hour, for one year, beginning with the ..... issue, for which I enclose $2.50.

Name .....

Street Address .....

City .....

State .....

Send cash, money order or draft. (12-26)

Design and Manufacture of Resistor Units

(Continued from page 20)

Second, it is comparatively easier to put a protecting layer over the conducting filament. Third, it is easier to make measurements of the conductivity of the coated fibre as the fibre is fed out of the coating machine. The case of measurement obtained in the case of the fibre insures a uniform product.

After the conducting coating has left the furnace it is next coated with durable protective film of insulating varnish which is then thoroughly dried by the application of heat. This impenetrable coating completely protects the conducting filament against atmospheric changes.

As the coated glass filament passed through the various stages of manufacture, its resistance per unit length is *continuously* tested. Literally, there is no inch of this fibre which has not been measured for resistance.

After the wire has passed through the measuring devices it is cut automatically in two foot lengths. It is then kept in sealed tubes until it is required for assembling the complete unit. Finally the wire is cut into lengths approximately 1¾" long and mounted in a glass tube with brass caps at two ends.

A new form of power resistor has recently been developed by the engineers of the company. In this type of unit the filament is wound into the form of a helix, the diameter of this helix being exactly the outside diameter of the enclosing tube. The two ends of the helix are embedded in an alloy within the caps. The helix permits the use of a very long heavily coated fibre in a very small space. With this device it is possible to dissipate from two to five watts depending upon the size of the unit with less than ten per cent variation in the resistance of the unit.

The alloy in which the filament is embedded in the caps, is the result of innumerable experiments. Its properties are such that it makes perfect electrical contact with the filament. The cap grips the contacting filament so tightly that it is impossible to pull the filament out without shattering it. It is almost as if the cap, filament and alloy were made of one piece.

After the resistors are assembled they are again tested. The resistance units are normally made within a five per cent variation. On special orders it is quite possible to make them within two and one half per cent.

All the meters used in the manufacture and assembly tests are constantly checked against laboratory standards. Production lots of samples are also tested periodically in a three stage amplifier to make certain they are noiseless.

Many Are Being Fooled in Radio By Believing Service Unnecessary

ANY radio, no matter what its price may be, nor who makes it, will only be as satisfactory as the trained service behind it.

In buying a radio there are a number of important things to consider—
APPEARANCE—
TONE—
VOLUME—
DISTANCE—
EASE OF TUNING—
and last but far the most important—
SERVICE.

Tone and Volume can very easily be determined by listening. The only real way to prove distance and ease of tuning is by operating the instrument yourself, but the quality of service must be determined only by careful investigation.

Far too often it seems customary to claim that radio service is unnecessary. For four years this company has been building a factory trained service organization until today it consists of 4364 men who know Ozarka instruments in every detail. These men have been trained directly under Ozarka Engineers, the men who originated and developed Ozarka Instruments.

You'll find it well worth your time to investigate this organization before you decide on your radio. A trained Ozarka service man is near you—why not discuss this matter with him?

When anyone tells you that radio service is not necessary, think it over, your own good sense will tell you differently. You have a right to receive from your radio consistent operation, night after night and year after year—the right service by a service man who knows how, will guarantee you that lasting satisfaction you are entitled to.

The claim that service will not be necessary is the poorest type of salesmanship—it only leads to dissatisfaction later—far too often it is used to cover up the fact that the seller is not in a position to deliver service.

In the past, the selling of radio instruments has depended largely on having stock on hand to deliver—in the rush to buy very few paid any attention to what service could be delivered in case any little trouble came up.

Today, service in radio is not only being recognized and demanded but people who know, go even farther and demand—service by factory trained men.

You would never consider letting any all round mechanic repair your car—then treat your radio in exactly the same manner. Demand not only service but the service of men who know—the day of the radio wizard who knows all radio instruments is gone—the factory trained service man has taken his place.

OZARKA
INCORPORATED
120 W. Austin Avenue B CHICAGO, ILL.

$132.50 F. O. B. Chicago. Ozarka Senior 5 Tube Model complete with Loud Speaker and all accessories.
Also built in a 7 Tube Model

$100 F. O. B. Chicago. Ozarka Junior 5 Tube Model complete with built-in speaker and all accessories.

$215 F. O. B. Chicago. Ozarka Console 5 Tube Model, solid walnut cabinet, complete with all accessories.
Also built in a 7 Tube Model

We have a few Openings for the Right Men

WHILE there are today 4364 Ozarka representatives, some territory is still open. We want men who believe in the future of radio—men who are tired of working for some one else—men who would like to add to their present income by devoting their evenings to Ozarka.

At the start you can keep your present position. Later on, after you have proven what you can do, then you will give us all your time because it will pay far more than your present position.

The man we want may not have much money but he is not broke. He has lived in his community for some time—he has a reputation that his word is good. He may not have made any startling success but he has never "put over something" just to make money. He may know nothing about radio or salesmanship but he will be successful if he is willing to study what we are willing to teach him, without cost.

The field in radio is wide open for the trained man. The success of the 4364 Ozarka representatives proves what men can do. If you are interested, ask for a copy of the Ozarka Plan, a 100 page book which tells a true story of how big money and a permanent business can be built in radio. It is a story of life; of why some men fail while others succeed. This book has shown many men how to start making extra money immediately and within a very short time establish a business of their own.

Get your copy of the 1926 Annual

Operates Phonographs Electrically

Richer and smoother tone is claimed for the device illustrated above which replaces the regular tone arm and horn on a phonograph and which operates the old style phonograph electrically. Amplification is secured either through the horn itself or for greater volume with the aid of a good power amplifier stage.

On Air Again

STATIONS WIOD and WMBF of Miami are again on the air with their regular programs. In fact WMBF began broadcasting the Saturday following the recent storm, with an improvised aerial and was soon reported as heard in Portland, Me. WIOD was also early in its return to the air.

Chief Operator

Walter R. Lindsay, recently appointed Chief Operator of Station WMAQ at Chicago, who is an old time sea-going "op".

Death Ray Tube Turns Gases Into Solids

(Continued from page 12)

rays or electrons. The penetration of the rays depends not only upon the voltage but upon the density of the substance they strike, so that with most solid substances the penetration is slight, and with dense metals almost negligible.

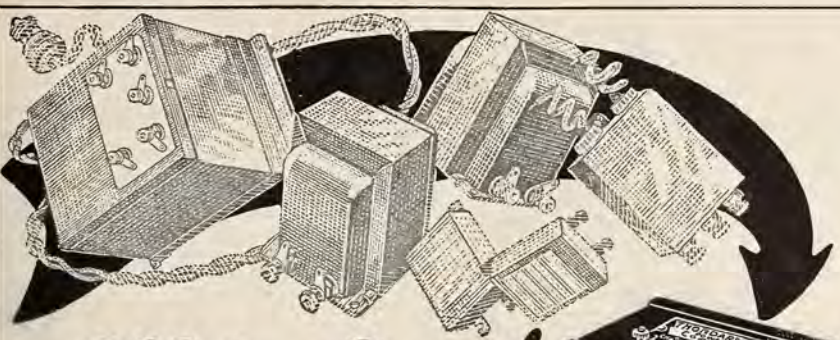
Startling Experiments

ONE of the most startling experiments performed with the new tube has been the production of a yellow compound when the rays are passed through acetylene gas. This compound, similar to that produced in very small amounts by radium treatment of the colorless gas, can be produced in relatively large quantities with the cathode ray tube either as a light, fluffy powder or as a varnish-like film on substances within the gas chamber, depending upon the electrical conditions. The compound has been found to be insoluble in all the many chemicals so far tried. It seems, therefore, that a use may be found for it as a protective coating for metals, to which it adheres tightly. Other substances, such as castor oil, can also be solidified by exposure to the rays.

In ascertaining the effect of the rays on living tissues, small circular areas of the ear of a gray rabbit were subjected to short exposures to the rays. Exposure of a tenth of a second caused a temporary loss of hair over that area. When the exposure on another area was increased to one second a scab was formed. When this fell away it took the hair with it, and weeks later the area became covered with a profuse growth of longer, snow-white hair. Exposure for a minute resulted in the formation of a scab on each side of the ear. A hole was left in the ear when the scabs fell away, and the edge later became fringed with white hair. In other experiments, bacteria and flies were killed almost instantly by the rays.

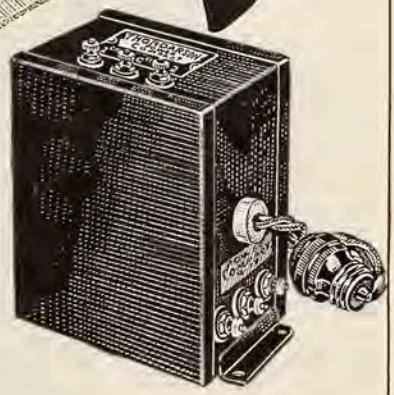
A crystal of calcite, a colorless and transparent mineral, glows with a bright orange light if sub-

(Please turn to page 52)



All in One!

THORDARSON POWER COMPACT



TYPE R-171

Contains a power supply transformer for Raytheon BH rectifier, 2 filter chokes, 2 buffer condensers, and a filament supply for UX 171 power amplifying tube.

$15.00

TYPE R-210

Contains a power supply transformer for UX 216-B rectifier, 2 filter chokes, and a filament supply of 7½ volts for UX 210 power amplifying tube.

$20.00

The Complete Foundation Unit

for power amplification and B supply

Simplified Assembly. The Power Compact contains within itself the greater part of the complete B supply unit. With the Type R-171, only 14 leads complete the Raytheon assembly. All terminals are carefully located for the greatest ease of assembly

Compactness. The only additional apparatus required to build the B supply are the condenser block (Raytheon type), a Raytheon tube BH, and the resistance units. The complete eliminator occupies a space of but 6 in. x 9 in. without crowding.

High Efficiency. The power supply of either Power Compact furnishes the proper current for maximum efficiency of the rectifiers used; the chokes are of sufficient capacity to carry the maximum output. Conservatively rated, will not heat up in continuous service.

High Voltage Output. The R-171 Power Compact assembly will deliver a maximum plate voltage output of 300 volts at 30 milliamperes, or 275 volts at 40 milliamperes.

The R-210 type assembly will deliver 400 volts to the plate of the power tube, and in addition, will supply a constant 90 volts to the receiver at any current drain up to 40 milliamperes.

Silent in Operation. There is no traceable hum, either mechanical in the compact itself, or electrical through the loudspeaker.

Complete Supply for Power Amplification. The Power Compact not only supplies B voltage, but also provides for the filament current and grid bias of the stage of power amplification. *Makes it possible to use power amplification even on sets designed for dry battery operation.*

Electrically Centered Filament Supply. The power tube filament supply *is tapped at the exact electrical center for grid return.* The center tap is taken from the common lead of two perfectly balanced windings—completely obliterating the A. C. hum. (An exclusive Thordarson feature.)

Write for instruction booklets SD-49 and SD-50.
If your dealer cannot supply, order direct from the factory.

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

3446

Types of Rectifier Tubes Discussed

By FRANK L. EICHNER

IN THE past year, the B Battery eliminator has become a fact rather than a passing fancy. More and more radio set owners are acknowledging the fact that a good eliminator is better than the longest lived B batteries. The power is always there and beyond the cost of running it from the house current, there is no appreciable upkeep.

A word at this time on the subject of rectifier tubes may be of interest to the man who has an eliminator or to the fan who intends to build one.

There are two distinct types of rectifier tubes—the filament and the non-filament gaseous tube. I shall discuss the filament type first.

The filament type tube may be divided into two classes—half-wave and full-wave. There is only one full-wave, filament type tube at present on the market. This is the Rectron UX213. The characteristics of this tube are listed below. The tube contains two separate plates and two filaments which are connected in parallel.

Here are the operating characteristics:

Filament voltage—5 volts

Radio Corporation's 216-B Rectifier

Filament current—2 amperes.

Maximum plate voltage (A. C.)—220 volts per anode.

The capacity of this tube is 65 milliamperes the voltage dropping with the load at the output.

The half-wave rectifier tubes are more numerous. There is the Rectron UX 216-B, the Magnatron "Rex," the Perryman

This is the Magnatron Rex Tube

Rectifier and many others. I have only tried the tubes named, however, and I shall confine myself to a brief description of them.

The Rectron UX216-B is lighted from a 7.5 volt source and draws 1.25 amperes. The maximum A C voltage which can be applied to the plate is 550 volts. It will pass 65 milliamperes and when more than this is required, two of these can be connected for full-wave rectification. An A. B. C. power unit for 199 type tubes can be made with two of these tubes if the filaments of the 199 tubes are connected in series.

The Magnatron "Rex" has some of the characteristics of the 216-B with the exception of the plate voltage. The maximum voltage used by the author was 300 volts.

The Perryman tube draws 1.125 amperes at 5 volts and will pass about 40 milliamperes. 300 volts was also used on this tube. The "Rex" tube will pass about 50 milliamperes. These tubes can also be used for an A. B. C. power unit as explained above.

Now for the gaseous tubes. The oldest gas filled tube on the market is the "S" tube. This tube has no filament, and is a half-wave rectifier. It will pass 50 milliamperes and can be used at high voltages.

Newer and with more simplicity of construction are the Raytheon tubes, types B and BH.

The type B tubes have a maximum plate voltage of 250 volts per anode. Both tubes, by the way, are full-wave rectifiers. The type B has a maximum current of 60 milliamperes. The type BH will take 350 volts per anode and will pass 85 milliamperes. Ere this time, most radio magazines will have published full specifications for an A. B. C. power unit, using this tube.

A word on the operating principle of these tubes. They operate on the "short path principle" whereby a rarified gas acts as an insulator between surfaces which are close together. If the space between the anode and cathode is short

Perryman's 2-16B Rectifier is shown above

enough and a suitable gas is used at a very low pressure, an electron will pass between these points without danger of encountering molecules of gas and of ionization by collision. Therefore, the helium gas which is used is made to act as a perfect insulator at low pressures.

The filament type tubes are eminently satisfactory as rectifiers, but the fact that large filaments and plates are necessary create what is know as "back current" and this increases the load on the filter circuit, making the filtering out of the A. C. hum almost an impossibility.

The relatively small surfaces in the Raytheon tubes reduce the "back current" to a negligable quantity, thus giving increasing ease in eliminating the A. C. hum.

I hope that the foregoing data may answer the needs of those fans who are about to build or to buy an eliminator. Most units using Raytheon tubes are sold with the tubes as a part, but in the filament type rectifiers the builder or buyer is generally left to his own devices.

New Type Reproducer

A physician and an army officer have discovered what is stated to be a new method of sound amplification represented in the reproducer shown above. Its inventors have taken a leaf from Nature's notebook and followed closely her mechanism for sound amplification.

$50.00 Cash Prizes

Every Month in RADIO AGE

To encourage our readers in developing their ideas along radio, electrical, mechanical or scientific lines, Radio Age will offer each month two prizes of twenty-five dollars each for the best new and original stories or pictures, or both, submitted to its Editors covering the fields of radio, telegraphic and telephonic communication, maritime, automotive or railroad transportation, aviation or any of the present day scientific, electrical or mechanical arts.

One prize will be awarded for the best article along radio lines, while the second one will cover ideas other than radio. Sketches should accompany the contestant's manuscript, which should be limited to 1,000 words. Decision will rest entirely with the Editors of this magazine and awards made each month.

Articles which do not win a prize will be published in Radio Age if found desirable and will be paid for at our usual rates. Address all manuscripts for this contest to

Contest Editor
RADIO AGE, INC.
500 N. Dearborn St.
Chicago, Ill.

Imagine Talking Over This Power Line!

Above is shown the result of opening a disconnect switch on the modern 110,000 volt transmission line of the Georgia Railway & Power Company at Atlanta, Ga. This unusual view presents in graphic detail the tremendous power carried in present-day transmission lines.

Over these same power lines there is operating a Western Electric power line carrier telephone system furnished by the Graybar Electric Company, which uses the conductors carrying this tremendous voltage as the medium for telephone communication. This adaptation of power lines for telephonic purposes is one of the recent advances of science in the art of communication.

Wired Radio Programs

AN experiment intended to provide telephone subscribers of Saint Paul with radio broadcast programs picked up by a central receiving station is being carried out by the Tri-State Telephone and Telegraph Company. It is proposed to install loud speakers in the residences of the phone subscribers, and offer them entertainment picked up by a centrally located radio receiver. Officials of the company say that they do not plan to superimpose the programs on the regular telephone lines, but to utilize spare wires for this purpose. So far it has proven feasible, and it is reported that less distortion and interference is experienced by the subscribers, who, of course, do not have to provide themselves with radio receivers. On the other hand, it has its disadvantages over radio since the recipients must be satisfied with what selections are sent them.

FREE This 84 Page WONDER BOOK

Send For It TO-DAY

You must have this latest guide to Radio prices and Radio quality. All of our vast resources and radio experience have been utilized to assemble for you in one gigantic institution, the best and newest things in radio. The Randolph catalog is indeed the radio market place of the world—a masterpiece of merchandising that befits our house—THE LARGEST EXCLUSIVE RADIO MAIL ORDER HOUSE IN THE WORLD.

Radio Bargains

OVER 2000 ITEMS

From the most beautiful, fully equipped console radio set, down to the smallest part or tool for the set builder—kits, parts and supplies of every conceivable type and style. 5, 6, 7 and 8 tube sets, with three dial, two dial, and the newest and most popular single simplified control. All sets are assembled in beautiful, genuine mahogany and walnut cabinets in a choice of latest types and designs.

A complete line of **"B" batteries, eliminators,** including the famous **Raytheon Eliminators;** latest types loud speakers, cone speakers, "A" power units. Everything in radio at **money saving prices.**

RADIO KITS

Includes the following well known circuits, designed and approved by the world's foremost radio engineers: Madison Moore Super; Victoreen Super: Silver Marshal Six; Sargent's Infradyne; Remler Super; Short Wave Kits; 9-in-Line Super; New Acme Reflex; Cockaday; Neutrodyne; Browning-Drake: all classes of radio frequency. Super Heterodyne and every other approved popular circuit.

Save 1/3 to 1/2

We Save You Money because we handle radio exclusively and sell a tremendous volume of everything in Radio.

Volume purchases regulate prices.

We command rock bottom prices from manufacturers, and in many cases we contract for entire factory output of exclusive products. You will benefit by our great volume of purchases and sales, by securing anything you may want in radio at a substantial saving.

The New Ampliphonic Six

The Latest Two-Dial Receiver WITH THE

Genuine Amplion Unit

Genuine dark tone and shaded walnut cabinet. Stands 39 in. high. Top measures 27x16 in. Beautifully etched burl walnut panels. Built-in loud speaker with Amplion unit. Large doors open to smaller doors enclosing a large compartment for batteries, chargers, eliminators, etc., everything concealed in this exquisitely designed radio cabinet.

6 Tube Tuned Radio Frequency

6-tube tuned radio frequency two dial control receiver. 3 stages of direct and transformer amplification. Has provision for power tube and an additional tap for increased "B" battery voltage. Very latest construction including solenoid coils, bakelite sockets taking all the latest X-type tubes, modified straight line condensers. Wonderful volume, nothing like it on the market at more than twice the price. Without Accessories **$79.50**

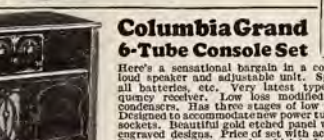
Symphonic Five

Brown Spanish leatherold finish cabinet with gold engraved walnut panel to match. Contrasted beautifully with the black fine tuning knobs. Two small knobs control volume and clarity. The volume control is of the finest smooth slow variation type. Roller bearing. Condensers are of the modified straight line frequency type, substantially constructed and of latest design. All is sub-panel mounted, using the new X-type socket. Latest development in solenoid coils. Two stages of low ratio audio amplification with high grade transformer offers the true amplification required for both low and high notes.

$24.90

Without Accessories

The set complete with five type X201A tubes, two 45 volt "B" batteries, one 100 Amp. Hr. storage battery, complete aerial equipment, one battery cable attached, including cone speaker of the same type as pictured..... **$54.75**



These sets are typical examples of the bargains in our catalog. You may order direct from this page, sending P. O. money order or draft for full amount. We ship freight or express, charges collect. We guarantee to back up every article with our own, as well as manufacturer's, assurance of quality.

Columbia Senior Six

Beautiful table set. New localized control. One hand to tune with, three rotating drums easily controlled and easily logged. Dark finish etched panel mahogany finished hand-rubbed cabinet. Size 7x22.

6-tube set, giving tremendous volume, wonderful tone quality, latest straight line condensers, solenoid coils; sub-base mounting and new amplification. Designed to sell for over 100.00. Price, without accessories **$36.50**

Set complete with two 45 volt "B" batteries, 100 amp. hr. Storage "A" battery, one 4½ volt "C" battery, six type X-201A tubes, complete aerial kit, attached battery cable, quality cone speaker or Victor horn type loud speaker..... **$65.45**

Beautiful hand rubbed, two-toned mahogany finished cabinet, size 18x19x36. Built-in loud speaker.

Columbia Grand 6-Tube Console Set

Here's a sensational bargain in a console radio with built-in loud speaker and adjustable unit. Spacious compartment for all batteries, etc. Very latest type 6 tube tuned radio frequency receiver. Low loss modified straight line frequency condensers. Has three stages of low ratio audio amplification. Designed to accommodate new power tube. Equipped with X-type sockets. Beautiful gold etched panel with handsomely engraved designs. Price of set with accessories..... **$42.65**

This set with all accessories which include 2 45 volt "B" batteries, 100 Amp. Hr. storage "A" battery, 6 201A tubes, aerial and ground equipment—everything complete, nothing else to buy..... **$65.95**

You Must Have This Book

Space limitations here prevent our telling you more about the Randolph Catalog. Simply fill out and mail the coupon—or you may send a postal or letter—and this truly remarkable Radio book will come to you **ABSOLUTELY FREE. MAIL THE COUPON NOW.**

This Coupon Brings the Great RADIO Book FREE

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180 North Union Avenue · Dept. 186 · Chicago, Ill.

Please Mention Radio Age When Writing To Advertisers.

Death Ray Tube Turns Gases Into Solids

(Continued from page 46)

jected to the rays, and the glow of cold light continues for hours. The glow comes from an area very near the surface of the crystal since the rays penetrate but little into the substance. Immediately after the crystal has been rayed, numerous bluish-white sparks or scintillations can be noticed beneath the surface of the crystal; these are electrical explosions, the result of the bombardment of the atoms in the crystal by the high-speed electrons.

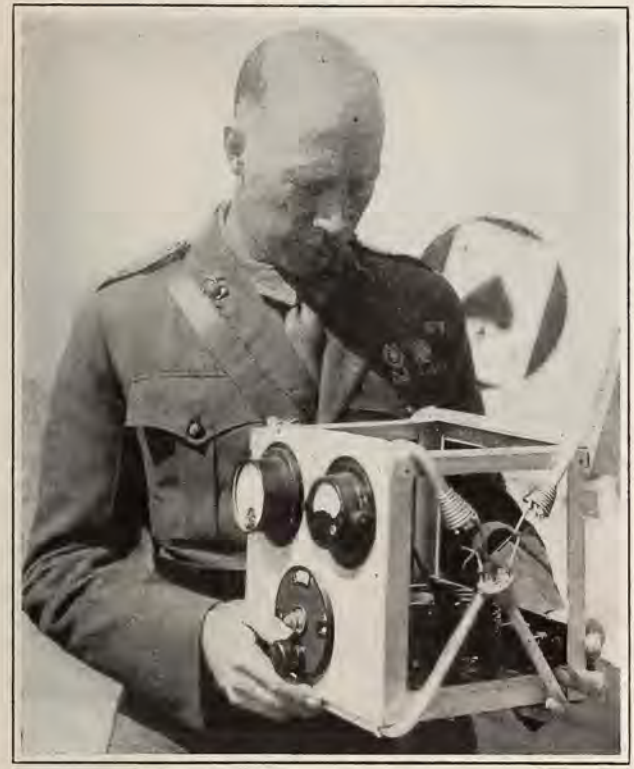
Granite, a mixture of several minerals, glows with several brilliant colors, some of the colors fading away immediately and others remaining for some time. Numerous other substances can be made to change in color, some permanently and others for a short time.

The commercial possibilities of the tube, still a laboratory development, are unknown but it is expected that the tube will be invaluable in scientific investigations regarding electronic phenomena.

Dual Range Meter

Shown above is a new Westinghouse high resistance DC voltmeter with a dual range, O-7½ volts and O-150 volts which will serve for measurement of either A, B or C voltages. Three foot leads are supplied with pin jack terminals for plugging in on any of the standard sets provided with voltmeter jacks

World's Smallest Radio



Smaller than a typewriter and weighing only 5 1-2 pounds, with a sending radius of 300 miles, a tiny transmitter has been built by United States Marine Corps aviators and installed in marine airplanes for "talking" to other pilots and to ground stations. In 50 separate tests, the little sender worked "perfectly" 47 times, and aviators said the three failures were due to factors outside the transmitter.

Capt. Francis E. Pierce, communications officer for the marine flying corps at San Diego, California, (shown in photograph) designed the transmitter. He built the first one from junk salvaged from the navy dump on North Island. The government contributed nothing while officers and men gave about $22 toward the building of the transmitter. The entire set, including transmitter, receiver, batteries and dash controls, weighs 17 1-4 pounds.

The transmitter, around which most interest centers, is built on an aluminum sheet. The front aluminum panel measures 9 by 10 inches and the base 9 by 9 1-2. The milliameter for measuring the total current in the tuned plate tank circuit and the variable tank circuit is mounted on the front. On the base are the clips for the one-inch-square quartz crystal, ground to a frequency of 3000-4000 kilocycles; the grid biasing resistance; the plate blocking condenser; socket for 50-watt tube; the grid and plate chokes; the inductance for the plate circuit, and the keying relay. For installation, the transmitter is slung on a shock absorber cord behind the pilot. Only the dash control is visible when the set is ready for use, and both transmitter and receiver are said to be fool proof.

Power is derived from a wind-driven generator, 10 volts being delivered through a wire wound resistor from an original 30-volt supply.

New Idea In Cabinets

Good taste and usefulness are combined in the art cabinet shown above which has been designed by a mid-Western concern for radio users or set builders.

The sides of the cabinet are made in the form of art panels, while the doors are arranged likewise. Batteries, both A and B, or power supply devices may be placed in the bottom. The radio set itself is put in the upper portion of the cabinet which looks like the typical phonograph housing. The panels and the set are removable.

Watch the January issue for more data on superheterodynes.

(Continued from page 34)

fact afforded. All they had to do was to ship the parts from their stock, there was no grief, and there was a steady sale. The result is that all those jobbers who felt inclined to get out of the parts business are getting back into it with both feet. What makes the actual state of affairs rather deceiving is the fact the proportion of manufacturers sales to the set manufacturers and to the trade has changed. For example whereas a few years ago the sales of a certain manufacturer may have been 70 per cent to jobbers and 30 per cent to manufacturers, they may now be 50 per cent to the manufacturer and 50 per cent to the jobber. However the radio business has increased to such an extent that in actual dollars and cents the manufacturer is selling much more than ever before to the trade. A recent private survey which we made personally among a number of representative manufacturers of standard, advertised, quality parts, shows clearly the above condition to be true. Unanimously these manufacturers agree their parts business to the trade is greater than ever before and all seem confident that with the number of excellent kits which are appearing on the market, and with proper consideration of the human element in the radio industry (which makes it difficult for a fan to be easily satisfied) the parts business is not only very far from dying, but is in an exceedingly healthy condition with every prospect of a long and useful life before it."

Opinions of other well known manufacturers arrived too late to be quoted in full, but bear out to a remarkable degree the fallacy of the statement that the parts business is dead.

Limited Licenses

AS SOON as Congress convenes, it is now understood that the old joint resolution limiting the term of radio licenses and requiring a waiver to all wavelength priority, unsigned in the rush of the closing days, will be signed forthwith.

$15.00

(West of Rockies, $18.00)

An astonishingly low price for this 22-inch Windsor Cone Loudspeaker mounted on sounding board and supplied with easel. Can be hung on wall or stood on table or floor.

This Amazing New Cone Speaker Hangs on Wall or Stands on Table!

Model 200
With 22-inch Cone

This Windsor Cone Loudspeaker Console is equipped with a 22-inch Windsor Cone Loudspeaker. Its top is 30" x 17" and is 29" high. The battery shelf provides ample space for batteries, charger, battery eliminator and other equipment. Beautifully finished in either Mahogany or Walnut. Price only . $29.00

(West of Rockies, $35)

In this Windsor Console is combined both the Windsor Moulded Composition Horn Loudspeaker and the 18-inch Windsor Cone Loudspeaker. The top is 30" x 17" and stands 29" high. Ample battery and equipment space is provided by large shelf in rear. Price finished in Walnut or Mahogany . $48.00

(West of Rockies $55)

Model 302
With Moulded Composition Horn Loudspeaker and 18-inch Cone Loudspeaker

NOW the radio world enjoys a new sensation—a 22-inch cone loudspeaker mounted on a sounding board and equipped with an easel back so that it can be hung on the wall, stood on a table, or placed on the floor.

And this is the famous Windsor Cone Loudspeaker that reproduces *all* the tones as they are broadcast. From the deepest throated pipes of the largest organ to the softest note of a crooning lullaby—from full volumed brass of a band playing "The Stars and Stripes Forever" to the last faint note of "Home Sweet Home" played by a master violinist—*every* tone, *every* sound is reproduced with perfect fidelity in all its beauty, just as it entered the microphone.

This wall and table model Windsor Cone Loudspeaker has no equal in value in the world of radio. When compared with the average cost of cone-type loudspeakers of even smaller size and without the sounding board and easel back, the cost of this Windsor model is amazingly low.

Dealers everywhere are showing this new radio wonder. Go to your dealer today—see and hear this marvelous loudspeaker—note its extreme utility—compare its low price with others—compare its tone—its volume—then you will have no other. If your dealer should not have one, send your name and address for complete information and prices on the entire Windsor line of Cone and Horn Loudspeakers and Loudspeaker Consoles.

Note to Dealers Write or wire today for details of the highly profitable Windsor selling franchise.

WINDSOR FURNITURE COMPANY
World's Largest Manufacturers and Originators of Loudspeaker Consoles
1416 CARROLL AVE. • • • CHICAGO, ILLINOIS
Los Angeles Branch, 917 Maple Ave.

Simplex Issues Fine Micrometer Coupler

EXPERIMENTERS and dyed-in-the-wool fans will welcome a micrometer coupler in which the inductive relationship of the plate coil (tickler) is governed by a micrometer movement through a knob on the panel.

This method of making minute inductive changes in the tickler circuit removes one of the objections previously held against the straight tickler tuned set since it was difficult to get a small enough movement of the tickler to allow ease in tuning.

The new coupler is made by the Simplex Radio Devices, Inc., and has a single hole mounting, is equipped with ball bearings and all in all is a nice workmanlike job.

New York and London Now Linked by Speediest Cable

(Continued from page 39)

at that point and they continued their work by wading up to their waists. About ten yards from the shore a third man, fully dressed, stood knee-deep in the water and cut the barrels from the cable as they drifted in. A fourth man rolled the barrels up on the beach.

When the last of the barrels came in the cable was buried in a shallow trench. All that remained then was to make the station connections and to splice the 170-mile shore end, which weighs 117 tons, to the oceanic end, which was kept afloat with the aid of a buoy. The entire cable is 3,400 nautical miles long. Its main section is about an inch in diameter.

The innermost section of this slender line of communication which links two continents is the copper conductor, less than one-fifth of an inch thick, which carries the electric current. Around this wire are wrapped six flexible copper tapes to carry the current around the gap in case the cable breaks. Also wrapped around the conductor is the continuous strip of permalloy, and next to the permalloy is the insulation, consisting of three layers of gutta percha.

Over the gutta percha insulation is a layer of jute yarn to act as a cushion for the armor which protects the cable from breaks that might be caused by the wreckage of sunken ships. This armor consists of 18 galvanized steel wires, each having a diameter of .09 inches. These are wrapped with a fabric to prevent oxidation under water. Finally, the cable is wrapped with two servings of jute yarn saturated in coal tar, wound on spirally and forming the outer covering.

Turning Soprano to Contralto is Feat of Single Side Band Set

(Continued from page 16)

exactly right, then true reproduction results and this is the only condition under which true reproduction may result. If the heterodyne frequency is low or high, then the reproduced signal will be low or high. *It is thus possible to make a contralto out of a soprano or vice-versa at the pleasure of the operator.*

The apparatus comprising the transmitter may be considered in two sections, the single-side band equipment and the power amplifier chain. The single side-band apparatus is installed in a metal screened room. This precaustion is taken to prevent the powerful fields of the amplifiers from disturbing the delicate balance of the modulators where the power level is in the neighborhood of one watt. In metal cabinets are two balanced modulators and the first stage of the power amplifier chain. This stage and the following stages raise the power level from about one watt to about fifty thousand watts. Quartz crystals are used for obtaining the desired carrier frequencies.

The filters are located overhead in the shielded room. Outside of the wire screened room is the power amplifier chain, three stages being provided to increase the power level to that desired.

New Radio Service For All Amateurs

THE Barawik Company of Chicago, pioneer radio merchants, announce the installation of a new department devoted entirely to the interests of short wave enthusiasts. The interest in short wave transmission and reception is continually growing because of the ease with which tremendous distances can be covered. For both the established transmitting amateur and the experienced broadcast listener, the Barawik Company has inaugurated this new department.

F. J. Marco, well-known amateur and radio consultant, who will direct the new radio service for the Barawik Company

F. J. Marco, consulting engineer, and owner of the experimental short wave station 9ZA, has been retained to direct this special department of the Barawik Company.

In the direction of this new department for the Barawik Company, Mr. Marco will endeavor to establish a center of short wave information and engineering service for the U. S. as well as internationally. The Barawik Company will be in a position to give technical information and supply all equipment pertaining to this field. In the design of the new equipment and the correction of difficulties with existing apparatus, the Barawik Company will constantly issue catalogs and bulletins.

The Barawik Company is making it possible for all those who are not already in the game to enter it.

Be sure to order your January Number Now— a treat is in store for you.

High Lights on Wavelengths and Frequencies Used

(Continued from page 15)

ten-kilocycle separation is maintained. Such interference may be due to the use of a receiving set of poor selectivity or it may be caused by the receiving set being too near the broadcasting station.

Where Squeals Originate

WHEN two broadcasting stations are operating on frequencies differing by ten kilocycles they will produce a beat note of 10,000 cycles in the phones of a receiving set tuned to one of the stations. Suppose that these stations shift their assigned frequencies in such a manner that they are separated by only seven kilocycles. You will now have a beat of 7,000 cycles in the receiving set. The 10,000-cycle beat is a pretty high, faint squeak and scarcely noticeable to the normal ear. The 7,000-cycles beat, however is likely to be annoying.

We see from these remarks the importance of keeping broadcasting stations on their assigned frequencies with the dual object of eliminating the beats and the side band interference. It seems that the ten-kilocycle separation between broadcasting stations is almost ideal: it makes available the maximum number of ether channels without undue interference. Then too, the use of this spacing expresses frequency assignments in good round numbers, an advantage in itself. It seems probable that this is the best scheme for allocating broadcasting stations which can be devised except in case a fundamentally different plan of modulation comes in vogue. The problem becomes one of keeping stations strictly on their assigned frequencies and we can readily see how chaos may result from indiscriminate use of frequencies.

It is a pretty safe guess that if all broadcasting stations had from the very beginning been designated by kilocycles the use of meters would seem strange and difficult. Who would want to remember that station WXQ had a wavelength of 344.6 meters, and that station BPR had a wavelength of 215.7 meters, that another station had some other odd wavelength and so on, when those stations can be designated by kilocycles in whole numbers which are multiples of ten?

Let us take out a portion of the wavelength background of radio and view it in the light of broadcasting. Imagine that you can see the successive waves shooting out from the antenna of a broadcasting station operating on a frequency of 600 kilocycles. This means that 600 waves will cut through your receiving antenna in one second and each wave produces a cycle of current in your receiving circuit. To paint the picture somewhat differently: the alternating currents in the transmitting circuit are converted into waves and shot out into space; the waves are reconverted into alternating currents in your receiving set. Thus we see that waves exist only in space and when you tune your receiving circuit you are making it responsive to a certain frequency. A wave of 468.5 meters would have to be a great contortionist to get in your receiving set since such a wave is about a third of a mile in length! However, the frequency of 640 kilocycles corresponding to that wavelength can live quite comfortably in the small cabinet housing your receiving circuit.

U. of Chicago Gets Weather Maps by Radio

Experiments to determine the possibility of transmitting weather maps from Arlington to Chicago by means of radio are under way at the University of Chicago following the installation of new receiving apparatus in the university's laboratory. Tests over much shorter distances have already proven successful, Dr. F. L. Moulton, in charge of the experiments, stated. C. Francis Jenkins, inventor of the apparatus, is keeping in touch with progress made by the studio from Washington, every day

The Radio Storm Detector

(Continued from page 12)

and more frequently; the System Operator orders more boilers and generators put into use.

It is a race between man and nature. The faster the storm travels and the more intense the darkness accompanying it, the harder the men in the generating stations must work to beat it. No baseball game or horse race was ever more interesting. Usually when the storm is within half an hour of the city, our generating stations are all ready to cope with the situation. Finally the black clouds appear over Manhattan; hundreds of thousands of persons, perhaps a million—in the big office buildings, in the homes, the factories, the hospitals, the schools—all step to the wall and push a button; all want light at once, and they get it—thanks to the genius of Thomas Alva Edison, the development of the science of radio, the splendid organization of the Edison Company's operating men, and the determination of the Company to be always "At Your Service."

Correct List of Broadcast Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDYL	Newhouse Hotel	Salt Lake City, Utah	246
KFAB	Nebraska Buick Auto Co.	Lincoln, Neb.	341
KFAD	Electrical Equipment Co.	Phoenix, Ariz.	273
KFAF	A. E. Fowler	San Jose, Calif.	217
KFAU	Independent School Dist.	Boise, Idaho	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	275
KFBC	W. Z. Azbill	San Diego, Cal.	380
KFBK	Kimball-Upson Co.	Sacramento, Calif.	535
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District No. One	Trinidad, Colo.	238
KFBU	St. Matthews Cathedral	Laramie, Wyo.	375
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFDD	St. Michael Cathedral	Boise, Idaho	275
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	316
KFDX	First Baptist Church	Shreveport, La.	236
KFDY	South Dakota State College	Brookings, S. D.	306
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank	Portland, Ore.	248
KFEL	Eugene P. O'Fallon, Inc.	Denver, Colo.	254
KFEQ	Scroggin & Co.	Oak, Neb.	268
KFEY	Bunker Hill & Sullivan	Kellogg, Idaho	233
KFFP	First Baptist Church	Moberly, Mo.	242
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFH	Hotel Lassen	Wichita, Kans.	268
KFHA	Western State College of Colo.	Cunnison, Colo.	252
KFHL	Penn. College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	467
KFIF	Benson Polytechnic Institute	Portland, Ore.	248
KFIO	North Central High School	Spokane, Wash.	272
KFIQ	First Methodist Church	Yakima, Wash.	256
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Commonwealth Reporter	Fond du Lac, Wis.	273
KFJB	Marshall Electric Co	Marshalltown, Iowa	248
KFJC	R. B. Fegan	Junction City, Kans.	219
KFJF	National Radio Mfg. Co.	Oklahoma City, Okla.	261
KFJI	E. E. Marsh	Astoria, Ore.	246
KFJM	University of North Dakota	Grand Forks, N. D.	278
KFJR	Ashley C. Dixon & Son	Portland, Ore.	263
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	W. E. Branch	Ft. Worth, Tex.	254
KFKA	Colo. State Teachers College	Greeley, Colo.	273
KFKB	J. R. Brinkley	Milford, Kan.	431
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Elec. & Mfg. Co.	Hastings, Neb.	288
KFKZ	Chamber of Commerce	Kirksville, Mo.	225
KFLR	University of New Mexico	Albuquerque, N. M.	254
KFLU	San Benito Radio Club	San Benito, Texas	236
KFLV	Swedish Evangelist Church	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFMR	Morningside College	Sioux City, Iowa	261
KFMX	Carlton College	Northfield, Minn.	337
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	461
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOB	KFOB, Inc.	Burlingame, Calif.	225
KFON	Echophone Radio Shop	Long Beach, Calif.	233
KFOO	Latter Day Saints' Union	Salt Lake City, Utah	236
KFOR	Tire & Electric Co.	David City, Neb.	226
KFOT	College Hill Radio Club	Wichita, Kans.	231
KFOX	Tech. High School	Omaha, Nebr.	248
KFOY	Beacon Radio Service	St. Paul, Minn.	252
KFPL	C. C. Baxter	Dublin, Texas	252
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Calif.	231
KFPW	St. Johns M. E. Church	Carterville, Mo.	258
KFPY	Symons Investment Co.	Spokane, Wash.	273
KFQA	The Principia	St. Louis, Mo.	261
KFQB	Lone Star Bdcast Co.	Fort Worth, Texas	508
KFQD	Anchorage Radio Club	Anchorage, Alaska	300
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	224
KFQU	W. E. Riker	Holy City, Calif.	231
KFQW	C. F. Knierim	Seattle, Wash.	216
KFQZ	Taft Products Co.	Hollywood, Calif.	226
KFRB	Hall Bros.	Beeville, Texas	248
KFRC	City of Paris	San Francisco, Calif.	268
KFRU	Stephens College	Columbia, Mo.	500
KFRW	Western Broadcasting Co.	Olympia, Wash.	219
KFSD	Airfan Radio Corp.	San Diego, Calif.	246
KFSG	Echo Park Evan. Assn.	Los Angeles, Calif.	275
KFUL	Thomas Groggan & Bros.	Galveston, Texas	258
KFUM	W. D. Corley	Colorado Springs, Colo.	240
KFUO	Concordia Seminary	St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital	Denver, Colo.	234
KFUR	Peery Bldg. Co., Inc.	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	256
KFUT	University of Utah	Salt Lake City, Utah	261
KFUU	H. C. Colburn and E. L. Mathewson,	Oakland, Calif.	220
KFVD	Chas. & W. J. McWhinnie	Venice, Calif.	205
KFVE	Benson Broadcasting Corp.	St. Louis, Mo.	240
KFVG	First M. E. Church	Independence, Kans.	236
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	240
KFVN	Carl E. Bagley	Fairmont, Minn.	227
KFVR	Moonlight Ranch	Denver, Colo.	244
KFVS	Cape Girardeau Battery Sta.,	Cape Girardeau, Mo.	224
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFWB	Warner Bros. Pictures	Hollywood, Calif.	252
KFWC	L. E. Wall	San Bernardino, Calif.	291
KFWF	St. Louis Truth Center	St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr.	Eureka, Calif.	254
KFWI	Radio Entertainments, Inc.	San Francisco, Calif.	250
KFWM	Oakland Educational Society	Oakland, Calif.	316
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWU	Louisiana College	Pineville, La.	238
KFWV	Wilbur Jerman	Portland, Ore.	213
KFXB	Bertram C. Heller	Big Bear Lake, Calif.	203
KFXD	Service Radio Co.	Logan, Utah	205
KFXF	Pike's Peak Broadcasting Co.	Denver, Colo.	430
KFXH	Bledsoe Radio Company	El Paso, Texas	242
KFXJ	R. G. Howell	near Edgewater, Colo.	216
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	214
KFXY	Harry M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	214
KFYJ	Houston Chronicle Pub. Co. (Portable)	Houston, Tex.	238
KFYO	Buchanan-Vaughan Co.	Texarkana, Tex.	210
KFYR	Hoskins-Meyer, Inc.	Bismarck, N. Dak.	248
KGAR	Tucson Citizen	Tucson, Ariz.	244
KGBS	A. C. Dailey	Seattle, Wash.	227
KGBU	Alaska Radio Co.	Ketchikan, Alaska	229
KGBW	Martin Brotherson	Joplin, Mo.	283
KGBX	J. B. Abercrombie	St. Joseph, Mo.	348
KGBY	Albert C. Dunning	Shelby, Nebr.	203
KGBZ	Federal Livestock Remedy Co.	York, Nebr.	333
KGCA	C. W. Greenley	Decorah, Iowa	280
KGCB	Wallace Radio Institute	Oklahoma, Okla.	331
KGCG	Moore Motor Co.	Newark, Ark.	234
KGCH	Wayne Hospital	Wayne, Nebr.	450
KGCI	S. M. Rhodes	San Antonio, Texas	240
KGCL	Louis Wasmer	Seattle, Washington	230
KGCM	Robert B. Bridge	San Antonio, Texas	263
KGCN	Alva E. Smith	Concordia, Kansas	210
KGCR	Cutler's Broadcasting Service	Brookings, S. D.	252
KGCX	First State Bank	Vida, Mont.	240
KGDE	Jaren Drug Co.	Barrett, Minn.	232
KGO	General Electric Co.	Oakland, Calif.	361
KGTT	Glad Tidings Tabernacle, Inc.	San Francisco, Calif.	207
KGU	Marion A. Mulrony	Honolulu, Hawaii	270
KGW	Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College	Lacey, Wash.	278
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Spokane, Wash.	395
KICK	Atlantic Automobile Co.	Anita, Ia.	273

Start Radio with a Crystal Receiver

(Continued from page 7)

given conditions may not fit your conditions. That is why it is well to work out your own problems instead of following the other fellow's design.

A condenser is used with the inductance coil. One rated at .001 microfarads capacity comes about as near meeting the needs of the crystal detector set builder as any, but it is well to start with an elastic unit. Buy a frame, thirteen or more plates and a dial from the five-and-ten, or better ones that will last longer from a radio shop. Assemble all the plates, test out the condenser, then reduce the number of plates until the correct capacity for your needs is obtained.

THERE is a certain balance that must be maintained between the coil and condenser. In the appendices of the radio textbooks found in public libraries are tables showing how much inductance and capacity are needed to tune to a given wavelength and keep out other wavelengths. More or less of each may be used, as long as the inductance and capacity, multiplied together, give the product required for the given wavelength. Don't remove the appendix just because the contents are hard to digest—some other fellow may want to use it! Figuring out a coil and condenser for a desired range of wavelengths is not a very hard job for anyone who has covered grammar school arithmetic.

When you have your coil, hitch one end of it to the aerial and the other end to the ground wire. Connect the ends of the coil with the terminals of the condenser. If this does not work well, try connecting the condenser between the aerial and the coil. Then try it between the coil and the ground wire. The crystal should be connected bewteen the two ends of the coil, with one phone cord tip on each side of the crystal. Or, the phones may be tried between the coil and the crystal, on either side of the latter.

While the experimental work is in progress, the parts may as well be strung out on a table where they can be hooked up and unhooked with the least trouble. After you have found a hook-up that brings in what you want, there will be time to design panels, cabinets, or lay-outs. Some like to anchor the apparatus to the table.

Circuit diagrams and constructional details for all types of crystal sets can be found in books at the libraries. Many have been published in this magazine. The Superintendent of Documents, Government Printing Office, Washington, D. C., sells good pamphlets at five to ten cents each. State colleges and universities have designed sets and issued instructions that can be obtained free of charge or for small sums.

Whether you are interested primarily in pleasure or profit, you cannot afford to overlook radio, for you can build a crystal set for less than five dollars that will keep you in touch with broadcasting stations within a radius of five to twenty-five miles and possibly reach out further. Most of the parts can be used later in a tube set, if you decide to build one, which you probably will!

KJBS	J. Brunton & Sons Co.	San Francisco, Calif.	234
KJR	Northwest Radio Service Co.	Seattle, Wash.	384
KLDS	Reorganized Church of Jesus Christ,	Independence, Mo.	441
KLS	Warner Brothers	Oakland, Calif.	250
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	265
KMA	May Seed & Nursery	Shenandoah, Iowa	461
KMJ	Fresno Bee	Fresno, Calif.	234
KMMJ	M. M. Johnson Co.	Clay Center, Nebr.	229
KMO	Love Electric Co.	Tacoma, Wash.	250
KMOX	Voice of St. Louis	St. Louis, Mo.	280
KMTR	Echophone Mfg. Co.	Los Angeles, Calif.	372
KNRC	C. B. Juneau	Hollywood, Calif.	208
KNX	Los Angeles Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	322
KOAC	Oregon Agriculture College	Corvallis, Oreg.	280
KOB	N. Mex. College of Agric.	State College, N. Mex.	349
KOCH	Omaha Central High School	Omaha, Neb.	258
KOCW	Oklahoma College for Women	Chickasha, Okla.	252
KOIL	Mona Motor Oil Co.	Council Bluffs, Iowa	306
KOIN	KOIN, Inc.	Portland, Ore.	319
KOMO	Birt F. Fisher	Seattle, Wash.	306
KOWW	Frank A. Moore	Walla Walla, Wash.	285
KPJM	Wilburn Radio Service	Prescott, Ariz.	215
KPO	Hale Bros., Inc.	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Printing Co.	Houston, Texas	297
KPSN	Star-News	Pasadena, Calif.	316
KQW	First Baptist Church	San Jose, Calif.	333
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	275
KRE	Berkeley Daily Gazette	Berkeley, Calif.	256
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Pulitzer Publishing Co.	St. Louis, Mo.	545
KSEI	Broadcasting Association	Pocatello, Idaho	261
KSL	Radio Service Corp.	Salt Lake City, Utah	300
KSMR	Santa Maria Valley Railroad	Santa Maria, Calif.	283
KSO	A. A. Berry Seed Co.	Clarinda, Iowa	242
KTAB	Associated Broadcasters	Oakland, Calif.	303
KTBI	Bible Institute	Los Angeles, Calif.	294
KTBR	M. E. Brown	Portland, Ore.	263
KTHS	New Arlington Hotel	Hot Springs, Ark.	375
KTNT	N. Baker	Muscatine, Iowa	333
KTUE	Uhalt Electric	Houston, Texas	263
KTW	First Presbyterian Church	Seattle, Wash.	454
KUOA	University of Arkansas	Fayetteville, Ark.	300
KUOM	University of Montana	Missoula, Mont.	244
KUSD	University of South Dakota	Vermillion, S. D.	278
KUT	University of Texas	Austin, Texas	231
KVOO	Southwestern Sales Corp.	Bristow, Okla.	375
KWCR	H. F. Parr	Cedar Rapids, Iowa	278
KWG	Portable Wireless Telegraph Co.	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	236
KWKH	W. G. Patterson	Kennonwood, La.	312
KWSC	State College of Washington	Pullman, Wash.	349
KWTC	J. W. Hancock	Santa Ana, Calif.	261
KWUC	Western Union College	Le Mars, Iowa	252
KWWG	City of Brownsville	Brownsville, Texas	278
KXRO	Brott Laboratories	Seattle, Wash.	240
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
KZM	Preston D. Allen	Oakland, Calif.	240
WAAD	Ohio Mechanical Institute	Cincinnati, Ohio	258
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	278
WAAM	Isaiah R. Nelson	Newark, N. J.	263
WAAT	F. V. Bremer	Jersey City, N. J.	235
WAAW	Omaha Grain Exchange	Omaha, Nebr.	384
WABB	Harrisburg Radio Co.	Harrisburg, Pa.	204
WABC	Asheville Battery Co.,	Asheville, N. C.	254
WABI	1st Univeralist Church	Bangor, Me.	240
WABO	Hickson Elec. Co., Inc.	Rochester, N. Y.	278
WABQ	Haverford College Radio Club	Haverford, Pa.	261
WABR	Scott High School	Toledo, Ohio	263
WABW	College of Wooster	Wooster, Ohio	207
WABX	Henry B. Joy	Mt Clemens, Mich.	246
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Colis Place Baptist Church	New Orleans, La.	275
WADC	Allen T. Simmons	Akron, Ohio	258
WAFD	Albert P. Parfet	Port Huron, Mich.	275
WAGM	R. L. Miller	Royal Oak, Mich.	275
WAGS	Willow Garage, Inc.	Sommerville, Mass.	250
WAHG	A. H. Grebe	Richmond Hill, N. Y.	316
WAIT	A. H. Waite & Co.	Taunton, Mass.	229
WAIU	American Insurance Union	Columbus, Ohio	294
WAMD	Raddison Radio Corp.	Minneapolis, Minn.	244
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	461
WARC	American Radio & Research	Medford, Mass.	261
WASH	Baxter Laundry Co.	Grand Rapids, Mich.	256
WATT	Edison Elec. Illum. (Portable)	Boston, Mass.	244
WBAA	Purdue University	W. Lafayette, Ind.	273
WBAC	James Milliken University	Decatur, Ill.	270
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAL	Consolidated Gas & Power Co.	Baltimore, Md.	246
WBAP	Carter Publications, Inc.	Ft. Worth, Tex.	476
WBAW	Braid Elec. Co. & Waldrum Drug Co.	Nashville, Tenn.	236
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	256
WBBC	P. J. Testan	Brooklyn, N. Y.	250
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	229
WBBM	Atlass Investment	Chicago, Ill.	226
WBBP	Petoskey High School	Petoskey, Mich.	238
WBBR	People's Pulpit Assoc.	Rossville, N. Y.	416
WBBS	First Baptist Church	New Orleans, La.	252
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Inf.	Charleston, S.C.	268
WBBZ	C. L. Carrell	(Portable,) Chicago Ill.	216
WBCN	Foster & McDonnell	Chicago, Ill.	266
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBMS	G. J. Schowerer	North Bergen, N. J.	224
WBNY	Baruschrome Corp.	New York, N. Y.	322
WBOQ	A. H. Grebe & Co., Inc.	Richmond Hill, N. Y.	236
WBRC	Birmingham Broadcasting Co.	Birmingham, Ala.	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBRL	Booth Radio Laboratories	Tilton, N. H.	365
WBRS	Universal Radio Mfg. Co.	Brooklyn, N. Y.	394
WBT	Charlotte Chamber of Commerce	Charlotte, N. C.	275
WBZ	Westinghouse Elect. & Mfg. Co.	Springfield, Mass.	333
WBZA	Westinghouse Elect. & Mfg. Co.	Boston, Mass.	333
WCAC	Connecticut Agricultural College	Mansfield, Conn.	275
WCAD	St. Lawrence University	Canton, N. Y.	263
WCAE	Kaufman & Baer Co.	Pittsburgh, Pa.	461
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	254
WCAL	St. Olaf College	Northfield, Minn.	337
WCAM	City of Camden	Camden, N. J.	236
WCAO	Brager, of Baltimore	Baltimore, Md.	275
WCAP	Chesapeake & Potomac Tel. Co.	Washington, D. C.	469
WCAR	Southern Radio Corp.	San Antonio, Texas	263
WCAT	School of Mines	Rapid City, S. Dak.	240
WCAU	Universal Broadcasting Co.	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	254
WCBD	Wilbur Glenn Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBH	University of Mississippi	Oxford, Miss.	242
WCBM	Hotel Chateau	Baltimore, Md.	229
WCBR	C. H. Messter	Portable	210
WCBS	H. L. Dewing, Portable,	Boston Mass.	242
WCCO	Washburn-Crosby Co.	Anoka, Minn.	416
WCFL	Chicago Fed. of Labor	Chicago, Ill.	492
WCFT	Knights of Pythias Home	Tullahoma, Tenn.	252
WCLO	C. E. Whitmore	Camp Lake Wis.	231
WCLS	H. M. Couch	Joliet, Ill.	214
WCMA	Culver Military Academy	Culver, Ind.	258
WCOA	City of Pensacola	Pensacola, Fla.	222
WCRW	Clinton R. White	Chicago, Ill.	416
WCSH	Henry R. Rines	Portland, Maine	500
WCSO	Wittenberg College	Springfield, Ohio	248
WCWK	Chester W. Keen	Fort Wayne, Ind.	234

Dry Cell Batteries or Eliminators?

WITH so many and varied battery substitutes on the market this fall, the question of whether to use "B" batteries or socket-power devices is going to assume important proportions in the minds of many radio enthusiasts. Set owners and prospective set owners already are asking whether batteries or house-current attachments are more dependable, more economical, more generally satisfactory for "B" current supply.

Unfortunately, these questions cannot be answered as promptly and as emphatically now as they may be answered a few years hence. Socket-power devices, for "B" power supply may be vastly improved within the next few years and may be produced at considerably smaller costs than those which prevail today. On the other hand, the useful life of dry batteries may be decidedly lengthened by laboratory and manufacturing achievements in the near future. In this connection it may be well to remember that comparatively recently the process of building dry "B" batteries in layer cells rather than in cylindrical units, has lengthened battery life, for average use, approximately fifty per cent.

However, careful comparison of dry-cell "B" batteries and house-current "B" power devices as they are today, has brought to light certain general rules which may guide the set owner toward selection of the "B" power supply which is best suited to the needs of his individual set.

Radio receiving sets must be divided into two general classes, insofar as power requirements are concerned—namely, those which consume so much power that dry cell "B" batteries are inadequate to meet the demand for power, and those which consume so little power that dry cell "B" batteries can be relied upon to run them economically and dependably. So, after all, the real key to the set owner's solution of the problem of batteries versus "eliminators," lies in ascertaining whether his set is within the class which can depend only upon "eliminators" or within the class

WCWS	Chas. W. Selene (Portable)	Mass.	210
WCX	Detroit Free Press	Pontiac, Mich.	517
WDAD	Dad's Auto Accessories, Inc.	Nashville, Tenn.	226
WDAE	Tampa Daily Times	Tampa, Fla.	273
WDAF	Kansas City Star	Kansas City, Mo.	366
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAH	Trinity Methodist Church	El Paso, Texas	268
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	261
WDBE	Gilham-Schoen Elec. Co.	Atlanta, Ga.	270
WDBJ	Richardson Wayland Elec. Corp.	Roanoke, Va.	229
WDBK	M. F. Broz	Cleveland, Ohio	227
WDBO	Rollins College,	Winter Park, Fla.	240
WDBZ	Kingston Radio Club	Kingston, N. Y.	233
WDEL	Wilmington Elec. Specialty Co.	Wilmington, Del.	266
WDGY	Dr. George W. Young	Minneapolis, Minn.	263
WDOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	256
WDRC	Doolittle Radio Corp.	New Haven, Conn.	268
WDWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	441
WDXL	DXL Radio Corp.	Detroit, Mich.	297
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAF	Broadcasting Co. of America	New York, N. Y.	491
WEAI	Cornell University	Ithaca, N. Y.	254
WEAM	Bor. of N. Plainfield	North Plainfield, N. J.	261
WEAN	The Shepard Co.	Providence, R. I.	367
WEAO	Ohio State University	Columbus, Ohio	294
WEAR	Willard Storage Battery Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBH	Edgewater Beach Hotel	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEBL	R. C. A. Show (Portable)	New York, N. Y.	226
WEBQ	Tate Radio Corp.	Harrisburg, Ill.	226
WEBR	H. H. Howell	Buffalo, N. Y.	244
WEBW	Beloit College	Beloit, Wis.	268
WEBZ	Savannah Radio Corp.	Savannah, Ga.	263
WEDC	E. Denemark Station,	Chicago, Ill.	422
WEEI	The Edison Elec. Illuminating Co.	Boston, Mass.	349
WEHS	Oliver G. Fordham	Evanston, Ill.	203
WEMC	Emanuel Missionary College	Berrien Springs, Mich.	316
WENR	All-American Radio Corp.	Chicago, Ill.	266
WEW	St. Louis University	St. Louis, Mo.	360
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAV	University of Nebraska	Lincoln, Neb.	275
WFBC	First Baptist Church	Knoxville, Tenn.	250
WFBE	J. V. De Walle	Seymour, Ind.	226
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	278
WFBJ	St. John's University	Collegeville, Minn.	236
WFBL	Onondaga Hotel Co.	Syracuse, N. Y.	252
WFBM	Merchants Heat & Light Co.	Indianapolis, Ind.	268
WFBR	Fifth Infantry National Guard	Baltimore, Md.	254
WFBZ	Knox College	Galesburg, Ill.	254
WFCI	Frank Crook, Inc.	Pawtucket, R. I.	229
WFDF	F. D. Fallain	Flint, Mich.	234
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFKB	Vesta Battery Corp.	Chicago, Ill.	217
WFRL	Robert Morrison Lacey	Brooklyn, N. Y.	205
WGAL	Lancaster Elec. Supply & Const. Co.	Lancaster, Pa.	248
WGBB	H. H. Carman	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	278
WGBF	Fink Furniture Co.	Evansville, Ind.	236
WGBL	Scranton Broadcasters, Inc.	Scranton, Pa.	240
WGBS	Gimbel Brothers	Astoria, L. I., N. Y.	316
WGBU	Florida Cities Finance Co.	Fulford By-The-Sea, Fla.	278
WGBX	University of Maine	Orono, Me.	234
WGCP	May Radio Broadcast Corp.	Newark, N. J.	252
WGES	Oak Leaves Broadcasting Corp.	Chicago, Ill.	316
WGHB	Fort Harrison Hotel	Clearwater, Fla.	266
WGHP	G. H. Phelps	Detroit, Mich.	270
WGM	Verne and Elton Spencer	Jeanette, Pa.	372
WGMU	A. H. Grebe & Co. (Portable)	New York	236
WGN	The Tribune	Chicago, Ill.	303
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGST	Georgia School of Technology	Atlanta, Ga.	270
WGWB	Radiocast Corporation	Milwaukee, Wis.	384
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquette University	Milwaukee, Wis.	275
WHAM	Eastman School of Music	Rochester, N. Y.	278
WHAP	W. H. Taylor Finance Corp.	New York, N. Y.	431
WHAR	F. D. Cooks Sons	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co.	Kansas City, Mo.	366
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBC	Rev. E. P. Graham	Canton, Ohio	254
WHBD	Chamber of Commerce	Bellefontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBL	C. L. Carrell (Portable)	Chicago, Ill.	216
WHBM	C. L. Carrell, (Portable)	Chicago, Ill.	216
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	238
WHBP	Johnstown Automobile Co.	Johnstown, Pa.	256
WHBQ	St. John's M. E. Church South	Memphis, Tenn.	233
WHBU	Riviera Theatre & Bing's Clothing	Anderson, Ind.	219
WHBW	D. R. Kienzle	Philadelphia, Pa.	216
WHBY	St. Norbert's College	West de Pere, Wis.	250
WHDI	W. H. Dunwoody Institute	Minneapolis, Minn.	278
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WHFC	Hotel Flanders	Chicago, Ill.	258
WHK	The Radio Air Service Corp.	Cleveland, Ohio	273
WHN	George Schubel	New York, N. Y.	361
WHO	Banker's Life Co.	Des Moines, Ia.	526
WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	238
WIAD	Howard R. Miller	Philadelphia, Pa.	250
WIAS	Home Electric Co.	Burlington, Iowa	254
WIBA	Capital Times-Strand Theatre	Madison, Wis.	236
WIBG	St. Paul' Protestant E. Church	Elkins Park, Pa.	222
WIBH	Elite-Radio Stores	New Bedford, Mass.	210
WIBI	Frederick B. Zittell, Jr.	Flushing, L.I., N.Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBM	Billy Maine (Portable)	Chicago, Ill.	216
WIBO	Nelson Brothers	Chicago, Ill.	226
WIBR	Thurman A. Owings	Weirton, W. Va.	246
WIBS	T. F. Hunter	Elizabeth, N. J.	203
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WIBX	WIBX, Inc.	Utica, N. Y.	234
WIBZ	A. D. Trum	Montgomery, Ala.	231
WIL	Benson Radio Co.	St. Louis, Mo.	258
WIOD	Earl G. Fisher Co.	Miami, Fla.	248
WIP	Gimbel Bros.	Philadelphia, Pa.	508
WJAD	Jackson's Radio Eng. Laboratories	Waco, Texas	353
WJAF	J. S. Fenberg	Ferndale, Mich.	407
WJAG	Norfolk Daily News	Norfolk, Neb.	270
WJAK	Kokomo Tribune	Kokomo, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co.	Providence, R. I.	306
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	275
WJAX	City of Jacksonville	Jacksonville, Fla.	337
WJAZ	American Bdcast Corp.	Mt. Prospect, Ill.	329
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	Financial Journal	St. Petersburg, Fla.	254
WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WJBI	Robert S. Johnson	Red Bank, N. J.	219
WJBK	E. F. Goodwin	Ypsilanti, Mich.	233
WJBL	Wm. Gushard Dry Goods Co.	Decatur, Ill.	270
WJBO	Valdemar Jensen	New Orleans, La.	268
WJBR	Omro Drug Stores	Omro, Wis.	227
WJBT	John S. Boyd	Chicago, Ill.	468
WJBU	Bucknell University	Lewisburg, Pa.	211
WJBV	Union Course Laboratories	Woodhaven, N. Y.	288
WJBW	C. Carlson, Jr.	New Orleans, La.	270
WJBX	Henderson & Ross	Osterville, Mass.	280

for which batteries are not only more economical, but also more satisfactory generally.

Of course, at present, the high power sets which must use "eliminators," are comparatively few in number. There are some, however, which operate at abnormally high voltages—180 volts or more—and such sets will exhaust the very best of the heavy duty "B" batteries so rapidly that the upkeep expense becomes burdensome. On such receivers, the comparatively high first-cost of the really dependable socket-power device is fully justified.

For the customary types of receivers operating at normal "B" voltage of 90 or 135 volts, well made, heavy duty "B" batteries usually are cheaper than any other form of "B" power supply, are not subject to any of the power interruptions to which any house-current device is subject, and, of course, supply the only pure direct current. The money spent for a good "eliminator" will keep the average set of this class supplied with heavy duty "B" batteries for three years or more and unless the "eliminator" can be used for three years without repairs or replacements, the eliminator will be much more costly than batteries in the long run.

Most of the instances of so-called battery trouble can be traced to the use of the wrong size "B" battery. Practically all of the receiving sets in use today should be powered with the heavy duty size, rather than the smaller light duty "B" battery.

Spokane To Get New Broadcasting Station

CONSTRUCTION on a broadcasting station to cost between $50,000 and $75,000, will be started at Spokane, Wash., immediately.

The new station will be linked with four other new Pacific coast plants, making one of the most powerful broadcasting chains in the country.

Announcement of the coming of this new station to Spokane was made recently by W. A. Watson of Seattle, superintendent and engineer of the chain. J. H. Sahlin of Spokane, is local manager and director.

WJBY	Electric Construction Co.	Gadsden, Ala.	270
WJJD	Supreme Lodge, L. O. of Moose	Mooseheart, Ill.	370
WJR	Jewett Radio & Phonograph Co.	Pontiac, Mich.	517
WJUG	U. B. Ross	New York, N. Y.	517
WJY	Radio Corp. of America	New York, N. Y.	405
WJZ	Radio Corp. of America	Bound Brook, N. J.	454
WKAF	WKAF Broadcasting Co.	Milwaukee, Wis.	261
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	341
WKAR	Michigan State College	East Lansing, Mich.	286
WKAV	Laconia Radio Club	Laconia, N. H.	422
WKBA	Arrow Battery Co.	Chicago, Ill.	210
WKBB	Sanders Bros.	Joliet, Ill.	283
WKBC	H. L. Ansley	Birmingham, Ala.	225
WKBE	K. & D. Electric Co.	Webster, Mass.	270
WKBF	N. D. Watson	Indianapolis, Ind	244
WKBG	C. L. Carrell (Portable)	Chicago, Ill.	216
WKBH	Callaway Music Co.	LaCrosse, Wis.	250
WKBI	F. L. Schoenwolf	Chicago, Ill.	220
WKBJ	Gospel Tabernacle Inc.	St. Petersburg, Fla.	280
WKBL	Monrona Radio Mfg. Co.	Monroe, Mich.	252
WKBM	J. W. Jones	Newburgh, N. Y.	215
WKBO	Camith Corporation	Jersey City, N. J.	309
WKBP	Enquirer and News	Battle Creek, Mich.	265
WKBQ	Starlight Amusement Park	New York, N. Y.	285
WKBR	C. J. Heiser	Auburn, N. Y.	225
WKBS	P. M. Nelson	Galesburg, Ill.	361
WKBV	Knox Battery and Electric Co.	Brookville, Ind.	236
WKDR	Edward A. Dato	Kenosha, Wis.	428
WKJC	Kirk Johnson & Co.	Lancaster, Pa.	258
WKRC	Kodel Radio Corp.	Cincinnati, Ohio	422
WKY	Hull and Richards	Oklahoma City, Okla.	275
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	275
WLB	University of Minnesota	Minneapolis, Minn.	278
WLBL	Wisconsin Dept. of Markets	Stevens Point, Wis.	278
WLIB	Liberty Weekly, Inc.	Elgin, Ill.	303
WLIT	Lit Bros.	Philadelphia, Pa.	394
WLS	Sears Roebuck & Co.	Crete, Ill.	345
WLSL	Lincoln Studios	Cranston, R. I.	441
WLTS	Lane Technical High School	Chicago, Ill.	258
WLW	Crosley Radio Corp.	Harrison, Ohio	422
WLWL	Paulist Fathers	New York, N.Y.	384
WMAC	C. B. Meredith	Casenovia, N. Y.	275
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	441
WMAK	Norton Laboratories	Lockport, N. Y.	266
WMAL	M. A. Leese Optical Co.	Washington, D. C.	290
WMAN	Haskett Radio Station	Columbus, Ohio	278
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	248
WMAZ	Mercer University	Macon, Ga.	261
WMBB	American Bond & Mortgage Co.	Chicago, Ill.	250
WMBC	Michigan Broadcasting Co., Inc.	Detroit, Mich.	256
WMBF	Fleetwood Hotel Corp.	Miami Beach, Fla.	384
WMBI	Moody Bible Institute	Chicago, Ill.	288
WMC	Commercial Pub. Co.	Memphis, Tenn.	500
WMCA	Greely Sq. Hotel Co.	Hoboken, N. J.	341
WMRJ	Peter J. Prinz	Jamaica, N. Y.	227
WMSG	Madison Sq. Gard. Bdcast. Corp.	New York, N. Y.	302
WNAB	Shepard Stores	Boston, Mass.	280
WNAC	Shepard Stores	Boston, Mass.	430
WNAD	University of Oklahoma	Norman, Okla.	254
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAT	Lenning Brothers Co.	Philadelphia, Pa.	250
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNBH	New Bedford Hotel	New Bedford, Mass.	248
WNJ	Radio Shop	Newark, N. J.	252
WNOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	268
WNRC	W. B. Nelson	Greensboro, N. C.	224
WNYC	Dept. of Plants & Structures	New York, N. Y.	526
WOAI	Southern Equipment Co.	San Antonio, Texas	394
WOBB	Longacre Eng. & Const. Co.	Chicago, Ill.	555
WOAN	J. D. Vaughn	Lawrenceburg, Tenn.	283
WOAW	Woodman of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOCB	Orlando Broadcasting Co.	Orlando, Fla.	294
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCL	A. D. Newton	Jamestown, N. Y.	275
WODA	O'Dea Temple of Music	Paterson, N. J.	391
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	217
WOKO	Harold E. Smith	Peekskill, N. Y.	232
WOO	John Wanamaker	Philadelphia, Pa.	508
WOOD	Grand Rapids Radio Co.	Grand Rapids, Mich.	242
WOQ	Unity School	Kansas City, Mo.	278
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	People's Pulpit Assn.	Batavia, Ill.	275
WOS	State Market Bureau	Jefferson City, Mo.	441
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAK	N. D. Ag. College	Agricultural College, N. D.	275
WPAP	(See WQAO)	Cliffside, N. J.	361
WPCC	North Shore Cong. Church	Chicago, Ill.	258
WPCH	Concourse Radio Corp.	New York, N. Y.	273
WPDQ	H. L. Turner	Buffalo, N. Y.	205
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WPRC	Wilson Printing & Radio Co.	Harrisburg, Pa.	216
WPSC	Pennsylvania State College	State College, Pa.	261
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	220
WQAC	Gish Radio Service	Amarillo, Tex.	234
WQAE	Moore Radio News Station	Springfield, Vt.	246
WQAM	Electrical Equipment Co.	Miami, Fla.	285
WQAN	Scranton Times	Scranton, Pa.	250
WQAO	Calvary Baptist Church	Cliffside, N. J.	361
WQJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	447
WRAF	The Radio Club (Inc.)	LaPorte, Ind.	224
WRAH	S. N. Read	Providence, R. I.	235
WRAK	Economy Light Co.	Escanaba, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAV	Antioch College	Yellow Springs, Ohio	263
WRAW	Avenue Radio & Electric Shop	Reading, Pa.	238
WRAX	Beracah Church, Inc.	Philadelphia, Pa.	268
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WRCO	Wayne Radio Co.	Raleigh, N. C.	252
WREC	Wooten's Radio Shop	Coldwater, Miss.	254

What Do We Get From Boston?

(Continued from page 19)

to turned out to be the veriest rot, and it was with only a mild curiosity as to what you were up to now that I started the article. I had never come in contact with radio, and thought of it as something that appealed to small boys and people in isolated places. As real entertainment for people living in a city, I had never considered it, and I was literally amazed to learn what it had developed into.

"We had a set installed that week, and Sam said a few nights afterward, 'If you want to know where I am spending my evenings this winter it's right on that davenport. I can get all the entertainment I need right here at home.'

"He even cancelled his football tickets, for he said he had put in fifteen years freezing up at Ferry Field each fall, and he could get just as much of a thrill out of the games from the loud speaker. I accused him of senility, but agree with his statement that it requires too much effort to get anywhere nowadays. We'll probably tire of the radio in time, but it seems to be such an overwhelming proposition, and as Sam says we've gotten started so late it will take us a long time to get around the country. We've just discovered the bridge lessons . . . I wonder if there aren't a lot of people like ourselves who are overlooking radio simply because they don't know what it means. We have done some proselyting ourselves, and it has solved the Christmas problem in several cases. If you discover any more new continents let us know."

WREO	Reo Motor Car Co.	Lansing, Mich.	285
WRES	H. L. Sawyer	Woloaston, Mass.	300
WRHF	Wash. Radio Hospital Fund	Washington, D.C.	256
WRHM	Rosedale Hospital, Inc.	Minneapolis, Minn.	252
WRK	Doron Bros.	Hamilton, Ohio	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc.,	Motor Yacht "MU-1"	236
WRNY	Experimenter Publishing Co.	New York, N. Y.	374
WRR	City of Dallas	Dallas, Tex.	246
WRST	Radiotel Mfg. Co., Inc.	Bay Shore, N. Y.	216
WRVA	Larus & Brother Co., Inc.	Richmond, Va.	256
WSAI	United States Playing Card Co.	Cincinnati, Ohio	326
WSAJ	Grove City College	Grove City, Pa.	229
WSAN	Allentown Call Publishing Co. Inc.	Allentown, Pa.	229
WSAR	Daughty & Welch Electrical Co.	Fall River, Mass.	254
WSAV	Clifford W. Vick	Houston, Tex.	248
WSAX	Zenith Radio Corp. (Portable)	Chicago, Ill.	268
WSAZ	Chase Electric Shop	Pomeroy, Ohio	244
WSB	Atlanta Journal	Atlanta, Ga.	428
WSBC	World Battery Co.	Chicago, Ill.	288
WSBF	Stix Baer & Fuller	St. Louis, Mo.	273
WSBT	South Bend Tribune	South Bend, Ind.	315
WSDA	Seventh Day Adventist Church	New York, N. Y.	263
WSKC	World's Star Knitting Co.	Bay City, Mich.	261
WSM	Nashville Life & Accident Ins. Co.	Nashville, Tenn.	283
WSMB	Saenger Amuse. Co. & Maison B. Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275
WSOE	School of Engineering	Milwaukee, Wis.	246
WSRO	Harry W. Fahrlander	Hamilton, Ohio	252
WSSH	Tremont Temple Bap. Church	Boston, Mass.	261
WSUI	State University of Iowa	Iowa City, Iowa	484
WSVS	Seneca Vocational School	Buffalo, N. Y.	219
WSWS	Richmond Harris & Co.	Batavia, Ill.	275
WTAB	Fall River DailyHeraldPublishingCo.	Fall River, Mass.	266
WTAD	Robt. E. Compton	Carthage, Ill.	236
WTAG	Worcester Telegram	Worcester, Mass.	545
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	389
WTAQ	C. S. Van Gordon	Eau Claire, Wis.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	261
WTAW	Agricultural & Mech. Col. of Texas	College Sta. Texas	270
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	261
WTIC	Travelers Insurance Co.	Hartford, Conn.	476
WTRC	20th Dist. Republican Club	New York, N. Y.	240
WWAE	Electric Park	Plainfield, Ill.	384
WWJ	Evening News Assn. (Detroit News)	Detroit, Mich.	353
WWL	Loyola University	New Orleans La.	275
WWRL	Woodside Radio Labs.	Woodside, N. Y.	258

Dominion of Canada

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	356
CFCF	Marconi Wireless Teleg. Co., (Ltd.) Can.	Montreal, Que.	411
CFCH	Abitibi Power & Paper Co. (Ltd.)	Iroquois Falls, Ont.	500
CFCK	Radio Supply Co.	Edmonton, Alta.	517
CFCN	W. W. Grant (Ltd.)	Calgary, Alta.	434
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCT	Victoria City Temple	Victoria, B. C.	329
CFCU	The Jack Elliott (Ltd.)	Hamilton, Ont.	341
CFHC	Henry Birks & Sons	Calgary, Alta.	434
CFKC	Thorold Radio Supply	Thorold, Ont.	248
CFQC	The Electric Shop (Ltd.)	Saskatoon, Sask.	329
CFRC	Queens University	Kingston, Ont.	450
CFXC	Westminster Trust Co.	Westminster, B. C.	291
CFYC	Commercial Radio (Ltd.)	Vancouver, B. C.	411
CHBC	The Calgary Albertan	Calgary, Alta.	434
CHCM	Riley & McCormack (Ltd.)	Calgary, Alta.	434
CHCS	The Hamilton Spectator	Hamilton, Ont.	341
CHIC	Northern Electric Co.	Toronto, Ont.	357
CHNC	Toronto Radio Research Society	Toronto, Ont.	357
CHUC	International Bible Ass'n.	Saskatoon, Sask.	329
CHXC	R. Booth, Jr.	Ottawa, Ont.	434
CHYC	Northern Electric Co.	Montreal, Que.	411
CJCA	Edmonton Journal	Edmonton, Alta.	511
CJCL	A. Couture	Montreal, Que.	279
CJGC	London Free Press	London, Ont.	329
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	397
CKCK	Leader Pub. Co.	Regina, Sask.	476
CKCL	Dominion Battery Co.	Toronto	357
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	P. Burns & Co. (Ltd.)	Calgary, Alta.	434
CKFC	First Congregational Church	Vancouver, B. C.	411
CKLC	Wilkinson Electric Co. (Ltd.)	Calgary, Alta.	434
CKNC	Canadian National Carbon Co.	Toronto, Ont.	357
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	341
CKY	Manitoba Tel. System	Winnipeg, Man.	384
CNRA	Canadian National Railways	Moncton, N. B.	312
CNRC	Canadian National Railways	Calgary, Alta.	436
CNRE	Canadian National Railways	Edmonton, Alta.	517
CNRM	Canadian National Railways	Montreal, Que.	411
CNRO	Canadian National Railways	Ottawa, Ont.	435
CNRR	Canadian National Railways	Regina, Sask.	476
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRV	Canadian National Railways	Vancouver, B. C.	291
CNRW	Canadian National Railways	Winnipeg, Man.	384

Republic of Mexico

GYB	Mexico City	380	
GYL	Mexico City	400	
CZE	Mexico City	350	

Republic of Cuba

PWX	Cuban Telephone Co.	Havana	400
2BY	F. W. Borton	Havana	260
20K	M. G. Velez	Havana	360
20L	Oscar Collado	Havana	257
5DW	R. S. Calderon	Matanzas	200
6VY	Jose Ganduxe	Cienfuegos	260
6JK	F. H. Jones	Tuinucu	340
6KW	F. H. Jones	Tuinucu	272
7SR	S. Rionda	Central Elia	350
8BY	A. Ravelo	Santiago de Cuba	250

Great Britain

2LO	London	365	
5IT	Birmingham	479	
5WA	Cardiff	353	
2BE	Belfast	440	
5XX	Daventry	1600	
2RN	Dublin	390	
6BM	Bournemouth	386	
2ZY	Manchester	378	
5NO	Newcastle	404	
5SC	Glasgow	422	
2BD	Aberdeen	495	

France

YN	Lyons	550	FL	Paris (Eiffel Tower)	2,650	8AJ	Paris	1,780	ESP	Paris	458

Short Wave Phone Broadcasting

		KC	Meters			KC	Meters
2XK	Schenectady, N. Y.*	4600	65.16	KDKA	Pittsburgh, Pa.*	5100	58.79
KDKA	Pittsburgh, Pa.*	4760	63.00	2XAF	Schenectady, N. Y.*	9143	32.79

*Crystal Control

CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook RADIO AGE'S classified advertisements.

The classified advertising rates are but five cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, making rate of 4 1-2, 4 and 3 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for the January issue must be sent in by November 25.

AGENTS WANTED

WANTED, AN ACTIVE MAN TO TAKE ORDERS for Hardy fruit trees, berry bushes, evergreens, flowering shrubs and roses. Liberal commission. Free replacement. Sales instruction and outfit free. Sherman Nursery Company, attention Mr. Smith, Charles City, Iowa.

Gold Wave Aerial. Greatest Side Line out. Guaranteed to bring in more stations—gives greater distance and selectivity. Reduces static to a minimum. Sells all dealers handling radio. Unlimited field. Big commissions and re-orders. Luxem and Davis Mfg. Co., 8231 Broadway, Dept. 61, Chicago.

MAN in each town to plate auto parts, reflectors, bath fixtures, silver mirrors, refinish beds, chandeliers by new method; $10 daily; no capital or experience required; outfits furnished; write today. Gunmetal Company, Avenue J, Decatur, Illinois.

SELLS for $9.75. Prints ad on wrapping paper, envelopes, etc. $1.00 commission. Send 10c for sample work. Automatic Ad-Stamper, Joplin, Mo.

BOOKS AND MAGAZINES

What could be better than magazine subscriptions for holiday gifts. Send stamp for our special list of subscription bargains. Midland Products, Dept. R. A., 524 Courtland Ave., Park Ridge, Illinois.

Twentieth Century Book of Receipts, Formulas and processes, an 807 cloth bound book containing 10,000 proven formulas for the manufacturer, workshop, laboratory, office and home. Sent prepaid upon receipt of $4.00. Send stamp for our 48 page catalog of latest and best practical, scientific mechanical and industrial books. Midland Products Co., Dept. RA, 524 Courtland Ave., Park Ridge, Ill.

BUSINESS OPPORTUNITIES

LAND FREE if planted to bananas. Bananas bear a full crop the second year. $5.00 monthly will plant five acres, which should pay $1,500 profit annually. Reliable Companies will cultivate and market your bananas for 1/3. Bananas ripen every day and you get your check every 30 days. For particulars address National Development Company, Empire Building, Block 135, Pittsburg, Pennsylvania.

CODE

DO YOU WANT TO MEMORIZE THE WIRELESS TELEGRAPH CODE? THE CORYDON SNYDER CODE METHOD IS EASIEST, QUICKEST, PATENTED Send 10c coin for complete method to Corydon Snyder, 1243 Rosemont Avenue, Chicago, Illinois.

COLLECTIONS

Three Collection Letters That Actually Collect: Product, 23 years' experience, $1.75. Address J. A. Hillsman, Lynchburg, Virginia.

DOGS

BEAUTIFUL REGISTERED BULL PUPS $15. Bulldogs, 501 Rockwood, Dallas, Texas.

For Sale—Arkansas Hounds, trained and untrained, 30 years dog business, long trial, guaranteed, terms, list free. W. B. Caraway, Alma, Arkansas.

MISCELLANEOUS

FOR SALE: WATCHMAKER'S LATHE at a bargain. R. Jaggermann, 5615 Easton Ave., St. Louis, Missouri.

PERSONAL

LONELY HEARTS: Exchange letters; make interesting new friends in our jolly club. Particulars free. Eva Moore, Box 908, Jacksonville, Florida.

RADIO

Build the Quadraformer Super V. A real five tube set. Set of Genuine Quadraformers $12.75 including instructions. Booklet 25c. Literature on request. R. P. Tomamichel, 2244 Seminary Avenue, Chicago, Illinois.

TROUBLE-SHOOTING. Do you know the key to the knowledge of any electrical circuit? You can find correct answer in a booklet written by nationally known authorities on Radio and Electricity. Ask your radio dealer for, "Practical Guide for Every Radio Builder and Owner" or send 10c to-day to Universal Test Equipment Co., 2939 N. Oakley Ave., Chicago, Ill. Sold at all news stands in the city of Chicago.

Buyers Service for Readers of Radio Age. I will buy for you standard radio merchandise if you cannot obtain same in your locality. Remit list price of articles wanted, and if same are not obtainable by me I will make refund. R. P. Tomamichel, 2244 Seminary Ave., Chicago, Illinois.

EXPERIMENTERS. Complete Chemical Apparatus and Radio Catalog, 1000 illustrations. Price 25c; refunded on $5.00 order. Laboratory Materials Company, 646 East 71st Street, Chicago.

End all your troubles and join the Questionnaire Club, something every radio fan should belong to, send stamp for full particulars, Web Radio Co., Box 849, Chicago, Ill., Dept. QC.

Guaranteed tubes, 199 and 201A types $1.00 each. $7.50 units to make a loud speaker of your Phonograph only $2.49. $4.00 list head phones only at $1.69. This is real value, a standard make 3 tube set with long range and lots of volume for $8.95, (less accessories), while they last. $12.00 loud speakers with genuine Bakelite Bell at $6.95. Write for our prices before you buy your radio parts. Outlet Sales, 112 Calvert Ave., Detroit, Michigan.

Do you want to build a real radio set at low cost? The circuit of the Web Wonder Four is just out, send stamp for full particulars, Web Radio Co., Box 849, Chicago, Ill. Dept. B. F.

Chokes for Speaker or Filter service, 20H—25MA $1.00 —30H 50MA—$1.75, 50H 60MA $2.00 prepaid. Write for list of Audio Transformers impedance amplifiers, Raytheon transformers, etc. Radio Parts Sales Co., Box 24, Orange, N. J.

RADIO TROUBLES OVER. Hoff's trouble finder locates, explains Remedy, 103 radio ailments. Particulars free. Smith, 514 Main, St. John, N. B.

IVORY RADIO PANEL beats them all. Write for FREE Sample. Ivorylite Radio Panel Co., 3222 Ave. F, Fort Worth, Texas.

A new circuit just out, something different. Send 2 cent stamp for information how to build your own set. Web Radio Company, Box 849, Chicago, Ill.

Want to dispose of my Kennedy Universal Receiver type 110 and two stage Amplifier type 525. Excellent condition guaranteed. No reasonable offer refused. K. F. Ourlein, 2943 Cambridge St., Philadelphia, Pa.

ATTENTION SET BUILDERS. Increase efficiency and selectivity by installing a set of binocular type radio frequency coils. Set Builders use extensively. Set of three $6.45. Money-saving price list mailed upon request. All articles sold on money back guarantee. Midwest Radio Supply, Dept. C., Box 222, Racine, Wisconsin.

Radio books—Construction of a modern Super Heterodyne Type Receiver including Testing and Operation $1.00; Henley's 222 Radio Circuit Designs, 267 pages, $1.00; The ABC of Vacuum Tubes used in Radio Reception 132 pages, 75 cents; Henley's Workable Radio Receivers 196 pages $1.00; Experimental Wireless Stations 392 pages $2.00; Wireless Telegraphy and Telephony Simply Explained 154 pages $1.00. Sent prepaid on receipt of price. Send stamp for our 48 page catalog of latest and best practical, scientific, mechanical and industrial books. Midland Products Co., Dept. RA, 524 Courtland Av., Park Ridge, Illinois.

SILICON Transformer Steel cut to order .014". 10 lbs. 25 cents, 5 lbs. 30 cents, less than 5 lbs. 35 cents per lb., 4 cubic inches to the lb. .007" for radio frequency transformers, 50c cubic inch, postage extra. At least 1/2 cash with order—balance C. O. D. Geo. Schulz, Calumet, Michigan.

Bakelite subpanels with five built in X type sockets, connections marked size 7x23, five dollars by mail order. Subpanel brackets, seven inches long, two and half inches high, one dollar a set. Satisfaction guaranteed or money refunded. Arrow Radio Products, 350 Fifth Avenue, Venice, Calif.

99.7% Pure aluminum for Rectifiers, B Eliminators, Trickle chargers and transmitters 1-2" round, 1-4x1" rectangular 5c inch, 1-4"x3-4 4c inch, 3-8" round lead elements 3 1-2" long 15c, 7 for $1.00 all with brass terminals, prepaid to 5 zone. No order less than $1.00. Geo. Schulz, Calumet, Michigan.

CRYSTALS—NOT GALENA

CELERUNDUM—the most sensitive crystal rectifier in the world. It is non-metallic sensitive all over; low resistance; greater volume. Will not burn out. Twelve crystals for $1.00 post paid.

De-Tex-It—A truly great fixed detector—Positive contact—Thousands in use. The best rectifier for Crystal Sets, Reflex T R Frequency and Super Hets 3 for $2.00 postpaid.

WE HAVE A BOOK THAT TALKS and sings, plays the piano and tells stories. Inside attractive covers is a compact, practical and complete radio outfit. No operating expense; no batteries or tubes to replace. Everything is included—(crystal set aerial and ground leads indoor antenna and pair of phones). The Talking Book, $5.00 complete connect it in a second and it goes for a life time. No overhead. E. W. Pitt Company, 115 Federal St., Boston, Mass.

PURE ALUMINUM and lead rectifier elements, holes drilled, with brass screws and nuts per pair 1/16" 1"x4", 13c, 1x6, 15c, 1 1/4x6, 17c, 1 1/2x6, 19c, single elements half price. Sheet aluminum 1/16", $1.00 1/8" $1.90. Lead $1.00 square foot all prepaid. Geo. Schulz, Calumet, Michigan.

CONDENSERS. 800 VOLT FILTER .1 mfd 45c, .25 51c, .5 60c, 1. 75c, 2. $1.20, 3. $1.80, 4. $2.40. 1500 VOLT FILTER, .1 51c, .25 60c, .5 75c, 1. $1.05, 2. $1.95, 3. $2.70, 4. $3.60. ELIMINATOR BLOCKS, 2, 2, and 8 $5.70, 2, 2, 8, and 1 $6.15, 2, 2, 8, 1 and 1 $6.60, .1 and .1 in series 90c. Many other capacities. Acme transformers and chokes. THE RADIO CLUB, INC., La Porte, Ind.

3 element Rectifier jars for B eliminators, B battery chargers and transmitters, 1 jar takes the place of 2 ordinary jars, 1/4" x 3/4" 99.7% pure aluminum, rubber covers binding posts 3" inside diameter $1.09 each, 4 for $3.00, prepaid to 5th zone, 1/2 cash with order balance C. O. D. Satisfaction or money back, Georgs Schulz, Calumet, Mich.

Audio transformers 70c up. $2.00 brings a 50 H 60 MA choke for use with your "B" eliminator or as a Bypass for your speaker. Write for list of transformers and parts. Radio Parts Sales Co., Box 24, Orange, N. J

Save up to 50% on Nationally Advertised Radio parts. Send for our new price list of Radio Kits, "B" eliminators, Radio Receivers and Parts. NATIONAL RADIO-PRINT CO., Room 404, 200 Broadway, New York.

Radio Panel Lamp. Rests on top cabinet. Lights dials. Uses battery current. Complete with bulb $1.25, postpaid. Satisfactory or money back. Robert Stevenson, Lancaster, Ohio.

SAVE MONEY on radio sets and parts. List free. All merchandise guaranteed. GEMRAD COMPANY, 631 E. Okmulgee, Muskogee, Okla.

SALESMEN WANTED

Make $100 WEEKLY in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays $100 profit. No big investment, no canvassing. Sharpe of Colorado made $955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. OZARKA, INC., 431 N. LaSalle Ave., T, Chicago.

Radio Age Classified Ads Bring Results

Please mention Radio Age when writing to advertisers

An Index to the Best in Radio Hookups!

HOW long have you postponed making that favorite hookup of yours because you couldn't find reliable and clear diagrams? We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

September, 1924
—How Careful Mounting Will Improve Reception.
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